

Force Sensor HSFPAR003A Data sheet

1. 弊社製品番号 HSFPAR003A
ALPS product No.

2. 製品概要 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。
General description

- 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.

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4. センサの構造と動作原理

Sensor structure and measurement principle

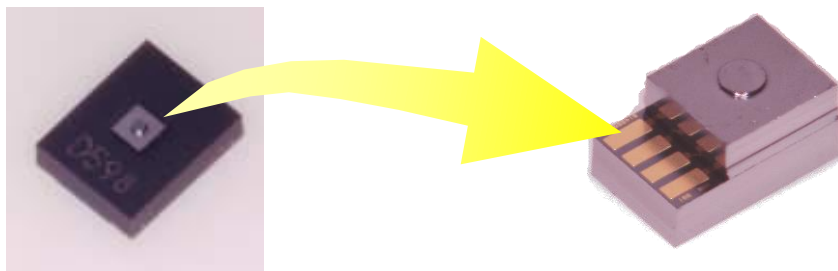


Fig-1 sensor package and sensor element

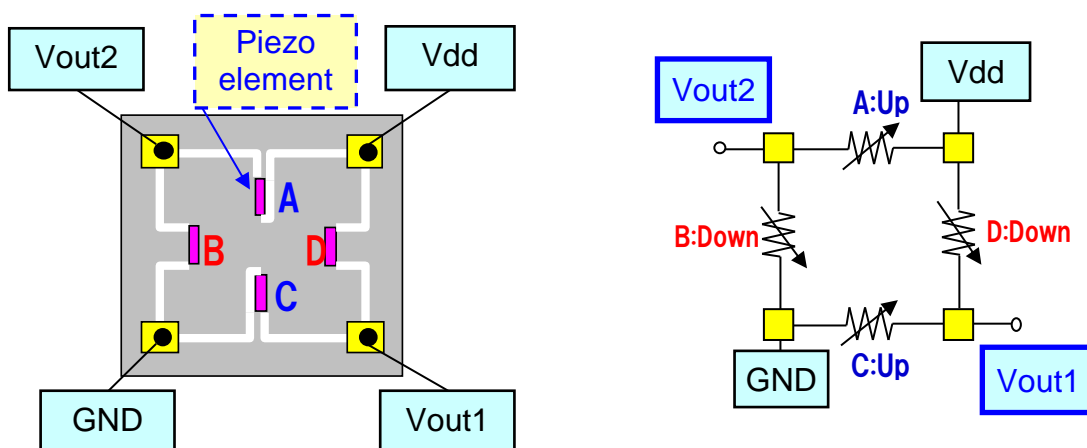


Fig-2 sensor structure

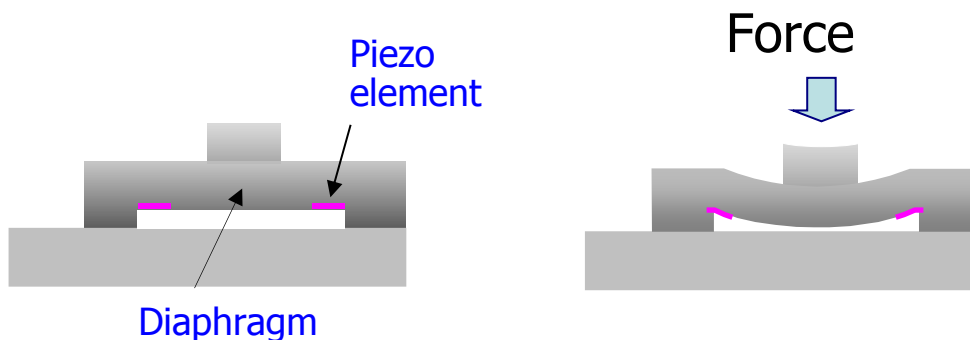


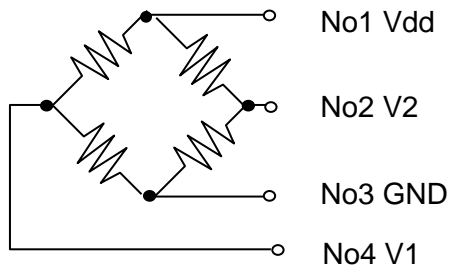
Fig-3 measurement principle

- (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.
($V_{out} = V_{out1} - V_{out2}$)

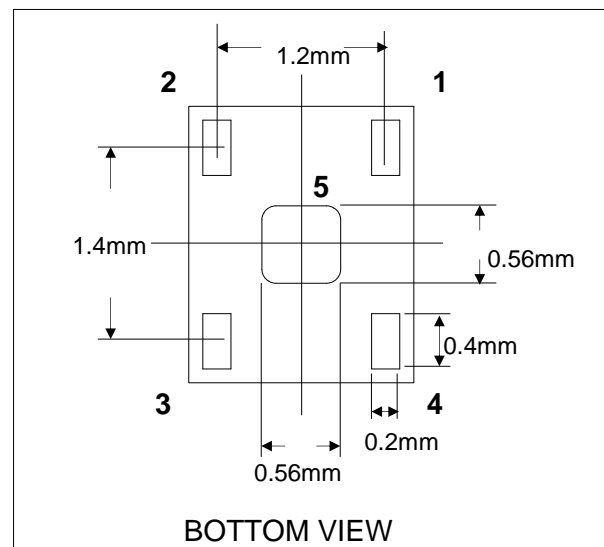
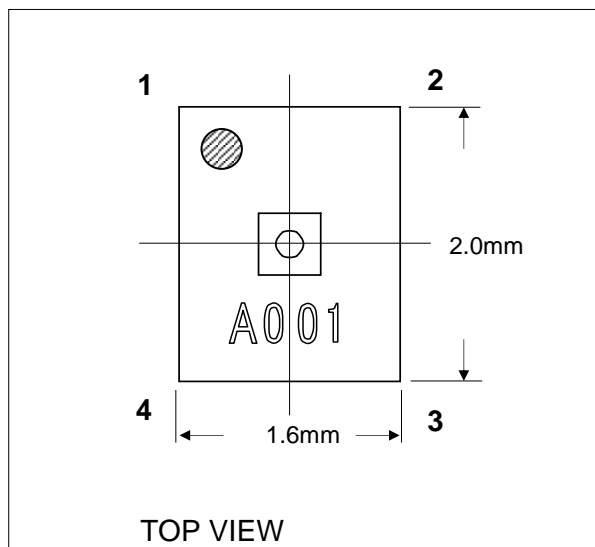
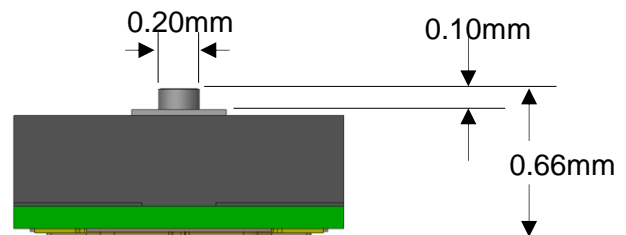
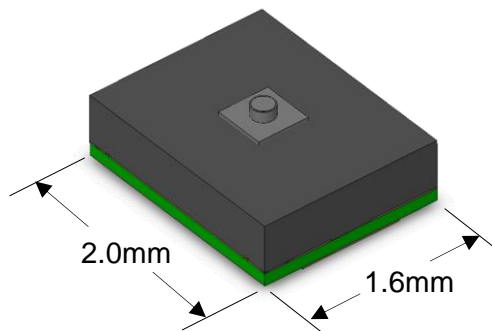
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5. ブロック図
Functional block diagram


