

# Force Sensor HSFPAR004A Data sheet

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、抵抗率に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. センサの構造と動作原理**  
**Sensor structure and measurement principle**

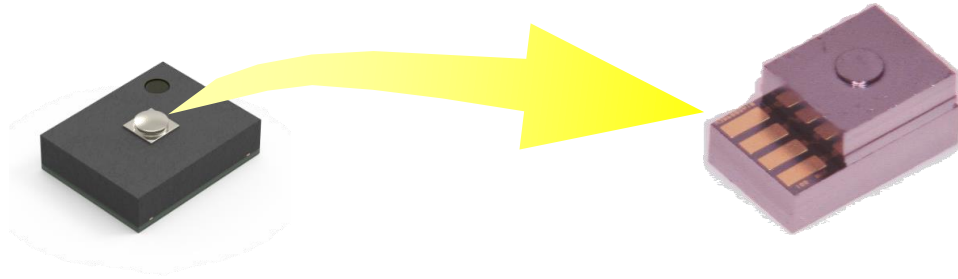


Fig-1 sensor package and sensor element

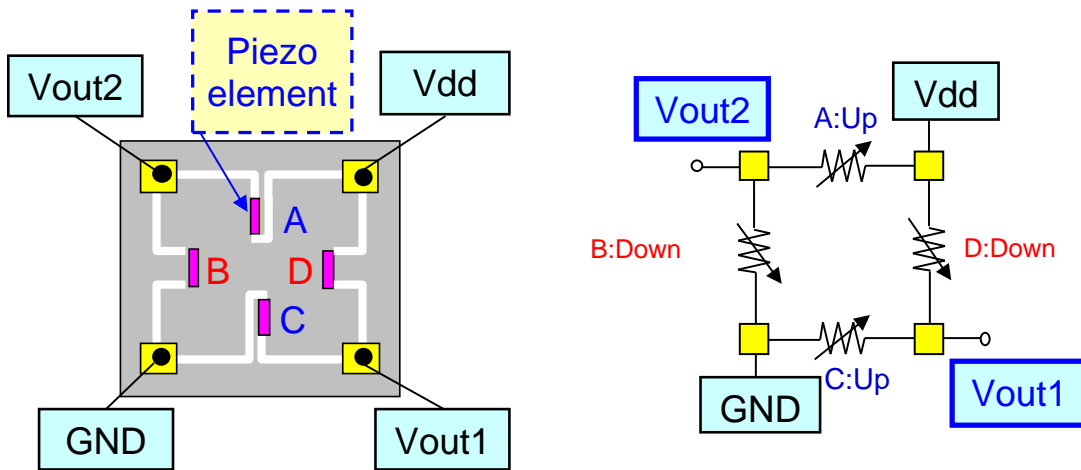


Fig-2 sensor structure

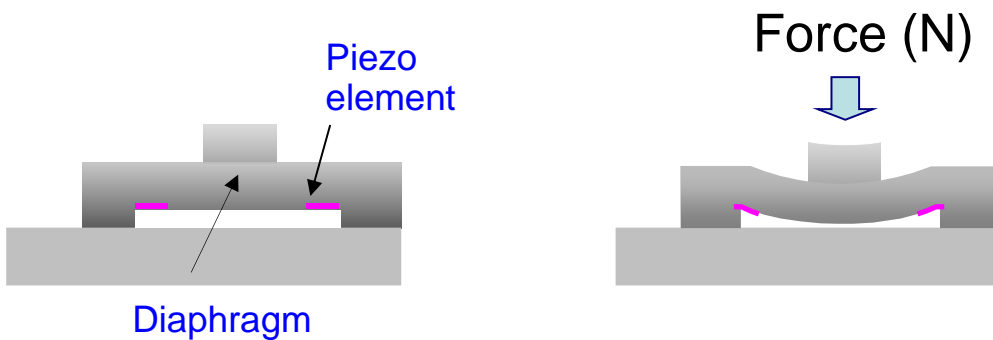
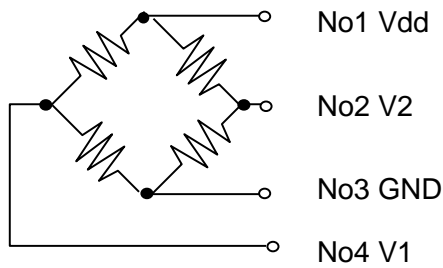


