S-5712 Series

LOW VOLTAGE OPERATION
BOTH POLES / UNIPOLAR DETECTION TYPE HALL IC

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Rev.4.0_00

The S-5712 Series, developed by CMOS technology, is a high-accuracy Hall IC that operates at a low voltage and low current consumption.
The output voltage changes when the S-5712 Series detects the intensity level of flux density. Using the S-5712 Series with a magnet makes it possible to detect the open/close state in various devices.
High-density mounting is possible by using the super-small SNT-4A or the small SOT-23-3 packages. Due to its low voltage operation and low current consumption, the S-5712 Series is suitable for battery-operated portable devices. Due to its high-accuracy magnetic characteristics, the S-5712 Series can make operation's dispersion in the system combined with magnet smaller.

■ Features

- Pole detection[*1]: Detection of both poles, south pole or north pole
- Detection logic for magnetism[*1]: Active "L", active "H"
- Output form[*1]: Nch open drain output, CMOS output
- Magnetic sensitivity[*1]: B_{OP} = 3.0 mT typ., 4.5 mT typ.
- Operating cycle (current consumption): Product with both poles detection
  50.50 ms (2.0 μA) typ.
  Product with south pole or north pole detection
  50.85 ms (1.4 μA) typ.
- Power supply voltage range: 1.6 V to 3.5 V
- Operation temperature range: −40°C to +85°C
- Lead-free (Sn 100%), halogen-free[*2]

***1.** The Option can be selected.
***2.** Refer to "■ **Product Name Structure**" for details.

■ Applications

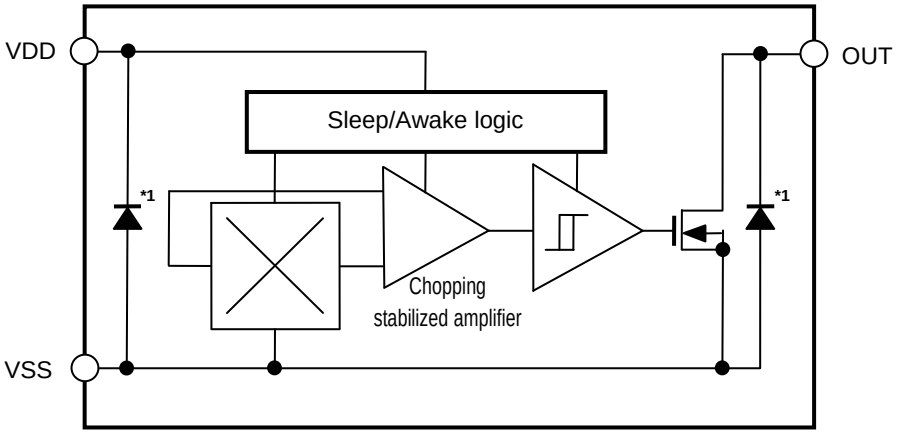
- Mobile phones (flip type, slide type, etc.)
- Laptop PCs
- Digital video cameras
- Playthings, portable games
- Home appliances

■ Packages

- SNT-4A
- SOT-23-3

■ Block Diagrams

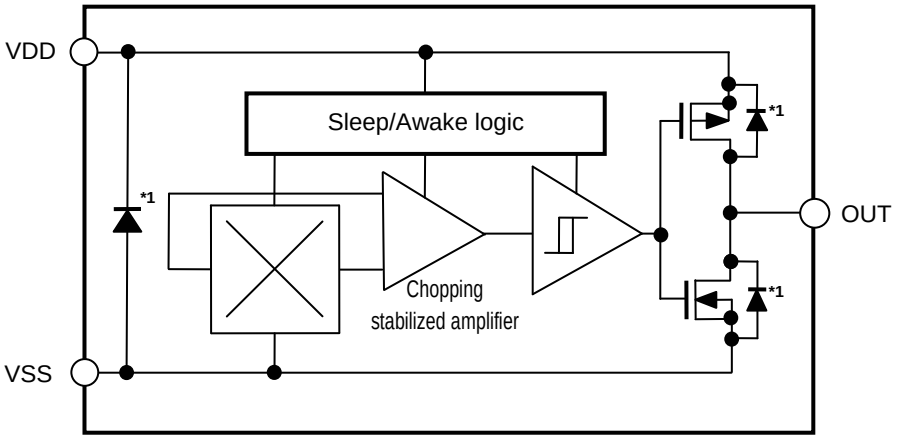
1. Nch open drain output product



***1.** Parasitic diode

Figure 1

2. CMOS output product



***1.** Parasitic diode

Figure 2

■ Product Name Structure

1. Product name

S-5712 A x x x x – xxxx U

- **U** : Environmental code
  - U : Lead-free (Sn 100%), halogen-free
- **xxxx** : Package name (abbreviation) and packing specifications*1
  - I4T1 : SNT-4A, Tape
  - M3T1 : SOT-23-3, Tape
- **x** : Magnetic sensitivity
  - 1 : B_{OP} = 3.0 mT typ.
  - 2 : B_{OP} = 4.5 mT typ.
- **x** : Detection logic for magnetism
  - L : Active “L”
  - H : Active “H”
- **x** : Pole detection
  - D : Detection of both poles
  - S : Detection of south pole
  - N : Detection of north pole
- **x** : Output form
  - N : Nch open drain output
  - C : CMOS output
- **A** : Operating cycle
  - A : t_{CYCLE} = 50.50 ms typ. (Product with both poles detection)
    t_{CYCLE} = 50.85 ms typ. (Product with south pole or north pole detection)

***1.** Refer to the tape specifications at the end of this book.

2. Packages

Package Name	Drawing Code			
	Package	Tape	Reel	Land
SNT-4A	PF004-A-P-SD	PF004-A-C-SD	PF004-A-R-SD	PF004-A-L-SD
SOT-23-3	MP003-C-P-SD	MP003-C-C-SD	MP003-Z-R-SD	–