端子番号/Pin No.	記号/Name	機能/Function
No1	Vdd	電源/Supply Voltage
No2	V2	-出力信号/Output(-)
No3	GND	GND
No4	V1	+出力信号/Output(+)

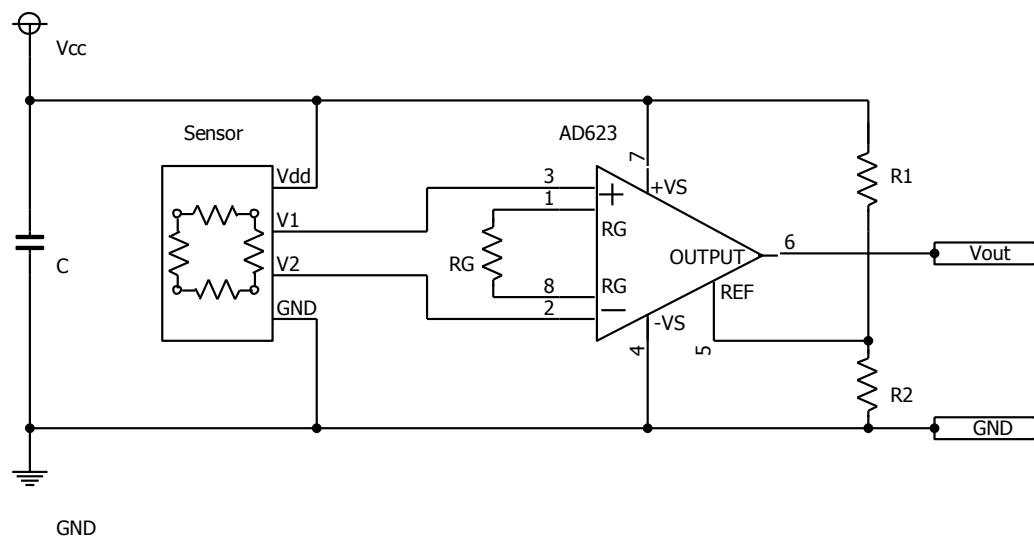
***Output = V1-V2**
6. 外形図
Full view


端子番号/Pin No.	記号/Name	機能/Function
1	Vdd	電源/Supply Voltage
2	V2	-出力信号/Output(-)
3	GND	GND
4	V1	+出力信号/Output(+)
5	GND	GND

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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

電源電圧 Source Voltage	Vcc	[V]	3.3
計装アンプ Instrumentation amplifier	-		AD623
増幅率調整抵抗 Gain adjustment Resistance	RG	[kΩ]	1.3
オフセット調整抵抗 Offset adjustment Resistance	R1	[kΩ]	10.0
	R2	[kΩ]	3.0
コンデンサ Capacitance	C	[uF]	0.1
感度 Sensitivity	Sens	[mV/N]	(952)

参考 Reference

増幅率 $\text{Gain} = (1 + 100\text{k}\Omega / \text{RG})$
 オフセット $\text{Offset voltage} = \text{R2} / (\text{R1} + \text{R2}) * \text{Vcc}$
 出力 $\text{OUTPUT} = \text{Gain} * \text{Vin} + \text{Offset voltage}$

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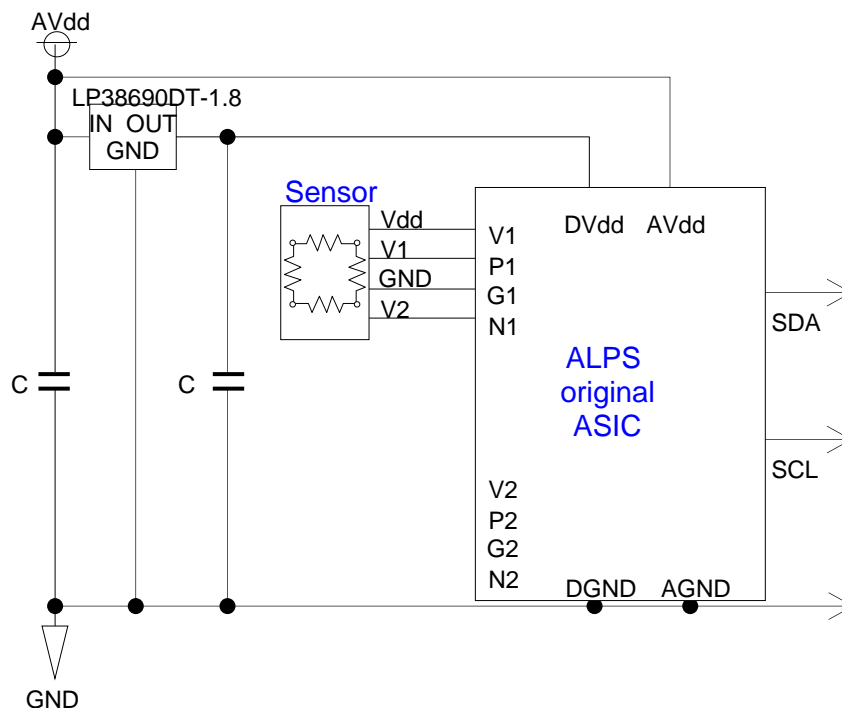
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7-2. デジタル回路例
Example circuit for digital output.

[1 Sensor use]



※ Alps original ASIC is supplied if there is a request.