Fig-3 measurement principle

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

**5. ブロック図**

**Functional block diagram**

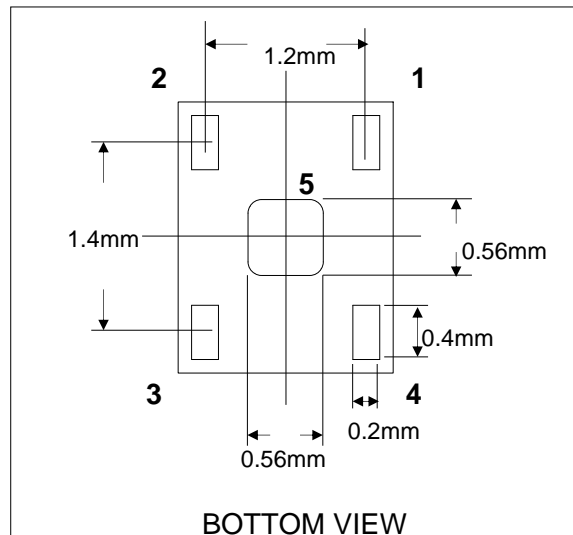
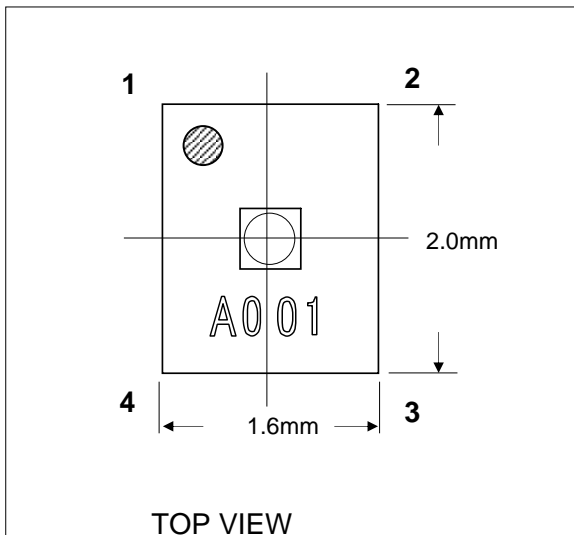
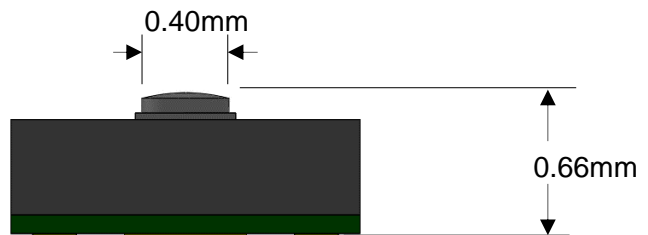
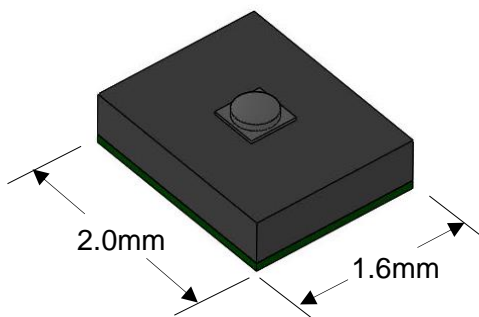


端子番号/Pin No.	記号/Name	機能/Function
No1	Vdd	電源/Supply Voltage
No2	V2	-出力信号/Output(-)
No3	GND	GND
No4	V1	+出力信号/Output(+)

\*Output = V1-V2

**6. 外形図**

**Full view**



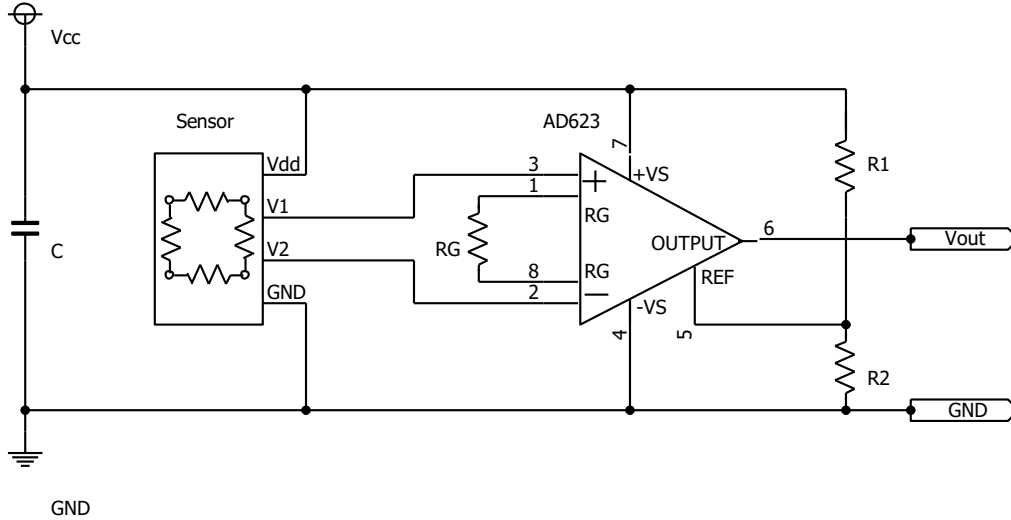
端子番号/Pin No.	記号/Name	機能/Function
1	Vdd	電源/Supply Voltage
2	V2	-出力信号/Output(-)
3	GND	GND
4	V1	+出力信号/Output(+)
5	GND	GND

**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 <sup>*1</sup> AD8237 <sup>*1</sup> AD8420 <sup>*1</sup> INA317 <sup>*1</sup> INA333 <sup>*1</sup>
増幅率調整抵抗 Gain adjustment Resistance	RG	[kΩ]	4.0
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]	(257.4)

\*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ありません。

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.

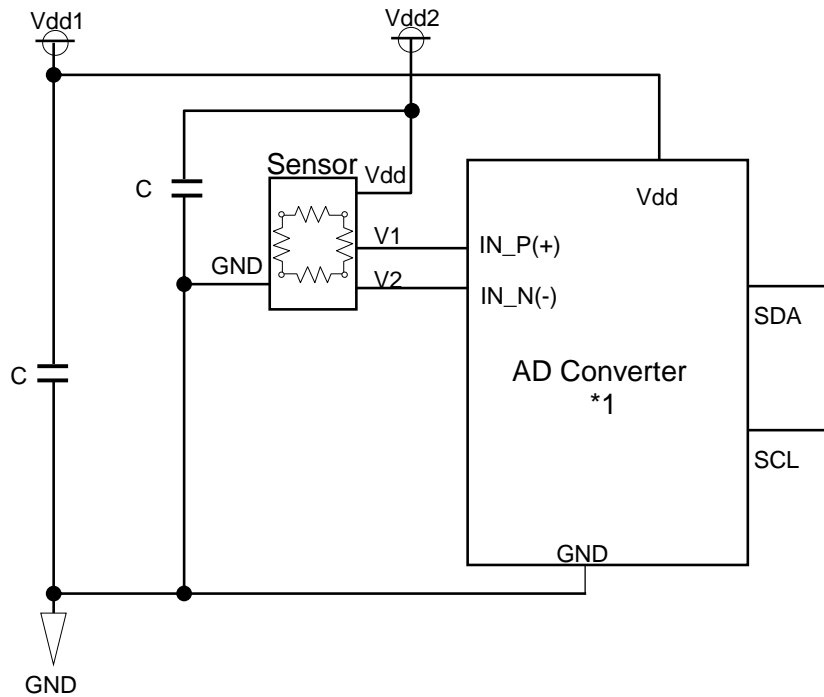
**参考 Reference**

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.