3. Product name list

Table 1

Output Form	Pole Detection	Detection Logic for Magnetism	Magnetic Sensitivity (B_{OP})	SNT-4A	SOT-23-3
Nch open drain output	Both poles	Active “L”	3.0 mT typ.	S-5712ANDL1-I4T1U	S-5712ANDL1-M3T1U
Nch open drain output	Both poles	Active “L”	4.5 mT typ.	S-5712ANDL2-I4T1U	S-5712ANDL2-M3T1U
CMOS output	Both poles	Active “L”	3.0 mT typ.	S-5712ACDL1-I4T1U	S-5712ACDL1-M3T1U
CMOS output	Both poles	Active “L”	4.5 mT typ.	S-5712ACDL2-I4T1U	S-5712ACDL2-M3T1U
CMOS output	South pole	Active “L”	3.0 mT typ.	S-5712ACSL1-I4T1U	S-5712ACSL1-M3T1U
CMOS output	South pole	Active “L”	4.5 mT typ.	S-5712ACSL2-I4T1U	S-5712ACSL2-M3T1U
CMOS output	North pole	Active “L”	3.0 mT typ.	S-5712ACNL1-I4T1U	S-5712ACNL1-M3T1U
CMOS output	North pole	Active “L”	4.5 mT typ.	S-5712ACNL2-I4T1U	S-5712ACNL2-M3T1U

Remark Please contact our sales office for products other than the above.

■ Pin Configurations

SNT-4A
Top view

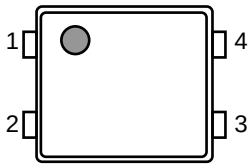


Figure 3

Table 2

Pin No.	Symbol	Pin Description
1	VDD	Power supply pin
2	VSS	GND pin
3	NC*1	No connection
4	OUT	Output pin

***1.** The NC pin is electrically open.
The NC pin can be connected to VDD or VSS.

SOT-23-3
Top view

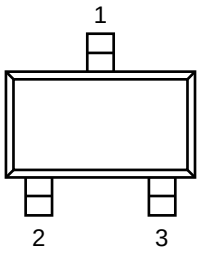


Figure 4

Table 3

Pin No.	Symbol	Pin Description
1	VSS	GND pin
2	VDD	Power supply pin
3	OUT	Output pin

■ Absolute Maximum Ratings

Table 4

(Ta = +25°C unless otherwise specified)

Item		Symbol	Absolute Maximum Rating	Unit
Power supply voltage		V_{DD}	V_{SS} − 0.3 to V_{SS} + 7.0	V
Output current		I_{OUT}	±1.0	mA
Output voltage	Nch open drain output	V_{OUT}	V_{SS} − 0.3 to V_{SS} + 7.0	V
	CMOS output		V_{SS} − 0.3 to V_{DD} + 0.3	V
Power dissipation	SNT-4A	P_D	300[*1]	mW
	SOT-23-3		430[*1]	mW
Operating ambient temperature		T_{opr}	−40 to +85	°C
Storage temperature		T_{stg}	−40 to +125	°C

***1.** When mounted on board

[Mounted board]

(1) Board size: 114.3 mm × 76.2 mm × t1.6 mm

(2) Name: JEDEC STANDARD51-7

Caution The absolute maximum ratings are rated values exceeding which the product could suffer physical damage. These values must therefore not be exceeded under any conditions.

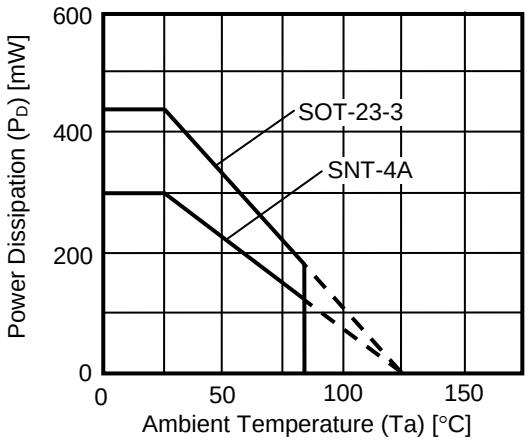


Figure 5 Power Dissipation of Package (When Mounted on Board)

■ Electrical Characteristics

1. Product with both poles detection

Table 5

(Ta = +25°C, V_{DD} = 1.85 V, V_{SS} = 0 V unless otherwise specified)

Item	Symbol	Conditions		Min.	Typ.	Max.	Unit	Test Circuit
Power supply voltage	V_{DD}	–		1.60	1.85	3.50	V	–
Current consumption	I_{DD}	Average value		–	2.0	4.0	μA	1
Output voltage	V_{OUT}	Nch open drain output product	Output transistor Nch, I_{OUT} = 0.5 mA	–	–	0.4	V	2
		CMOS output product	Output transistor Nch, I_{OUT} = 0.5 mA	–	–	0.4	V	2
			Output transistor Pch, I_{OUT} = −0.5 mA	V_{DD} − 0.4	–	–	V	3
Leakage current	I_{LEAK}	Nch open drain output product Output transistor Nch, V_{OUT} = 3.5 V		–	–	1	μA	4
Awake mode time	t_{AW}	–		–	0.10	–	ms	–
Sleep mode time	t_{SL}	–		–	50.40	–	ms	–
Operating cycle	t_{CYCLE}	t_{AW} + t_{SL}		–	50.50	100.00	ms	–

2. Product with south pole and north pole detection

Table 6

(Ta = +25°C, V_{DD} = 1.85 V, V_{SS} = 0 V unless otherwise specified)

Item	Symbol	Conditions		Min.	Typ.	Max.	Unit	Test Circuit
Power supply voltage	V_{DD}	–		1.60	1.85	3.50	V	–
Current consumption	I_{DD}	Average value		–	1.4	3.0	μA	1
Output voltage	V_{OUT}	Nch open drain output product	Output transistor Nch, I_{OUT} = 0.5 mA	–	–	0.4	V	2
		CMOS output product	Output transistor Nch, I_{OUT} = 0.5 mA	–	–	0.4	V	2
			Output transistor Pch, I_{OUT} = −0.5 mA	V_{DD} − 0.4	–	–	V	3
Leakage current	I_{LEAK}	Nch open drain output product Output transistor Nch, V_{OUT} = 3.5 V		–	–	1	μA	4
Awake mode time	t_{AW}	–		–	0.05	–	ms	–
Sleep mode time	t_{SL}	–		–	50.80	–	ms	–
Operating cycle	t_{CYCLE}	t_{AW} + t_{SL}		–	50.85	100.00	ms	–

■ Magnetic Characteristics

1. Product with both poles detection

1. 1 B_{OP} = 3.0 mT typ.