推奨値 Recommended value

アナログ電源電圧 Analog Source Voltage	AVdd	[V]	2.4~3.6
デジタル電源電圧 Digital Source Voltage	DVdd	[V]	1.7~AVdd
レギュレータ Regulator	-		LP38690DT-1.8
コンデンサ Capacitance	C	[uF]	0.1
感度 Sensitivity	Sens	[Count/N]	(1150)
動作荷重範囲 Force range	Frng	[N]	0~3.5

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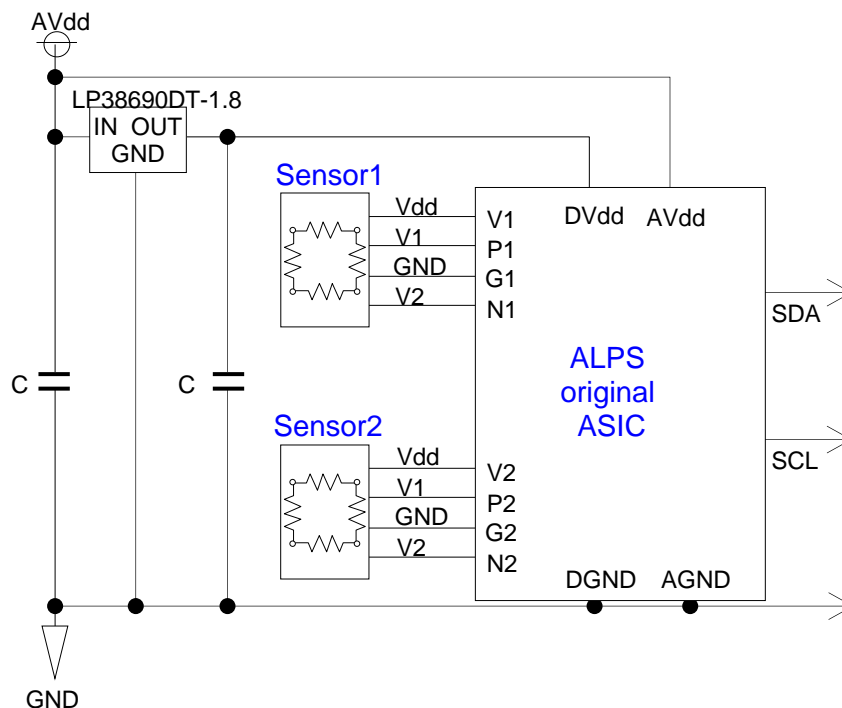
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[2 Sensor use]



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推奨値 Recommended value

アナログ電源電圧 Analog Source Voltage	AVdd	[V]	2.4~3.6
デジタル電源電圧 Digital Source Voltage	DVdd	[V]	1.7~AVdd
レギュレータ Regulator	-		LP38690DT-1.8
コンデンサ Capacitance	C	[uF]	0.1
感度 Sensitivity	Sens	[Count/N]	(1150)
動作荷重範囲 Force range	Frng	[N]	0~3.5

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**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.

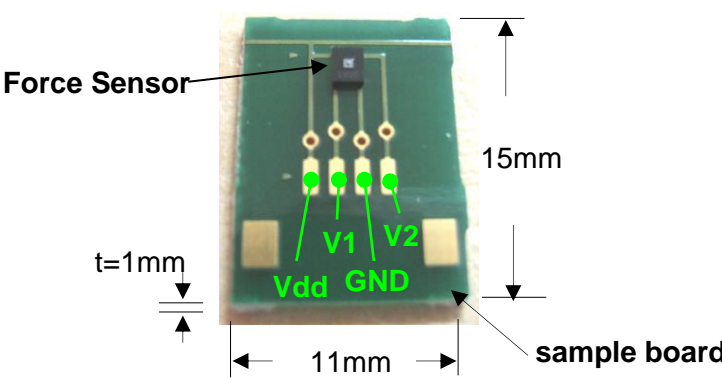
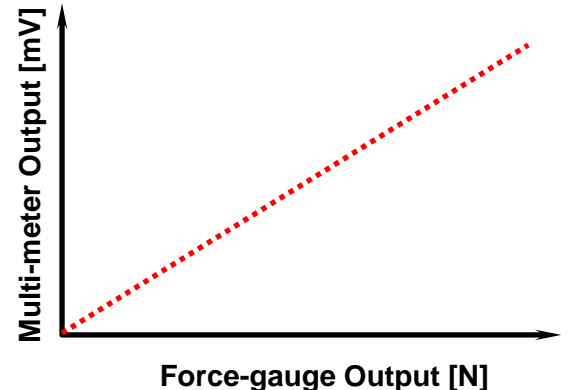
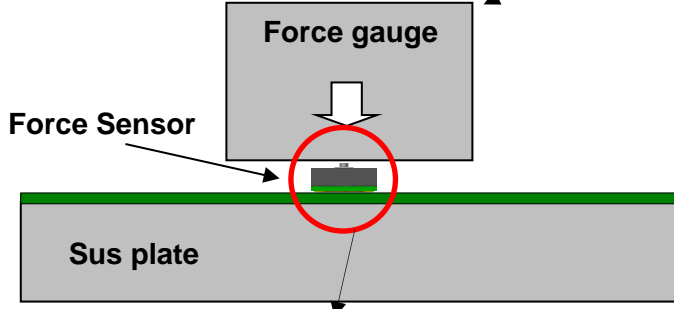
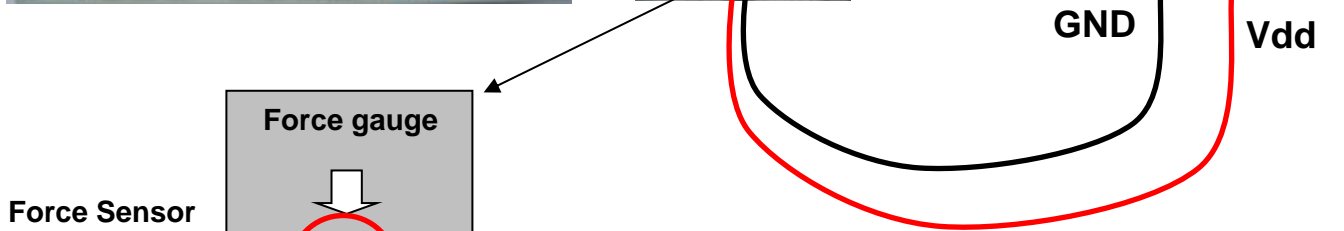
**Force gauge
(IMADA Co., Ltd.)**



DC power supply unit



Multi-meter

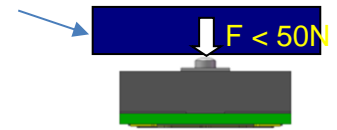


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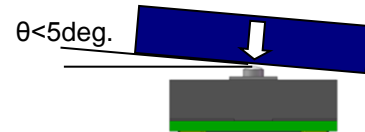
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**9. デザインガイド
Design guide**
9-1 PRECAUTIONS

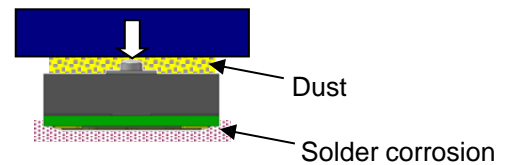
- Please do not apply the static force and the impact force of 50N or more to this sensor.