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



**DC power supply unit**



**Multi-meter**

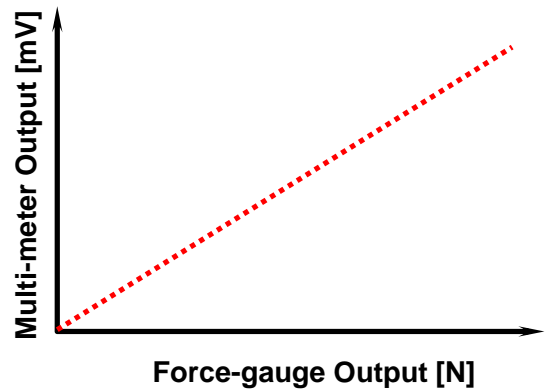
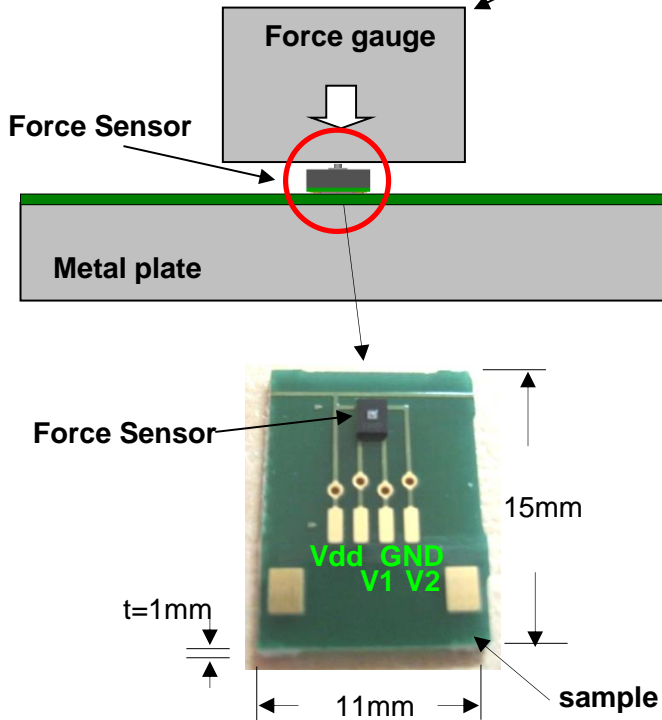


V1

V2

GND

Vdd

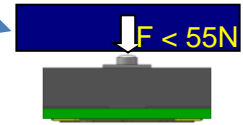


**9. デザインガイド**  
**Design guide**

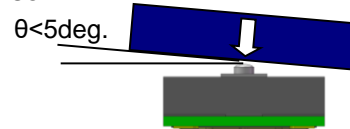
**9-1 Precautions**

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

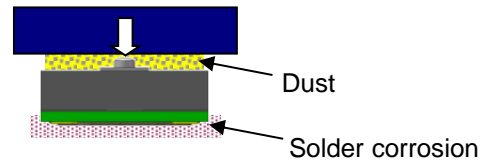
Recommendation :  
SUS440C, t=0.2mm



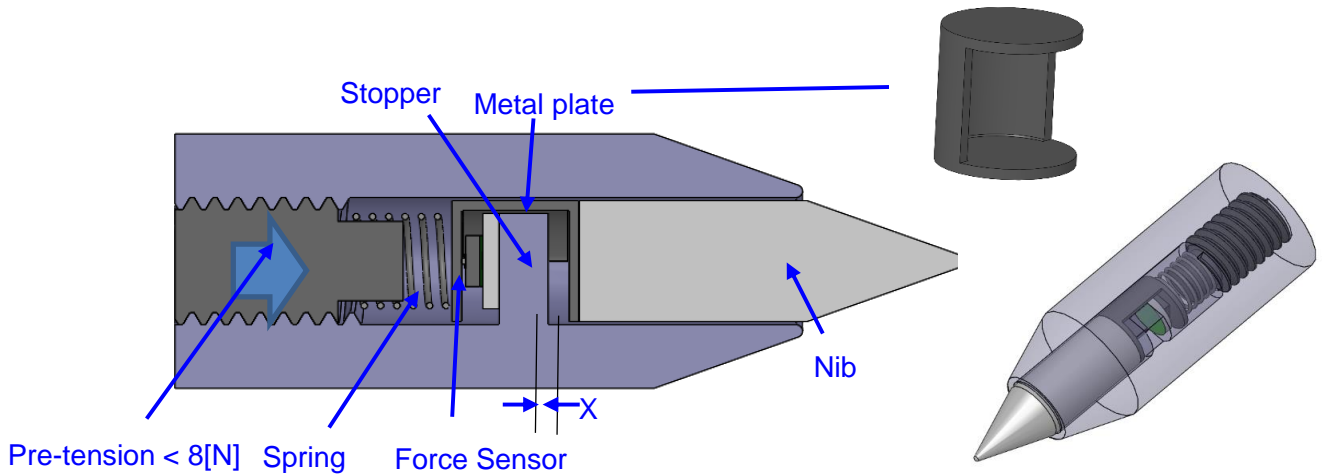
- Please do not apply force at an angle to the sensor.