Table 7

(Ta = +25°C, V_{DD} = 1.85 V, V_{SS} = 0 V unless otherwise specified)

Item		Symbol	Conditions	Min.	Typ.	Max.	Unit	Test Circuit
Operating point*1	South pole	B_{OPS}	–	1.4	3.0	4.0	mT	5
	North pole	B_{OPN}	–	–4.0	–3.0	–1.4	mT	5
Release point*2	South pole	B_{RPS}	–	1.1	2.2	3.7	mT	5
	North pole	B_{RPN}	–	–3.7	–2.2	–1.1	mT	5
Hysteresis width*3	South pole	B_{HYSS}	$B_{HYSS} = B_{OPS} - B_{RPS}$	–	0.8	–	mT	5
	North pole	B_{HYSN}	$B_{HYSN} = \|B_{OPN} - B_{RPN}\|$	–	0.8	–	mT	5

1. 2 B_{OP} = 4.5 mT typ.

Table 8

(Ta = +25°C, V_{DD} = 1.85 V, V_{SS} = 0 V unless otherwise specified)

Item		Symbol	Conditions	Min.	Typ.	Max.	Unit	Test Circuit
Operating point*1	South pole	B_{OPS}	–	2.5	4.5	6.0	mT	5
	North pole	B_{OPN}	–	–6.0	–4.5	–2.5	mT	5
Release point*2	South pole	B_{RPS}	–	2.0	3.5	5.5	mT	5
	North pole	B_{RPN}	–	–5.5	–3.5	–2.0	mT	5
Hysteresis width*3	South pole	B_{HYSS}	$B_{HYSS} = B_{OPS} - B_{RPS}$	–	1.0	–	mT	5
	North pole	B_{HYSN}	$B_{HYSN} = \|B_{OPN} - B_{RPN}\|$	–	1.0	–	mT	5

2. Product with south pole detection

2. 1 B_{OP} = 3.0 mT typ.

Table 9

(Ta = +25°C, V_{DD} = 1.85 V, V_{SS} = 0 V unless otherwise specified)

Item		Symbol	Conditions	Min.	Typ.	Max.	Unit	Test Circuit
Operating point*1	South pole	B_{OPS}	–	1.4	3.0	4.0	mT	5
Release point*2	South pole	B_{RPS}	–	1.1	2.2	3.7	mT	5
Hysteresis width*3	South pole	B_{HYSS}	$B_{HYSS} = B_{OPS} - B_{RPS}$	–	0.8	–	mT	5

2. 2 B_{OP} = 4.5 mT typ.

Table 10

(Ta = +25°C, V_{DD} = 1.85 V, V_{SS} = 0 V unless otherwise specified)

Item		Symbol	Conditions	Min.	Typ.	Max.	Unit	Test Circuit
Operating point*1	South pole	B_{OPS}	–	2.5	4.5	6.0	mT	5
Release point*2	South pole	B_{RPS}	–	2.0	3.5	5.5	mT	5
Hysteresis width*3	South pole	B_{HYSS}	$B_{HYSS} = B_{OPS} - B_{RPS}$	–	1.0	–	mT	5

3. Product with north pole detection

3. 1 B_{OP} = 3.0 mT typ.

Table 11

($Ta = +25°C$, $V_{DD} = 1.85$ V, $V_{SS} = 0$ V unless otherwise specified)

Item		Symbol	Conditions	Min.	Typ.	Max.	Unit	Test Circuit
Operating point*1	North pole	B_{OPN}	–	–4.0	–3.0	–1.4	mT	5
Release point*2	North pole	B_{RPN}	–	–3.7	–2.2	–1.1	mT	5
Hysteresis width*3	North pole	B_{HYSN}	$B_{HYSN} = \lvert B_{OPN} - B_{RPN} \rvert$	–	0.8	–	mT	5

3. 2 B_{OP} = 4.5 mT typ.

Table 12

($Ta = +25°C$, $V_{DD} = 1.85$ V, $V_{SS} = 0$ V unless otherwise specified)

Item		Symbol	Conditions	Min.	Typ.	Max.	Unit	Test Circuit
Operating point*1	North pole	B_{OPN}	–	–6.0	–4.5	–2.5	mT	5
Release point*2	North pole	B_{RPN}	–	–5.5	–3.5	–2.0	mT	5
Hysteresis width*3	North pole	B_{HYSN}	$B_{HYSN} = \lvert B_{OPN} - B_{RPN} \rvert$	–	1.0	–	mT	5

***1.** B_{OPN}, B_{OPS} : Operating points
The operating points are the values of magnetic flux density when the output voltage (V_{OUT}) is inverted after the magnetic flux density applied to the S-5712 Series by the magnet (north or south pole) is increased (the magnet is moved closer). Even when the magnetic flux density exceeds B_{OPN} or B_{OPS}, V_{OUT} retains the status.

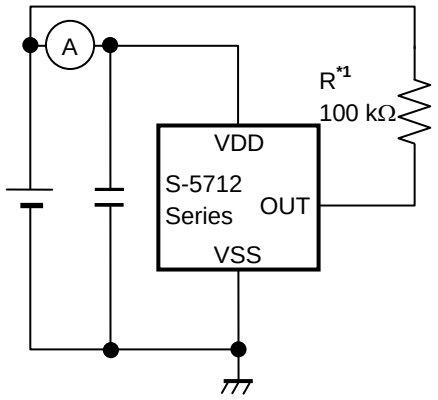
***2.** B_{RPN}, B_{RPS} : Release points
The release points are the values of magnetic flux density when the output voltage (V_{OUT}) is inverted after the magnetic flux density applied to the S-5712 Series by the magnet (north or south pole) is decreased (the magnet is moved further away).
Even when the magnetic flux density falls below B_{RPN} or B_{RPS}, V_{OUT} retains the status.

***3.** B_{HYSN}, B_{HYSS} : Hysteresis widths
B_{HYSN} and B_{HYSS} are the difference between B_{OPN} and B_{RPN}, and B_{OPS} and B_{RPS}, respectively.

Remark The unit of magnetic density mT can be converted by using the formula 1 mT = 10 Gauss.

■ Test Circuits

1.



***1.** Resistor (R) is unnecessary for the CMOS output product.

Figure 6

2.