 Recommendation :
 SUS404C,t=0.2mm


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

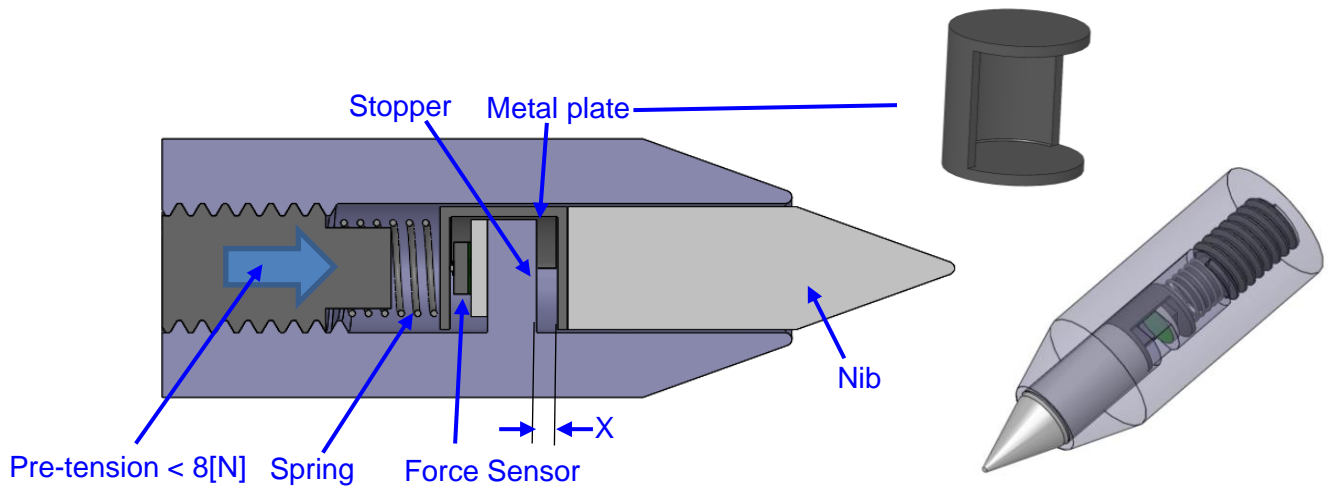


- The dust such as sand must not enter.
- Something that corrode solder must not enter.


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9-2 Design Guide for Stylus-pen


- 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 : $F < 8[N]$

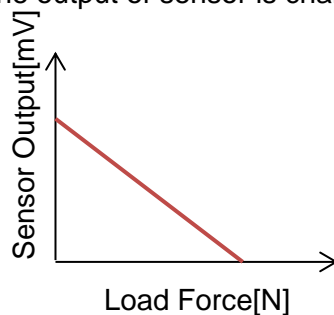
Spring constant : $k[N/mm]$, Displacement : $X[mm]$

$$F = kX < 8[N]$$

$$\text{Pre-tension} - F > 0[N]$$

- Metal plate is recommended stainless steel.
e.g.) Metal plate : SUS404C

- The output of sensor is changed as below figures.



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TITLE

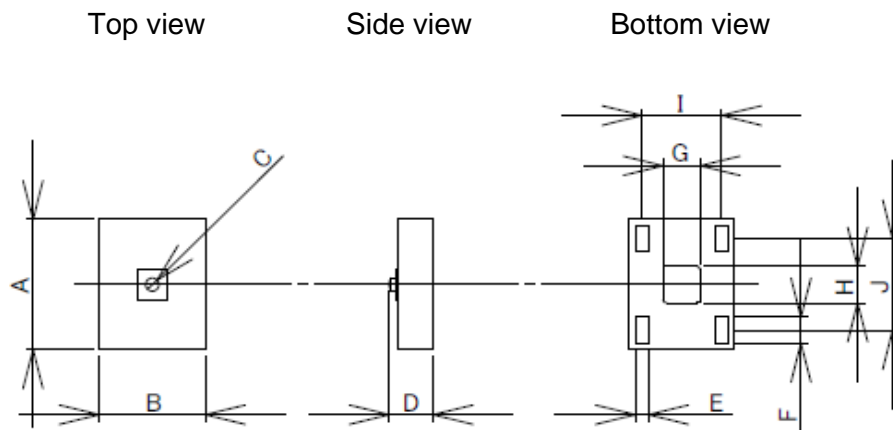
**Force Sensor
HSFPAR003A
Data sheet**

10 / 19
Rev.1.5
Jul. 2018

**10. パッケージ寸法
Package dimensions**

Dimension in millimeters			
Ref	Min.	Typ.	Max.
A	1.90	2.00	2.10
B	1.50	1.60	1.70
C	0.18	0.20	0.22
D	0.62	0.66	0.70

Dimension in millimeters			
Ref	Min.	Typ.	Max.
E	0.17	0.20	0.23
F	0.37	0.40	0.43
G	0.53	0.56	0.59
H	0.53	0.56	0.59
I	1.17	1.20	1.23
J	1.37	1.40	1.43



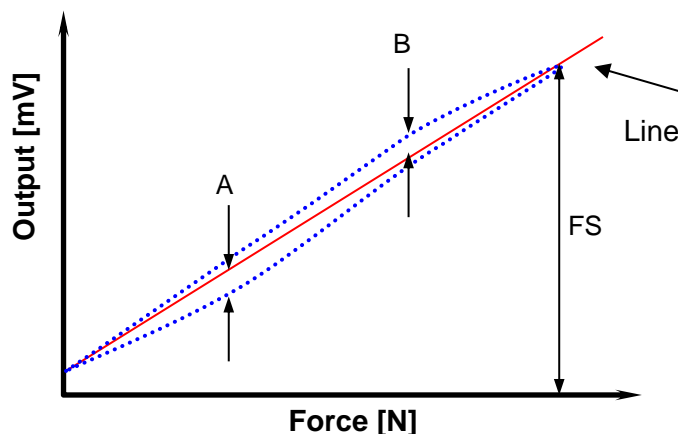
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11.電気特性
Electrical specifications