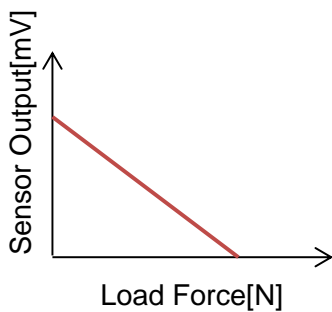
- The dust such as sand must not enter.
- Something that corrode solder must not enter.



**9-2 Design Guide for Stylus-pen**



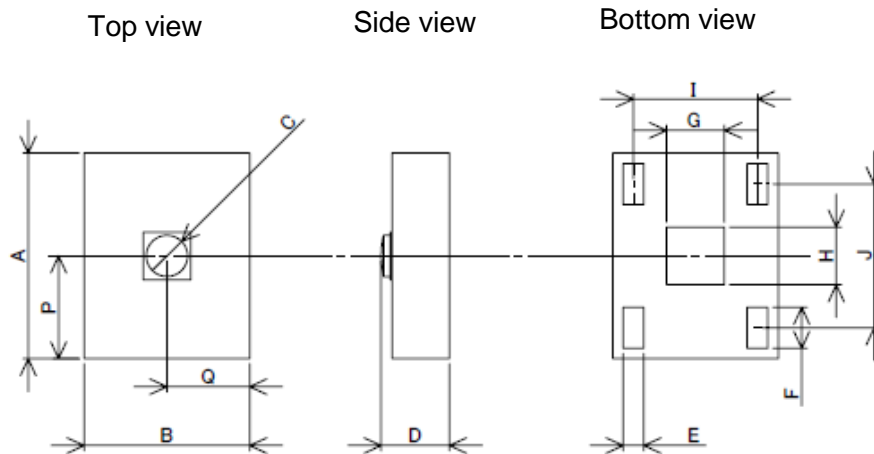
- This structure detects load force of pen tip as opposite direction.
- Therefore impact stress doesn't apply directly to the sensor projection.
  - Spring is recommended below.  
Coil spring
  - Displacement is limited to X[mm] by the stopper.
  - Limit the impact force applied to the sensor by the stopper.  
Recommendation) Limit force :  $F < 8[N]$   
Spring constant :  $k[N/mm]$  , Displacement :  $X[mm]$   
 $F = kX < 8[N]$   
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.





**10. パッケージ寸法**  
**Package dimensions**

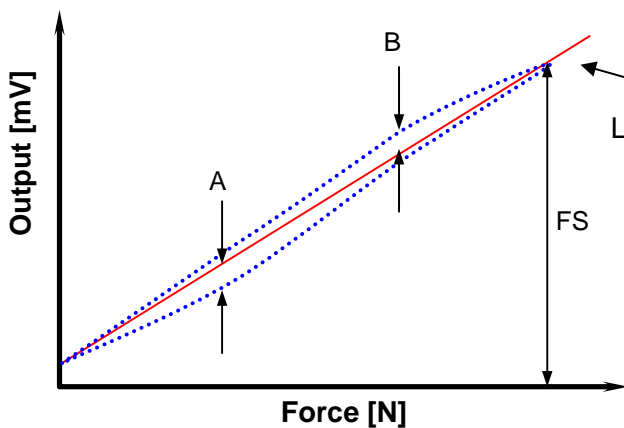
Dimension in millimeters			
Ref	Min.	Typ.	Max.
A	1.90	2.00	2.10
B	1.50	1.60	1.70
C	0.38	0.40	0.42
D	0.62	0.66	0.70
E	0.15	0.20	0.25
F	0.35	0.40	0.45
G	0.51	0.56	0.61
H	0.51	0.56	0.61
I	1.10	1.20	1.30
J	1.30	1.40	1.50
P	0.90	1.00	1.10
Q	0.70	0.80	0.90



**11.電気特性**

**Electrical specifications**

Item	Symbol	Unit.	Specification			Notes
			min.	Typ.	max.	
<b>最大定格 Absolute Maximum Ratings</b>						
定格電源電圧 Absolute limits supply voltage	Vlim	[V]	-4.0	-	4.0	
最大定格荷重 Max Load Rating	Llim	[N]	-	-	55	
保存温度範囲 Storage temperature	Tstr	[°C]	-55	-	+125	
ESD耐圧 ESD	HBM	[V]	-1000	-	+1000	
寿命 Durability	Drbl	[Cycles]	1000k	-	-	1-8N,5Hz, sine curve
<b>使用条件 Operating conditions</b>						
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	
<b>電氣的仕様 Electrical specifications (T=25°C)</b>						
感度 Sensitivity	Sens	[mV/V/N]	1.6	2.3	3.0	
リニアリティ Linearity	Lin	[%FS]	-	-	2.0	*FS:Full Span
オフセット電圧 Null Offset	V0	[mV/V]	-5.6	-2.6	0.4	
ブリッジ抵抗 Bridge Resistance	Rbrg	[kΩ]	4.5	5.5	6.5	