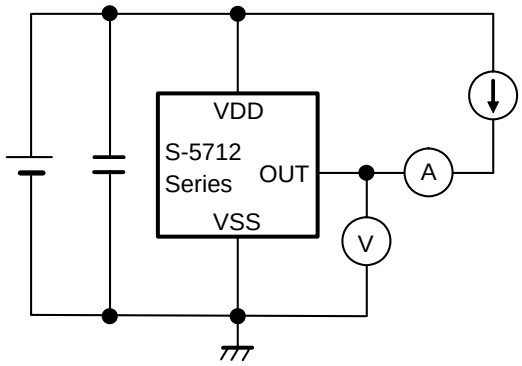


Figure 7

3.

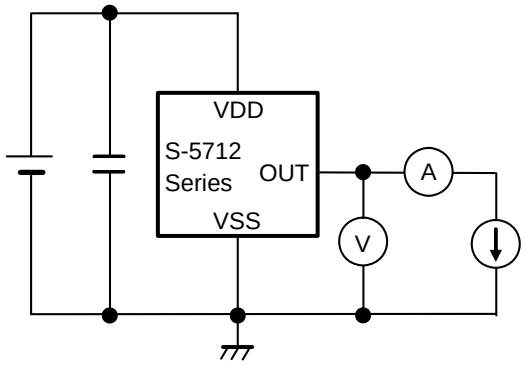


Figure 8

4.

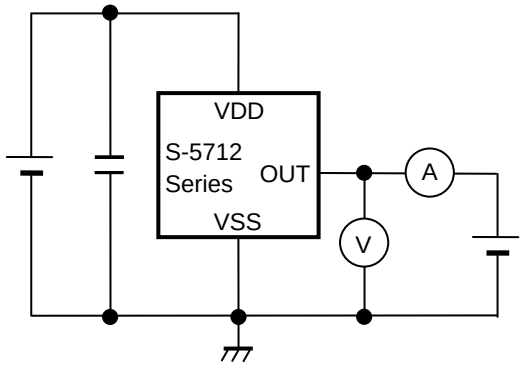
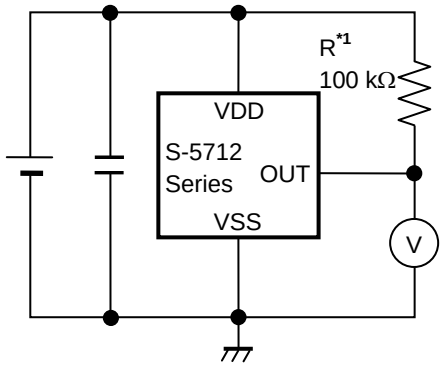


Figure 9

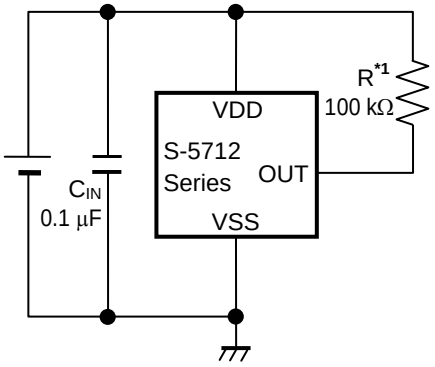
5.



***1.** Resistor (R) is unnecessary for the CMOS output product.

Figure 10

■ Standard Circuit



***1.** Resistor (R) is unnecessary for the CMOS output product.

Figure 11

Caution The above connection diagram and constant will not guarantee successful operation. Perform thorough evaluation using the actual application to set the constant.

■ Operation

1. Direction of applied magnetic flux

The S-5712 Series detects the flux density which is vertical to the marking surface.
In products with detection of both poles, the output voltage (V_{OUT}) is inverted when the south or north pole is moved closer to the marking surface.
In products with detection of the south pole, the output voltage (V_{OUT}) is inverted when the south pole is moved closer to the marking surface.
In products with detection of the north pole, the output voltage (V_{OUT}) is inverted when the north pole is moved closer to the marking surface.
Figures 12 and **13** show the direction in which magnetic flux is being applied.

1. 1 SNT-4A

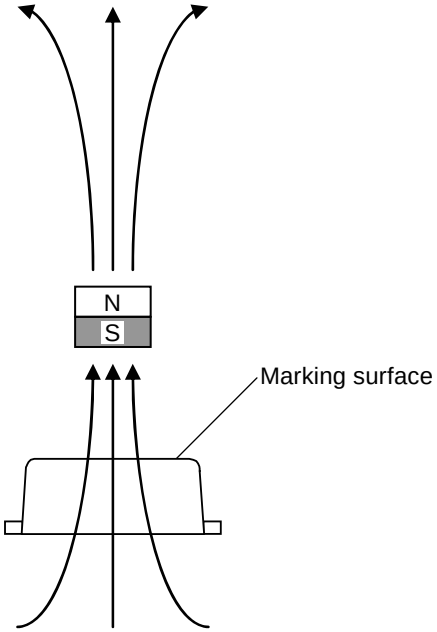


Figure 12

1. 2 SOT-23-3

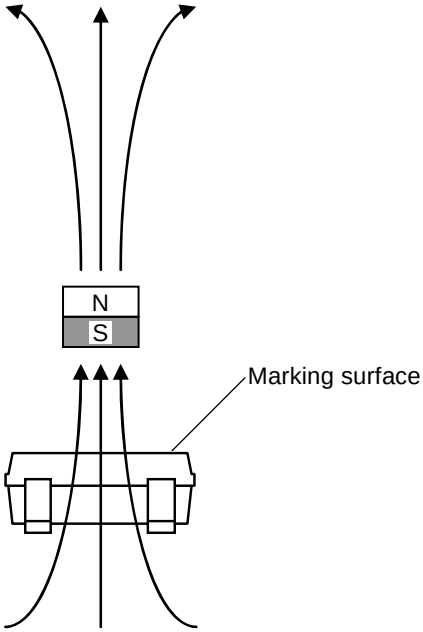


Figure 13

2. Position of Hall sensor

Figures 14 and **15** show the position of Hall sensor.
The center of this Hall sensor is located in the area indicated by a circle, which is in the center of a package as described below.
The following also shows the distance (typ. value) between the marking surface and the chip surface of a package.