Item	Symbol	Unit.	Specification			Notes
			min.	Typ.	max.	
最大定格 Absolute Maximum Ratings						
定格電源電圧 Absolute limits supply voltage	Vlim	[V]	-	-	4.0	
破壊荷重 Destroyed force	Flim	[N]	50	-	-	
保存温度範囲 Storage temperature	Tstr	[°C]	-55	-	+125	
ESD耐圧 ESD	HBM	[V]	1000	-	-	
寿命 Durability	Drbl	[Cycles]	1000k	-	-	1-8N,5Hz, sine curve
使用条件 Operating conditions						
動作荷重範囲 Force range	Frng	[N]	0	-	8	
電源電圧 Supply voltage	Vdd	[V]	1.5	-	3.6	
動作温度範囲 Operating temperature	Topr	[°C]	-40	-	+85	
電氣的仕様 Electrical specifications (T=25°C)						
感度 Sensitivity	Sens	[mV/V/N]	2.7	3.7	4.7	
リニアリティー Linearity	Lin	[%FS]	-	-	2.0	*FS:Full Span
オフセット電圧 Null Offset	V0	[mV/V]	-8	-4	0	
ブリッジ抵抗 Bridge Resistance	Rbrg	[kΩ]	4.5	5.5	6.5	



Linear fitting curve :

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

 *Sensitivity : α

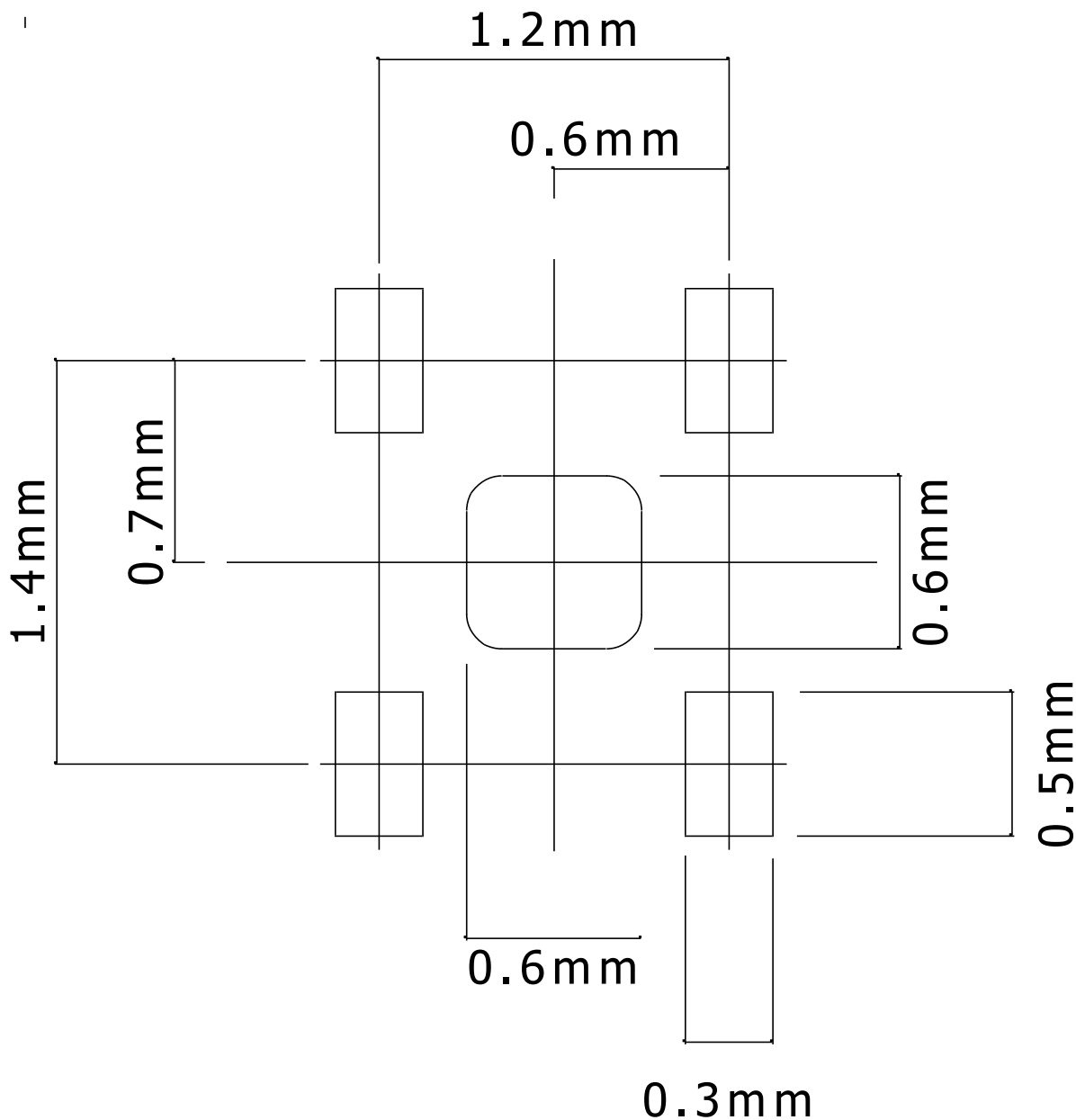
 *Null Offset : β

 *Linearity : $(A+B)/FS \times 100$
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**12. 推奨ランドパターン
Recommended land pattern**



基板搭載は基本的に実装機にて行って下さい。 補修などで手のせをする場合は、受圧部に手や物が触れないようご注意下さい。

Basically devices shall be mounted by the mounting machine.
In case of manual mounting, do not touch knob.