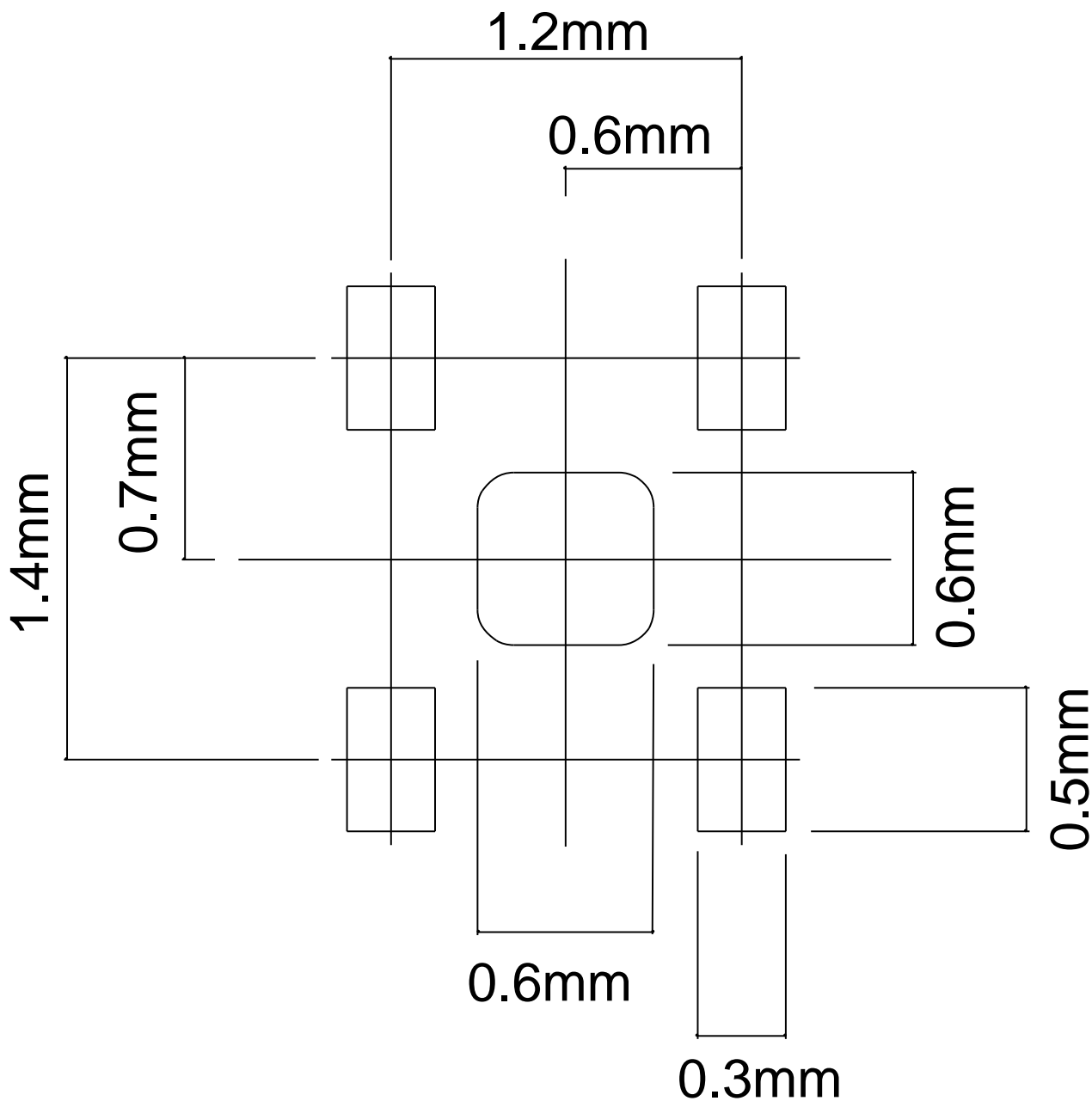


Linear fitting curve :  

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

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

12. 推奨ランドパターン  
Recommended land pattern



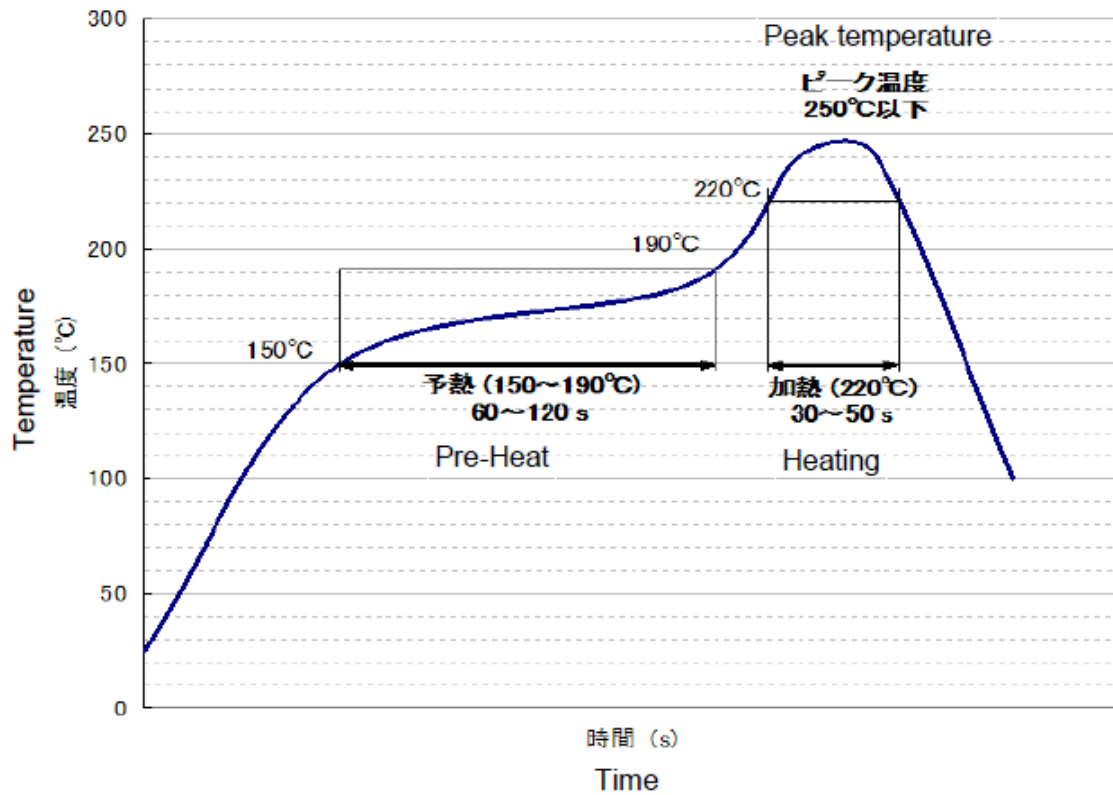
基板搭載は基本的に実装機にて行って下さい。補修などで手のせをする場合は、受圧部に手や物が触れないようご注意ください。

Basically devices shall be mounted by the mounting machine.