2. 1 SNT-4A

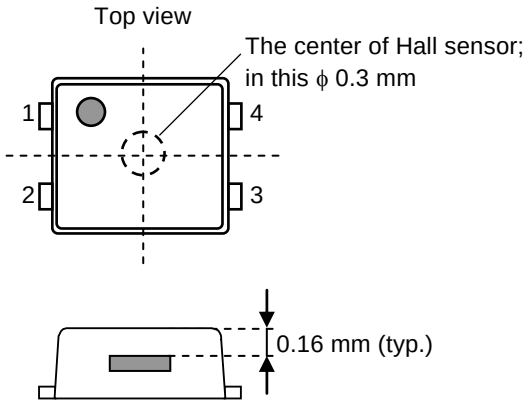


Figure 14

2. 2 SOT-23-3

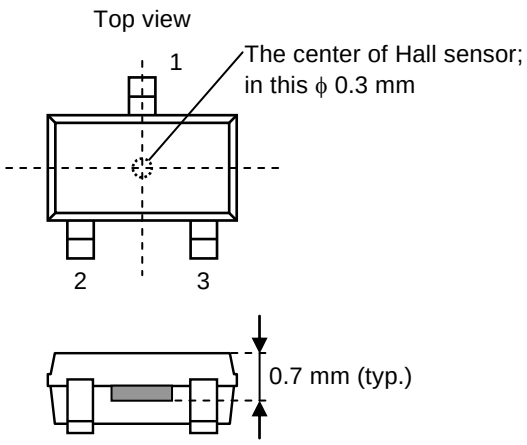


Figure 15

3. Basic operation

The S-5712 Series changes the output voltage level (V_{OUT}) according to the level of the magnetic flux density (north or south pole) applied by a magnet.
The following explains the operation when the magnetism detection logic is active "L".

3. 1 Products with detection of both poles

When the magnetic flux density vertical to the marking surface exceeds B_{OPN} or B_{OPS} after the south or north pole of a magnet is moved closer to the marking surface of the S-5712 Series, V_{OUT} changes from "H" to "L". When the south or north pole of a magnet is moved further away from the marking surface of the S-5712 Series and the magnetic flux density is lower than B_{RPN} or B_{RPS}, V_{OUT} changes from "L" to "H".
Figure 16 shows the relationship between the magnetic density and V_{OUT}.

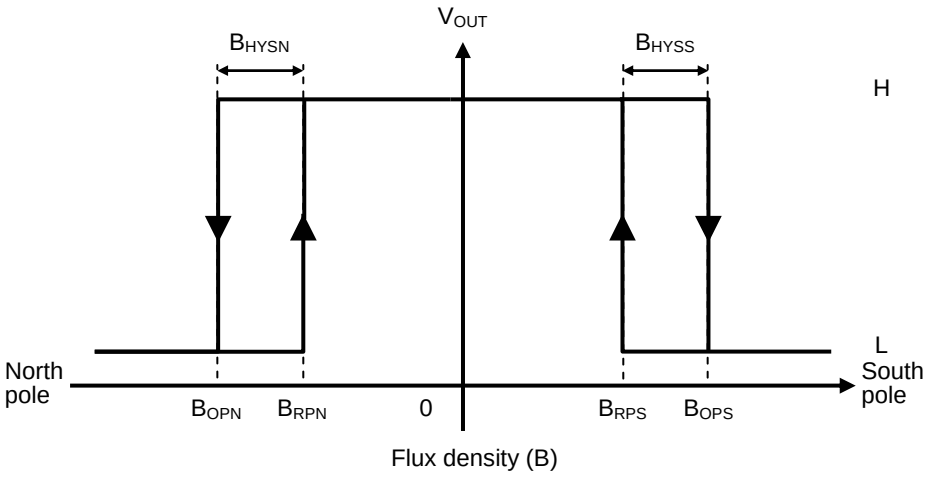


Figure 16

3. 2 Products with detection of south pole

When the magnetic flux density vertical to the marking surface exceeds B_{OPS} after the south pole of a magnet is moved closer to the marking surface of the S-5712 Series, V_{OUT} changes from "H" to "L". When the south pole of a magnet is moved further away from the marking surface of the S-5712 Series and the magnetic flux density is lower than B_{RPS}, V_{OUT} changes from "L" to "H".
Figure 17 shows the relationship between the magnetic density and V_{OUT}.

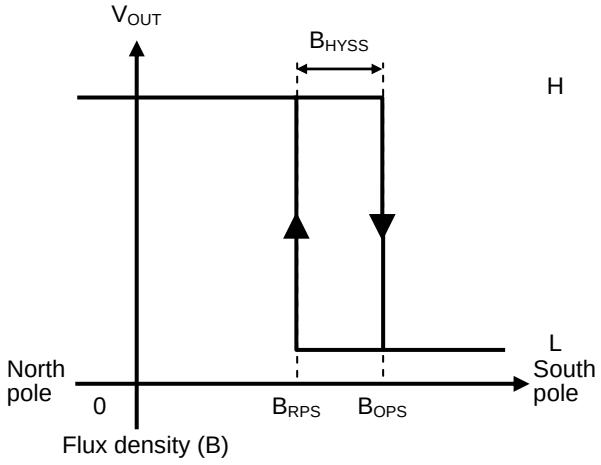


Figure 17

3. 3 Products with detection of north pole

When the magnetic flux density vertical to the marking surface exceeds B_{OPN} after the north pole of a magnet is moved closer to the marking surface of the S-5712 Series, V_{OUT} changes from "H" to "L". When the north pole of a magnet is moved further away from the marking surface of the S-5712 Series and the magnetic flux density is lower than B_{RPN}, V_{OUT} changes from "L" to "H".
Figure 18 shows the relationship between the magnetic density and V_{OUT}.