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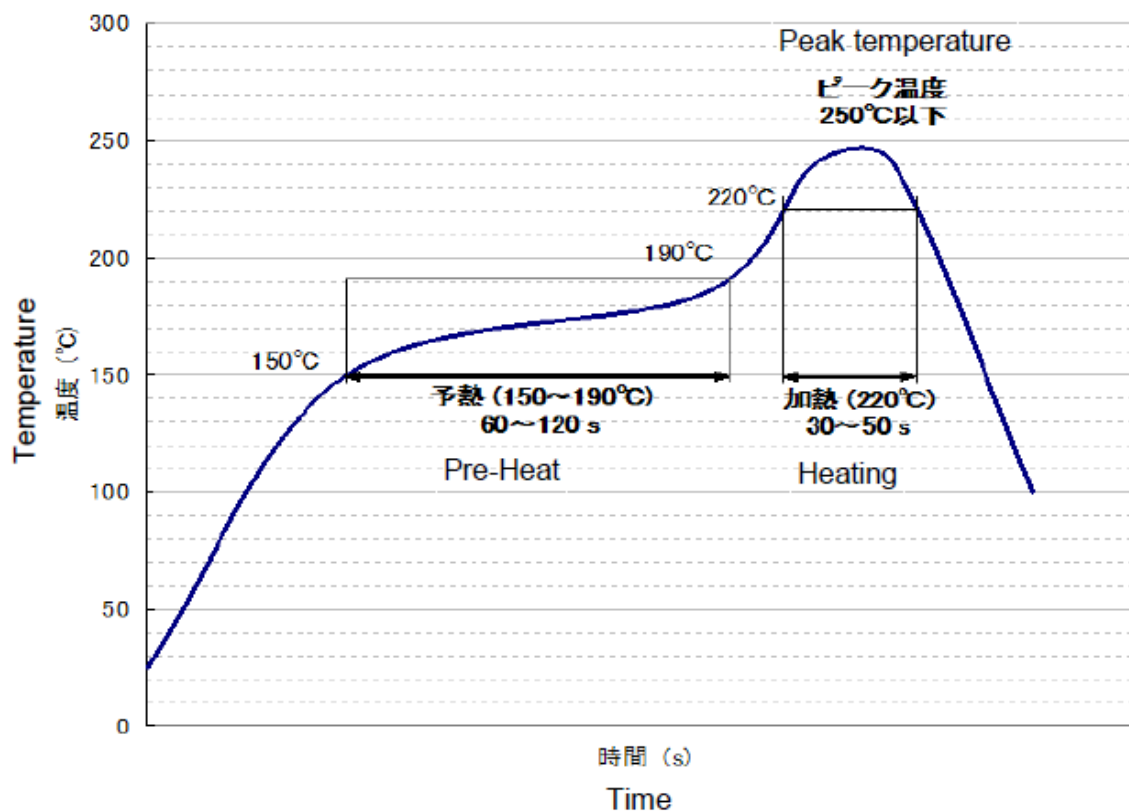
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13. 推奨温度プロファイル Recommended soldering conditions

ピーク温度： 250°C以下、10sec以内

Peak temperature : 250 °C or less, within 10 seconds.



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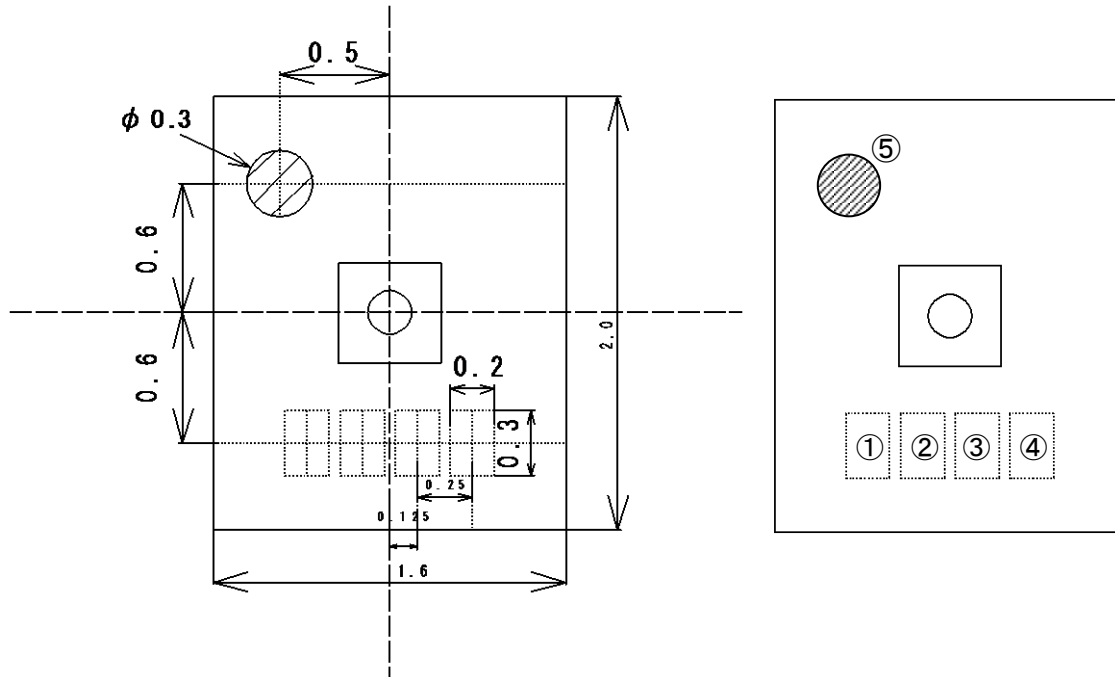
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**14. レーザーマーキング仕様
Laser marking specifications**

Unit : mm



Laser Mark No	Indication item	Content of indication
1	Manufacturing No.	0 ~ 9, A ~ Z (00 ~ ZZ)
2	Production month	1 ~ 9, A, B, C
3	Identification number	A ~ Z
4	1pin mark	『●』 Fix

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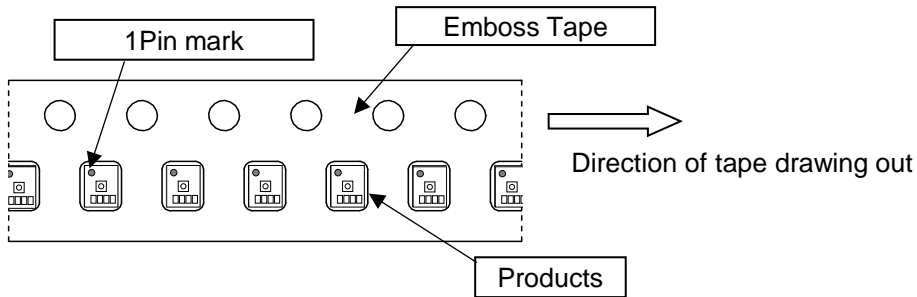
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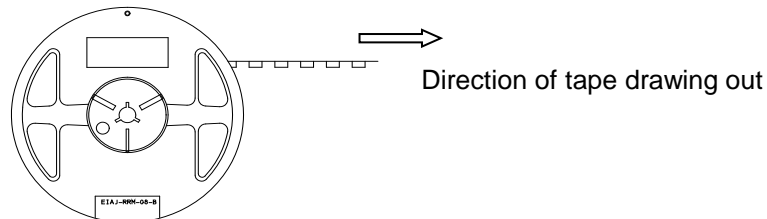
15. テープ&リール仕様