In case of manual mounting, do not touch knob.

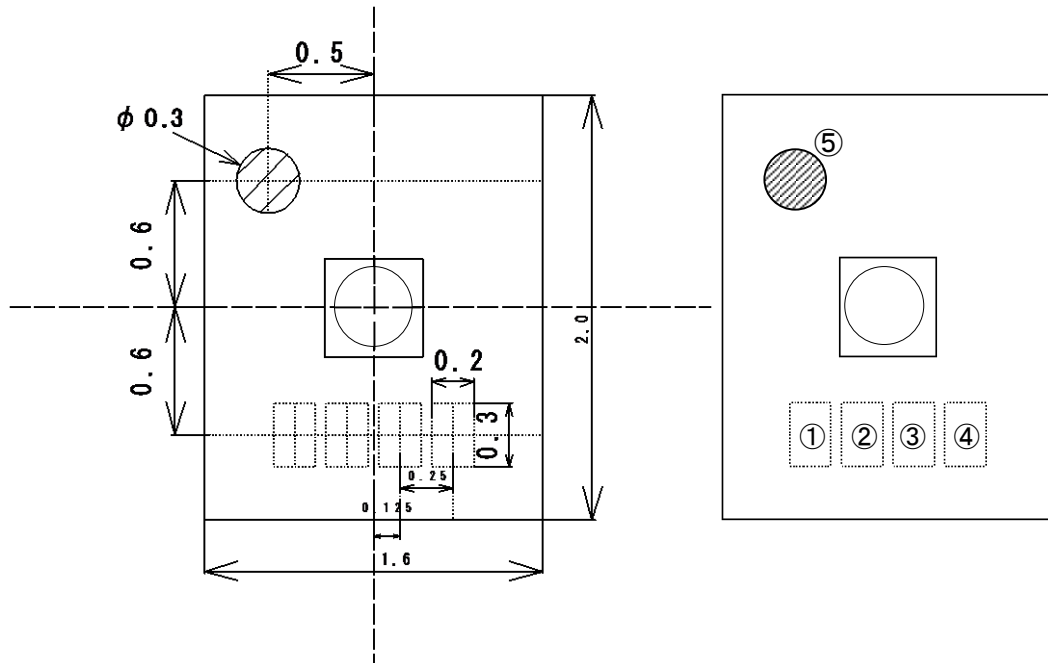
**13. 推奨温度プロファイル**  
**Recommended soldering conditions**

ピーク温度： 250°C以下、10sec以内  
Peak temperature : 250 °C or less, within 10 seconds.



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

Unit : mm

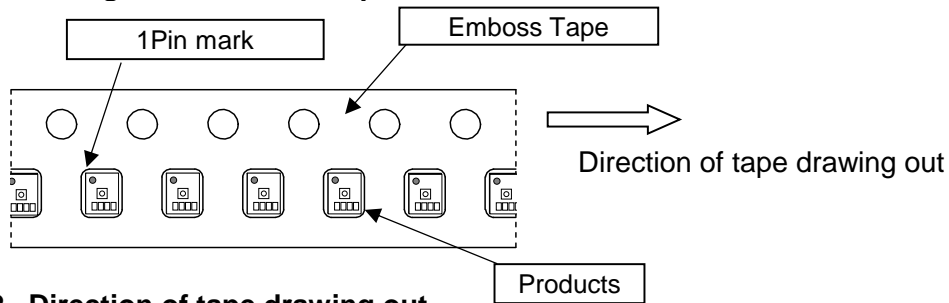


Laser Mark No	Indication item	Content of indication
1	Manufacturing No.	0 ~ 9, A ~ Z (00 ~ ZZ)
2		
3	Production month	1 ~ 9, A, B, C
4	Identification number	A ~ Z
5	1pin mark	『●』 Fix

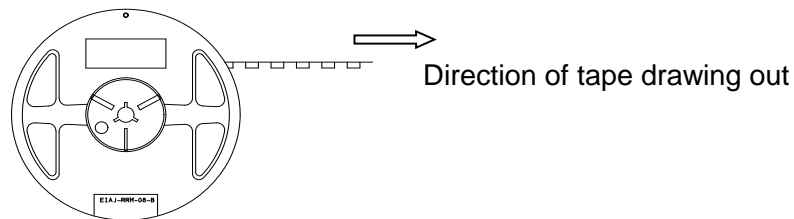
**15. テープ&リール仕様**

**Tape & Reel specifications**

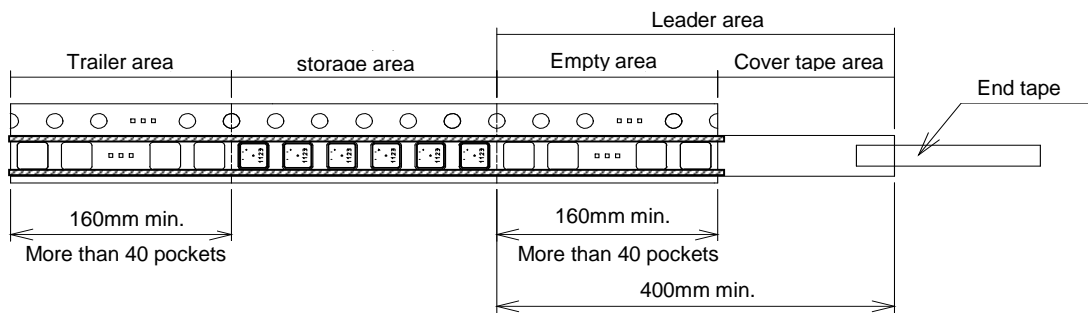
**15-1. Storage direction of the products**