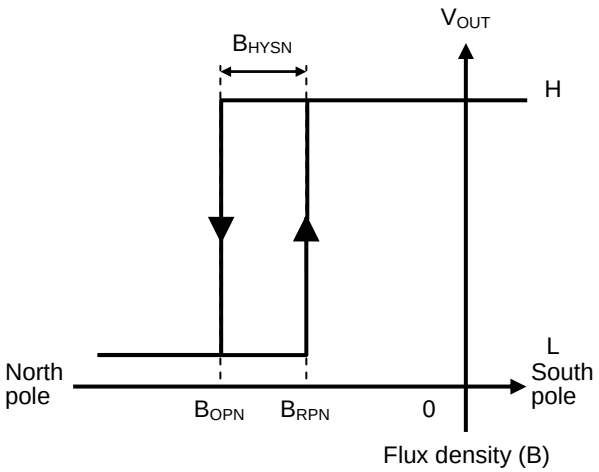


Figure 18

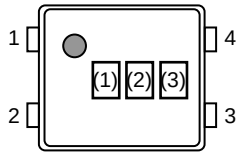
■ Precautions

- If the impedance of the power supply is high, the IC may malfunction due to a supply voltage drop caused by through-type current. Take care with the pattern wiring to ensure that the impedance of the power supply is low.
- Note that the IC may malfunction if the power supply voltage rapidly changes.
- Do not apply an electrostatic discharge to this IC that exceeds the performance ratings of the built-in electrostatic protection circuit.
- Large stress on this IC may affect on the magnetic characteristics. Avoid large stress which is caused by bend and distortion during mounting the IC on a board or handle after mounting.
- SII claims no responsibility for any disputes arising out of or in connection with any infringement by products including this IC of patents owned by a third party.

■ Marking Specifications

1. SNT-4A

SNT-4A
Top view



(1) to (3) : Product code (Refer to **Product name vs. Product code**.)

Product name vs. Product code

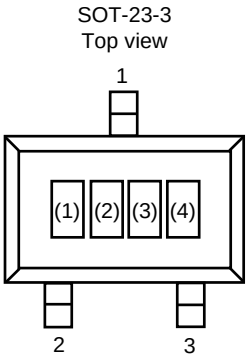
1. 1 Nch open drain output product

Product Name	Product Code		
	(1)	(2)	(3)
S-5712ANDL1-I4T1U	X	A	B
S-5712ANDL2-I4T1U	X	A	C

1. 2 CMOS output product

Product Name	Product Code		
	(1)	(2)	(3)
S-5712ACDL1-I4T1U	X	B	B
S-5712ACDL2-I4T1U	X	B	C
S-5712ACSL1-I4T1U	X	B	J
S-5712ACSL2-I4T1U	X	B	K
S-5712ACNL1-I4T1U	X	B	R
S-5712ACNL2-I4T1U	X	B	S

2. SOT-23-3



(1) to (3) : Product code (Refer to **Product name vs. Product code**.)
(4) : Lot number

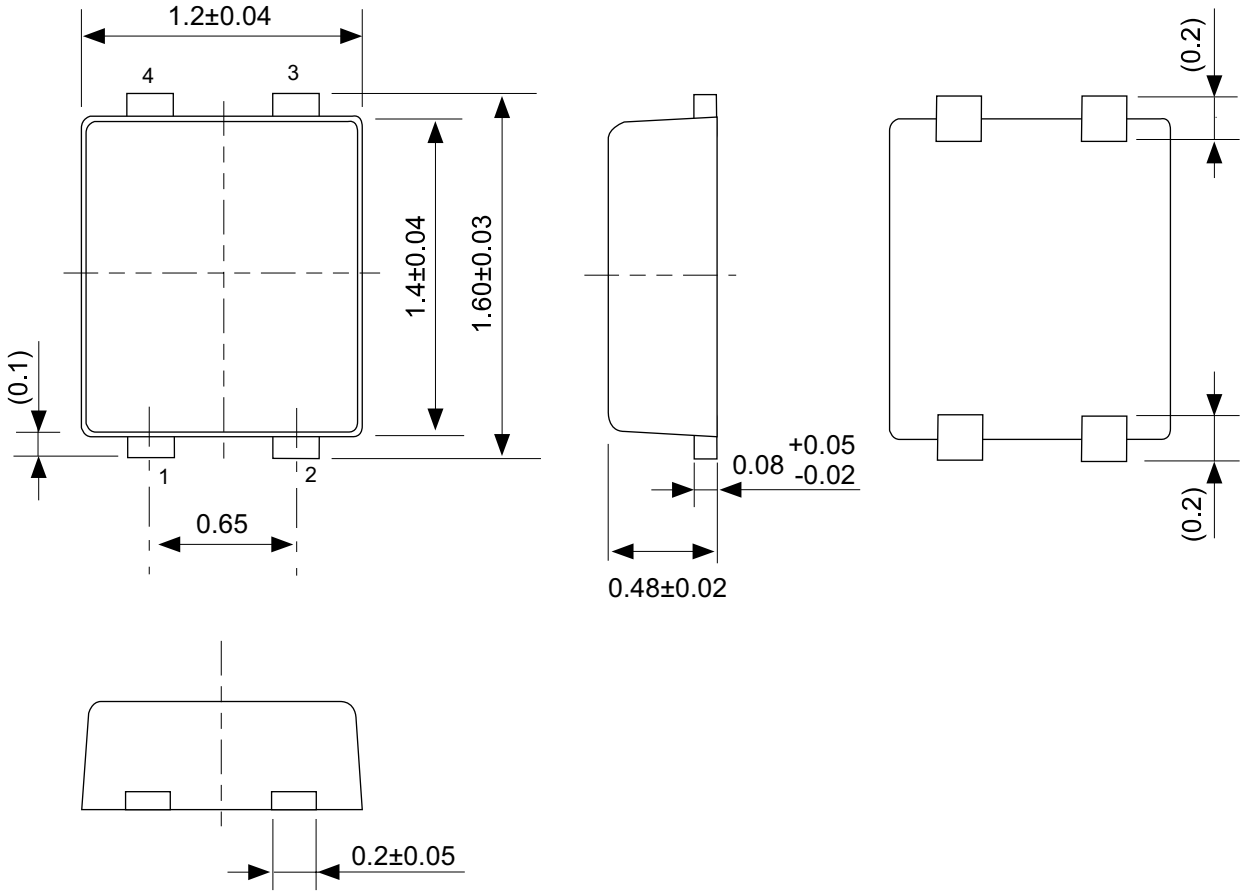
Product name vs. Product code

2. 1 Nch open drain output product

Product Name	Product Code		
	(1)	(2)	(3)
S-5712ANDL1-M3T1U	X	A	B
S-5712ANDL2-M3T1U	X	A	C