Tape & Reel specifications

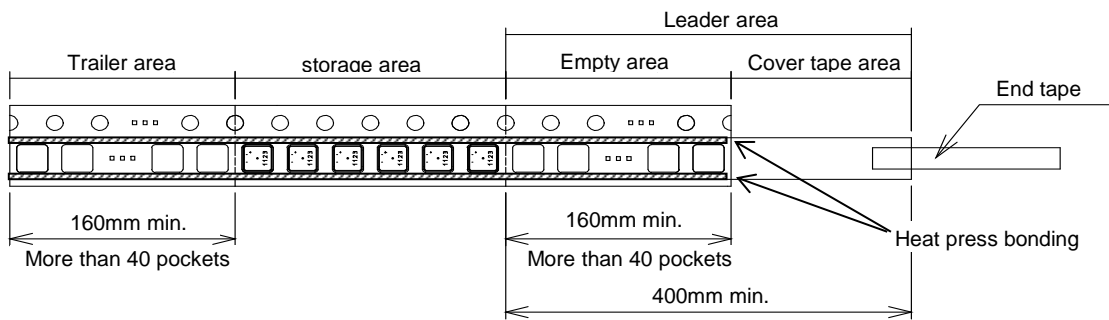
15-1. Storage direction of the products



15-2. Direction of tape drawing out

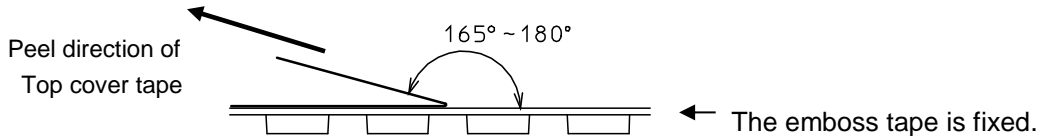


15-3. Taping

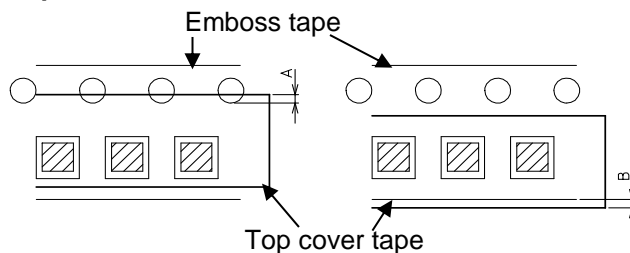


15-4. Peel strength

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



15-5. Top cover tape offset

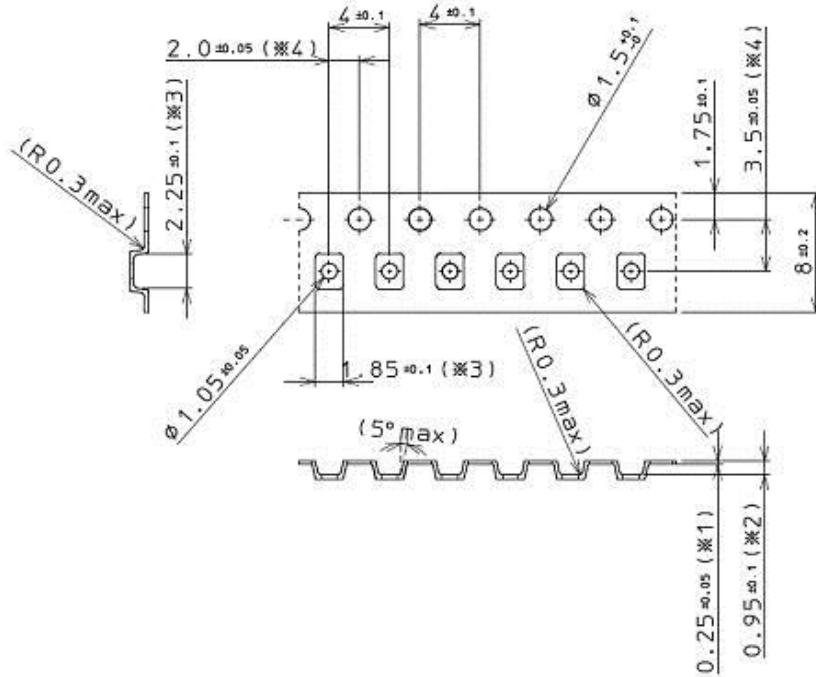


- Overlay of cover tape to the hole (A) is allowed by 0.5mm
- Bulge of top cover tape (B) is allowed by 0.5mm

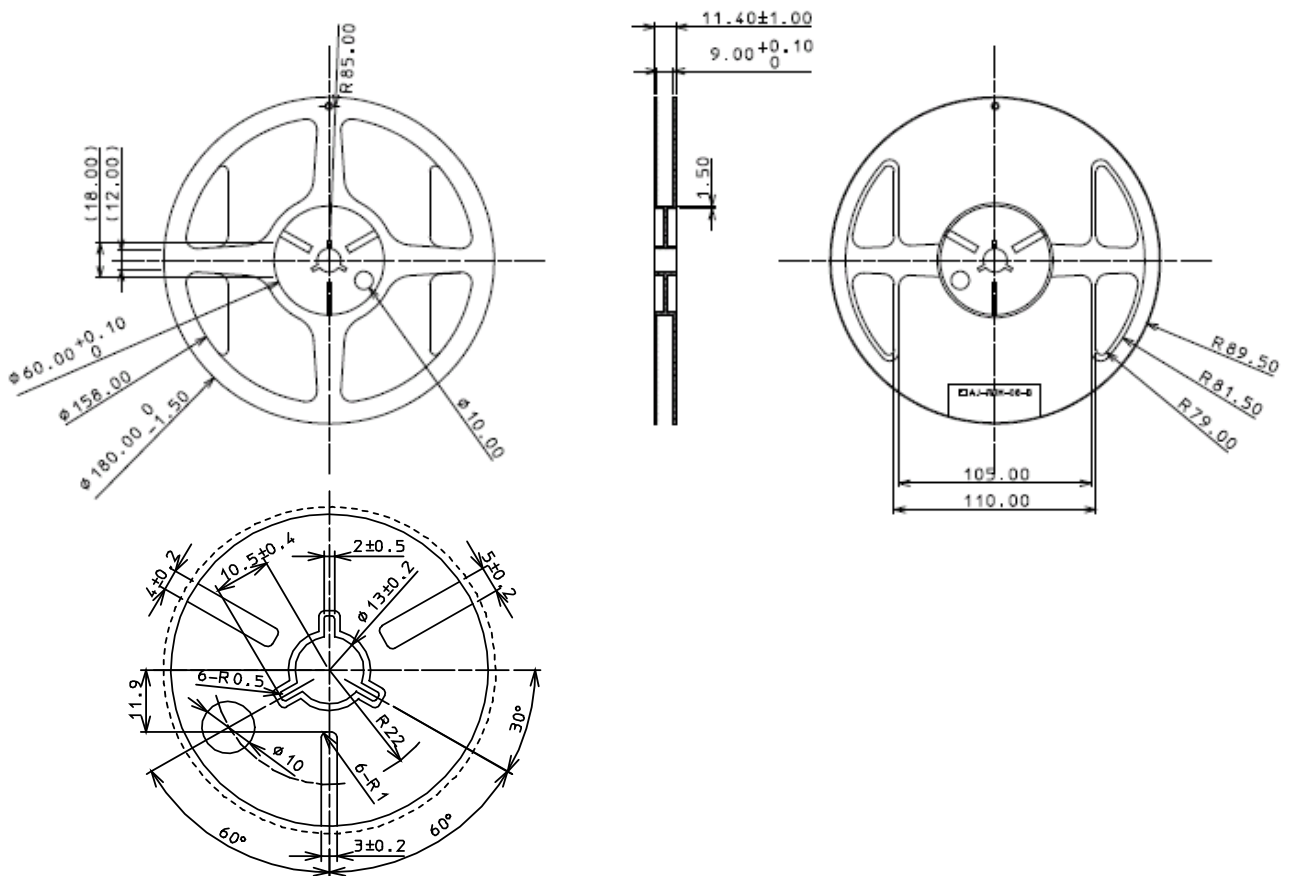
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15-6. Emboss Tape Dimensions (Unit mm)