**15-2. Direction of tape drawing out**

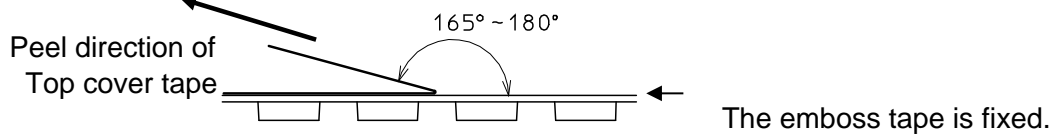


**15-3. Taping**

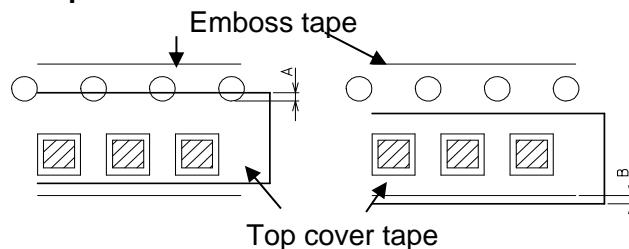


**15-4. Peel strength**

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

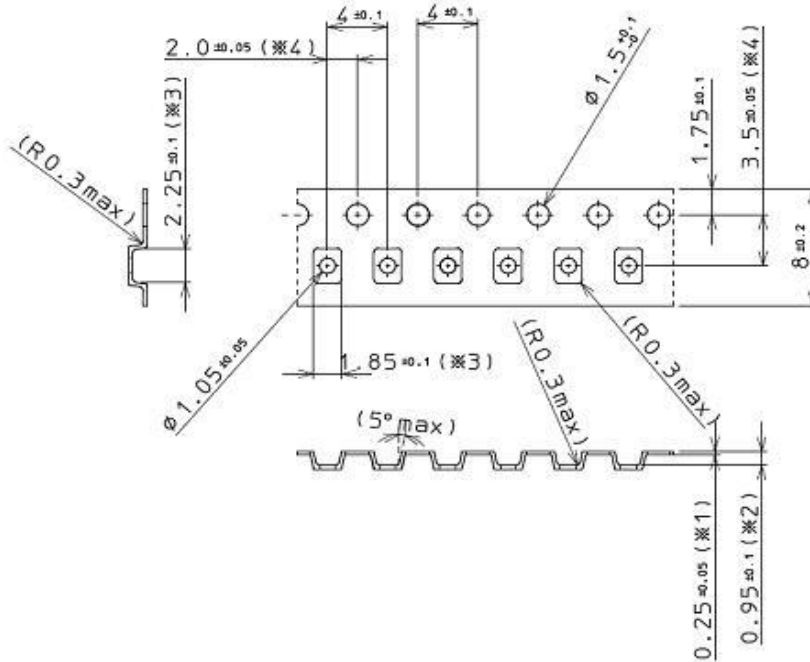


**15-5. Top cover tape offset**

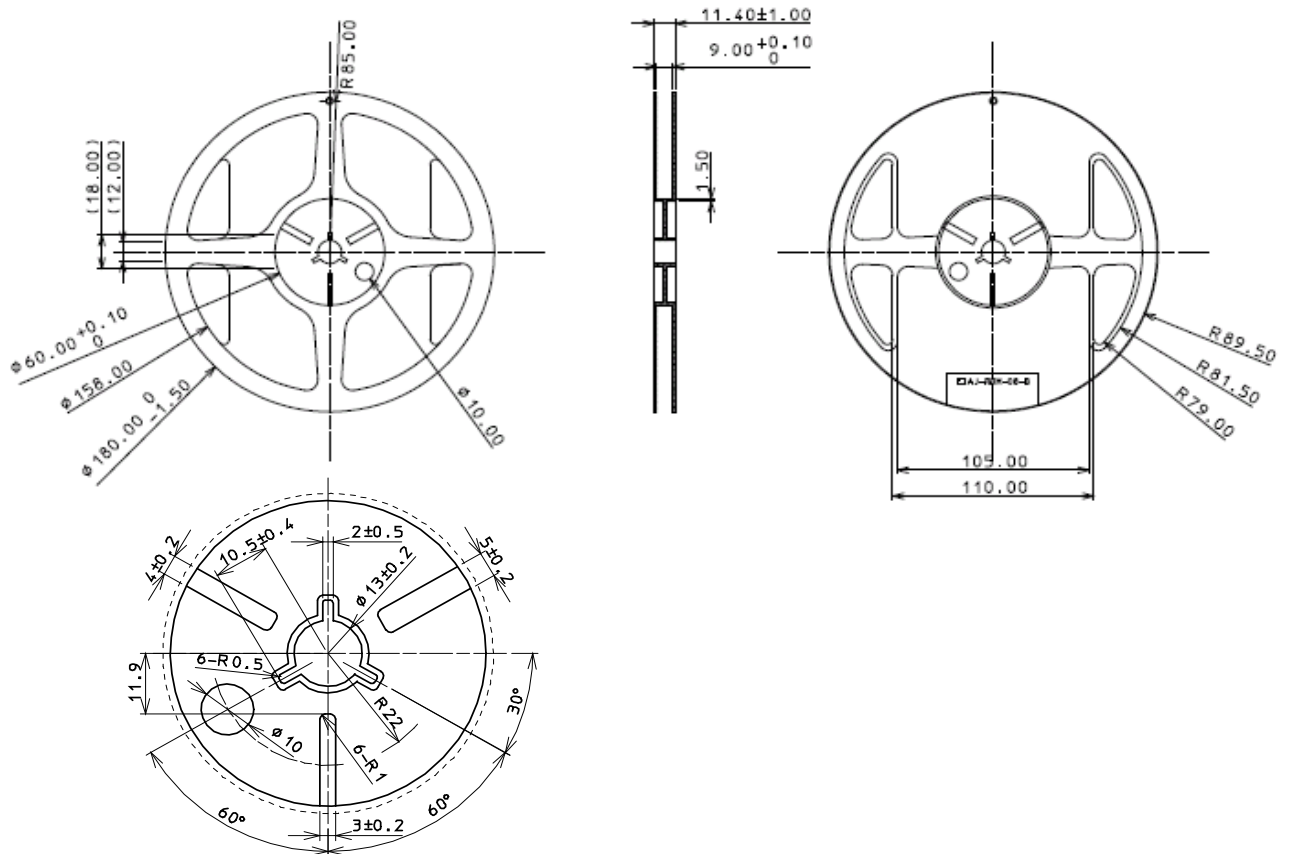


- Overlay of cover tape to the hole (A) is allowed by 0.5mm
- Bulge of top cover tape (B) is allowed by 0.5mm

**15-6. Emboss Tape Dimensions (Unit mm)**



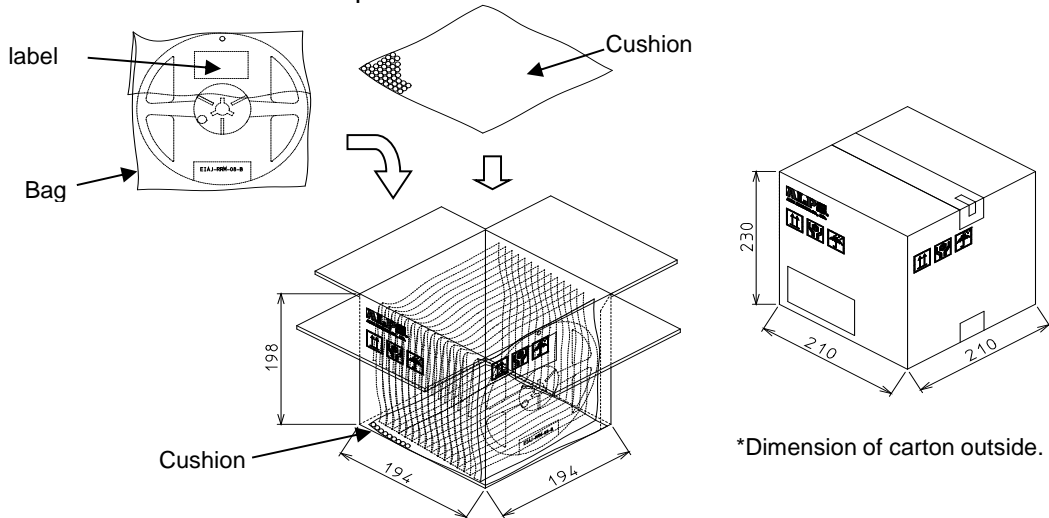
**15-7. Reel Dimensions (Unit : mm)**



**15-8. Packing**

● **For oversea**

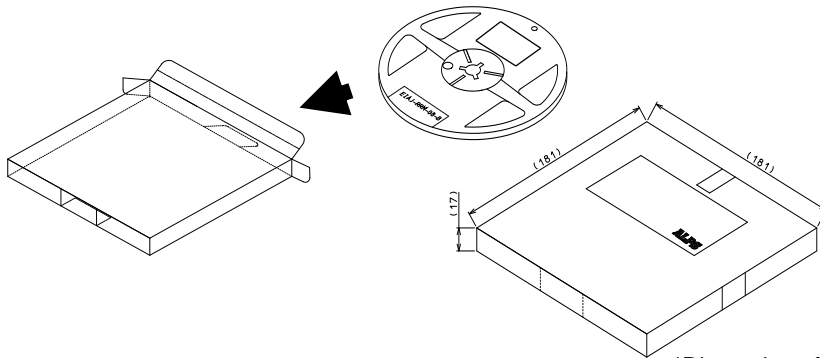
- This product is packed by tape wrapping (3,000 pcs/reel).
- The barcode label is put on each reel.
- One reel is stored in one Bag.
- 15 bags are put in 1 carton (max.45,000pcs/carton)
- The cushion is stored in the top and bottom of the carton.



\*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 oversea : Maximum 5cartons