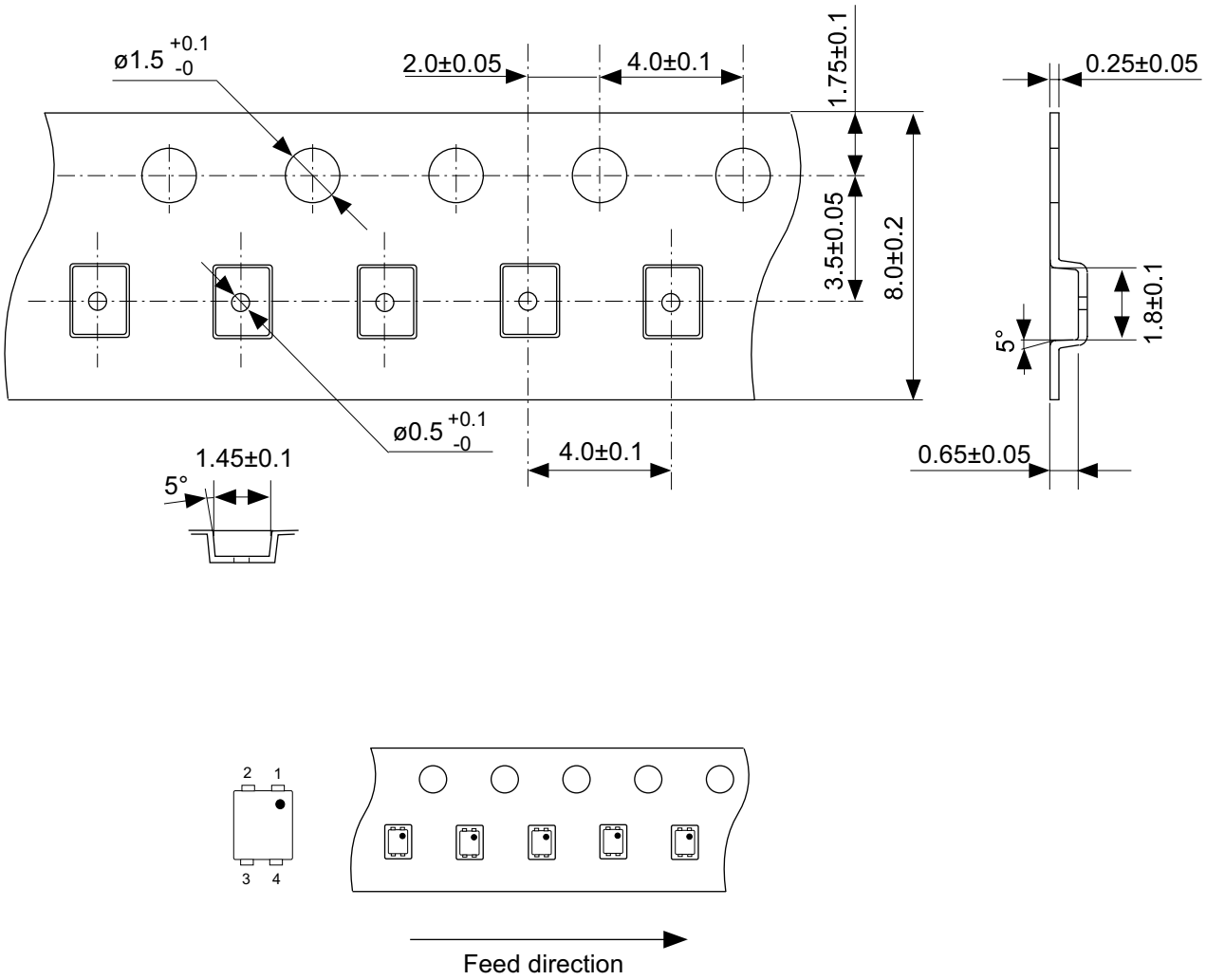
2. 2 CMOS output product

Product Name	Product Code		
	(1)	(2)	(3)
S-5712ACDL1-M3T1U	X	B	B
S-5712ACDL2-M3T1U	X	B	C
S-5712ACSL2-M3T1U	X	B	J
S-5712ACSL2-M3T1U	X	B	K
S-5712ACNL2-M3T1U	X	B	R
S-5712ACNL2-M3T1U	X	B	S