15-7. Reel Dimensions (Unit : mm)



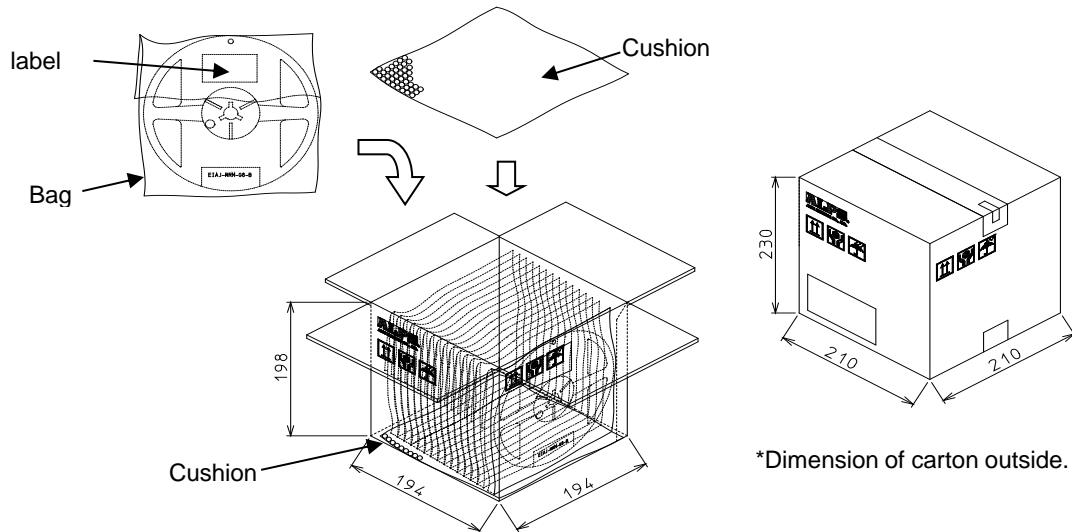
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15-8. Packing

●For oversea

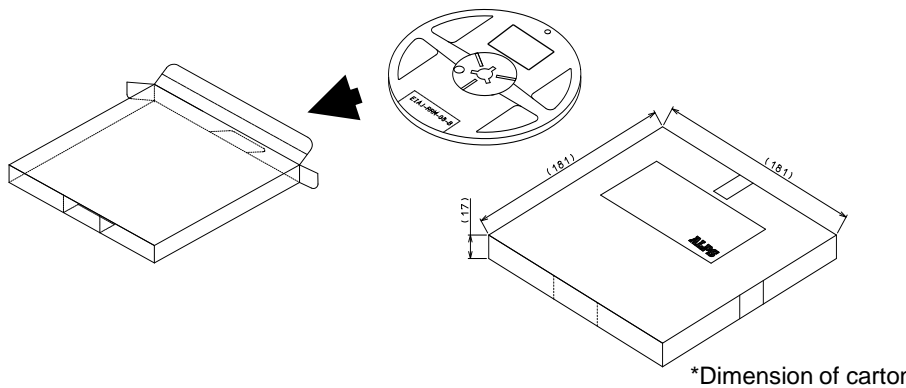
- This product is packed by tape wrapping (3,000 pcs/reel).
- The barcode label is put on each reel.
- One reel is stored in one Bag.
- 15 bags are put in 1 carton (max.45,000pcs/carton)
- The cushion is stored in the top and bottom of the carton.



*Dimension of carton outside.

●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)



*Dimension of carton

●Recommended storage condition
MSL1

●Damp-proof packing
None

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

●Minimum Order Quantity、Standard Packing Quantity
3,000 pcs

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16. LEGAL DISCLAIMER

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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. 軍事用途又はテロ等の反社会活動目的では、当製品を一切使用しないでください。また、最終的にそれら用途・目的で使用されるおそれがある法人・団体・個人等へも当製品を一切供給しないでください。

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. 当製品は、特に用途を指定していないかぎり、本来、AV、家電、事務機、情報機器、通信機器、アミューズメント機器等の一般電子機器用に設計、製造されたものです。したがって、原子力制御機器、宇宙・航空機で運行にかかわる機器等の用途では一切使用しないでください。

上記の使用禁止の用途以外で、医療機器、防犯機器、防災機器、海底用機器等の高度の安全性・信頼性を必要とする機器でのご使用の際は、弊社営業担当迄ご相談いただくか、またはセットでの十分な適合性の確認を行っていただいた上で、フェールセーフ設計、保護回路、冗長回路、誤動作防止設計、延焼対策設計等のセットでの安全対策設計を設けてください。

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 an Alps 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. 車載対応製品以外の製品を車載用にご使用される場合は、事前に弊社へご相談ください。

Before using products which were not specifically designed for use in automotive applications, please contact an Alps sales representative.

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17. Notes concerning patent

1. 当社では、当製品の構造を除いて、本資料における使用例を含めまして当製品の利用に関し、第三者が保有する一切の特許等の知的財産権を侵害していないことについて保証しかねますので、貴社にて調査含めましてご対応くださるようお願いいたします。

Except for the structure of this product, Alps 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.

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