- For Japan : Maximum 10cartons

● **Minimum Order Quantity,  
Standard Packing Quantity**

3,000 pcs



## 16. Legal Disclaimer

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[FC2311-0000-2000-L](#) [FX1901-0001-0025-L](#) [FX1901-0001-0100-L](#) [VBS020601](#) [VBS020701](#) [MF01-N-221-A04](#) [FS2050-0000-1500-G](#)  
[FX1900-0000-0025-L](#) [FX1901-0001-0050-L](#) [4543](#) [MF01A-N-221-A01](#) [MF01A-N-221-A03](#) [MF01A-N-221-A04](#) [MF01A-N-221-A06](#) [MF01-](#)  
[N-220-A01](#) [MF22-N-000-A01](#) [HSFPAR003A](#) [3173-1K](#) [FMAMSDXX015WC2C3](#) [FMAMSDXX025WCSC3](#) [FS01](#) [FS03](#)  
[FSAGPDXX001RCAB5](#) [FSAGPDXX010WCAA5](#) [FSAGPNXX001RC4C5](#) [FSAGPNXX1.5LCAC5](#) [FSG005WNPB](#) [FSG020WNPB](#)  
[FSS005WNGR](#) [FSS005WNSB](#) [FSS010WNSB](#) [FSS005WNGB](#) [FSS015WNGB](#) [FSS020WNGR](#) [FSS020WNSB](#) [FSS1500NGT](#) [FSS1500NSB](#)  
[FSS1500NSR](#) [FSS1500NST](#) [FC23-1-1-0000-0500](#) [FS1901-0000-1000-G](#) [FX292X-040B-0100-L](#)