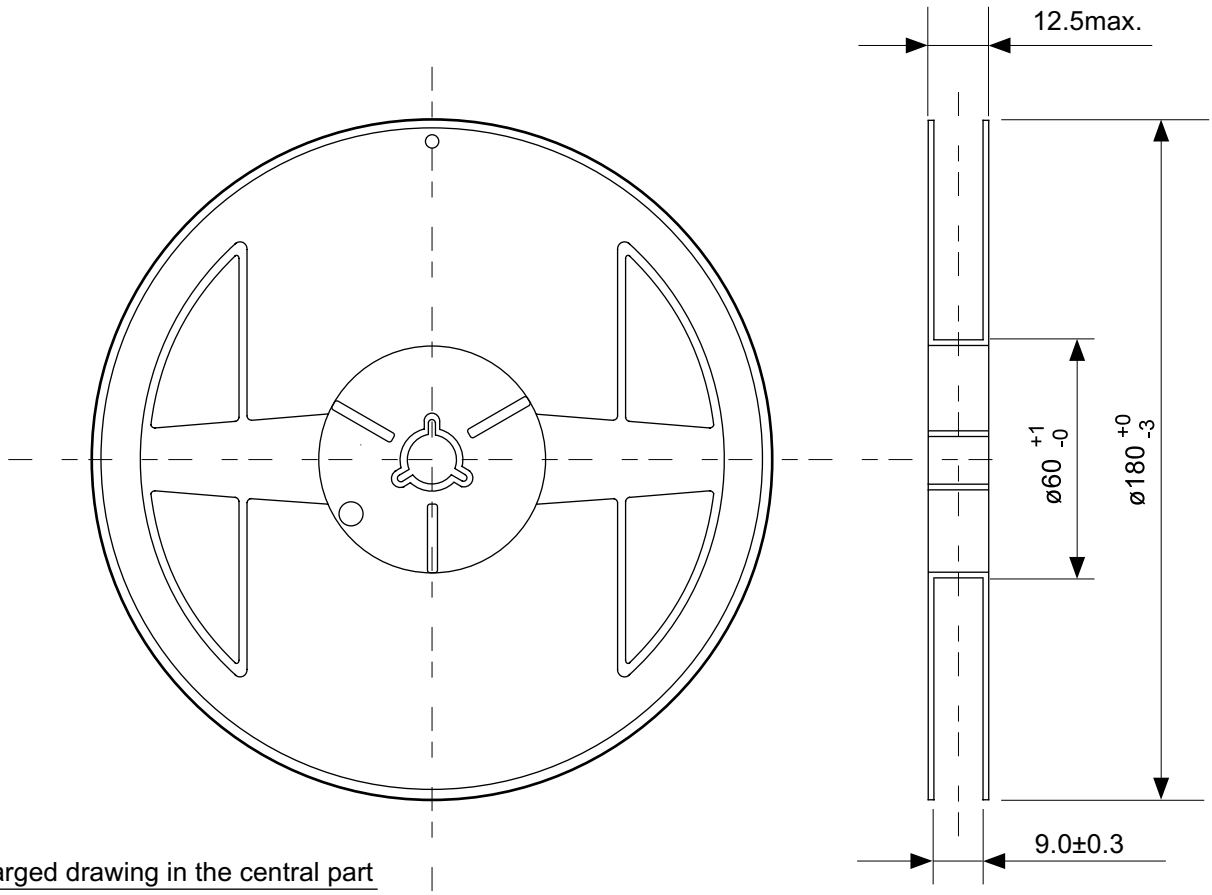
No. PF004-A-P-SD-4.0

TITLE	SNT-4A-A-PKG Dimensions
No.	PF004-A-P-SD-4.0
SCALE	
UNIT	mm
Seiko Instruments Inc.	

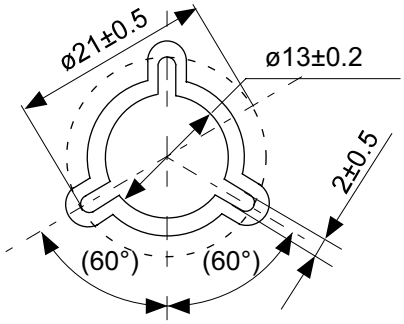


No. PF004-A-C-SD-1.0

TITLE	SNT-4A-A-Carrier Tape
No.	PF004-A-C-SD-1.0
SCALE	
UNIT	mm
Seiko Instruments Inc.	

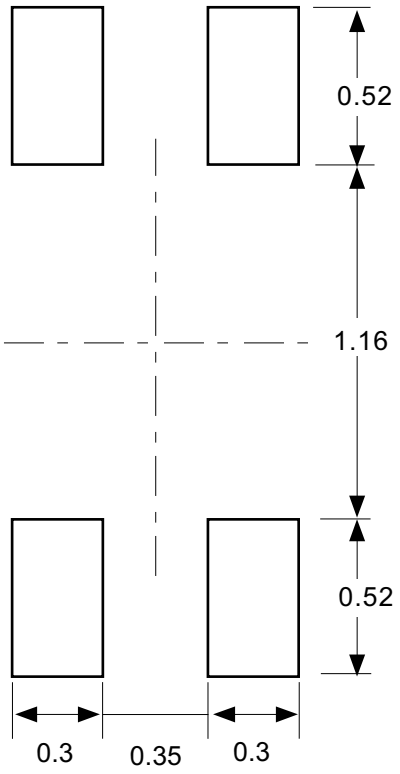


Enlarged drawing in the central part



No. PF004-A-R-SD-1.0

TITLE	SNT-4A-A-Reel		
No.	PF004-A-R-SD-1.0		
SCALE		QTY.	5,000
UNIT	mm		
Seiko Instruments Inc.			

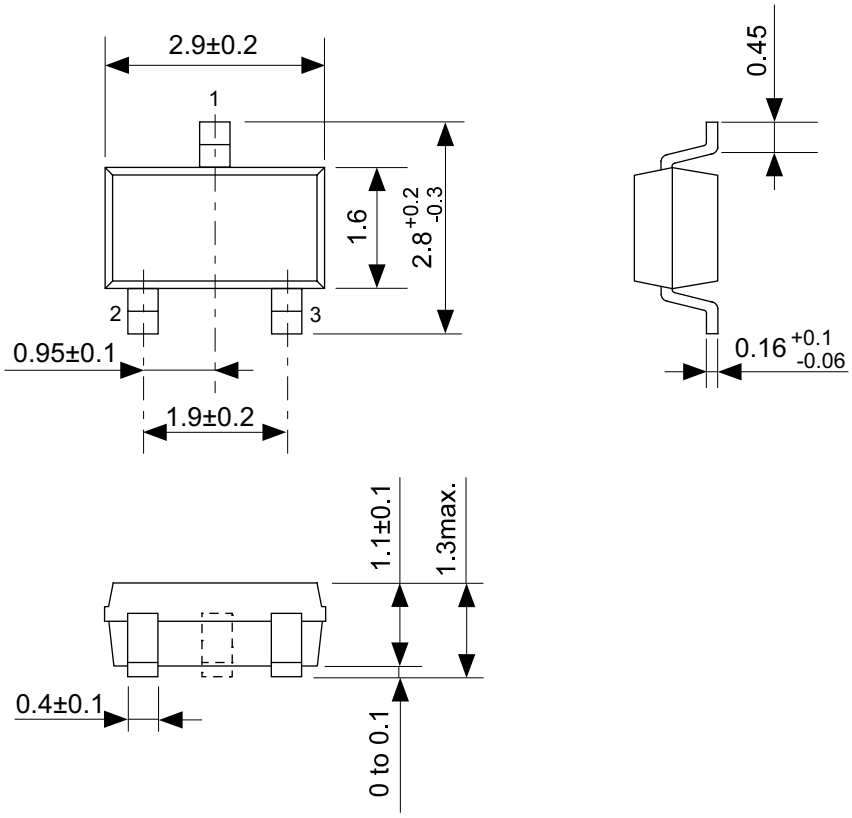


Caution Making the wire pattern under the package is possible. However, note that the package may be upraised due to the thickness made by the silk screen printing and of a solder resist on the pattern because this package does not have the standoff.

注意 パッケージ下への配線パターン形成は可能ですが、本パッケージはスタンドオフが無いので、パターン上のレジスト厚み、シルク印刷の厚みによってパッケージが持ち上がることがありますのでご配慮ください。

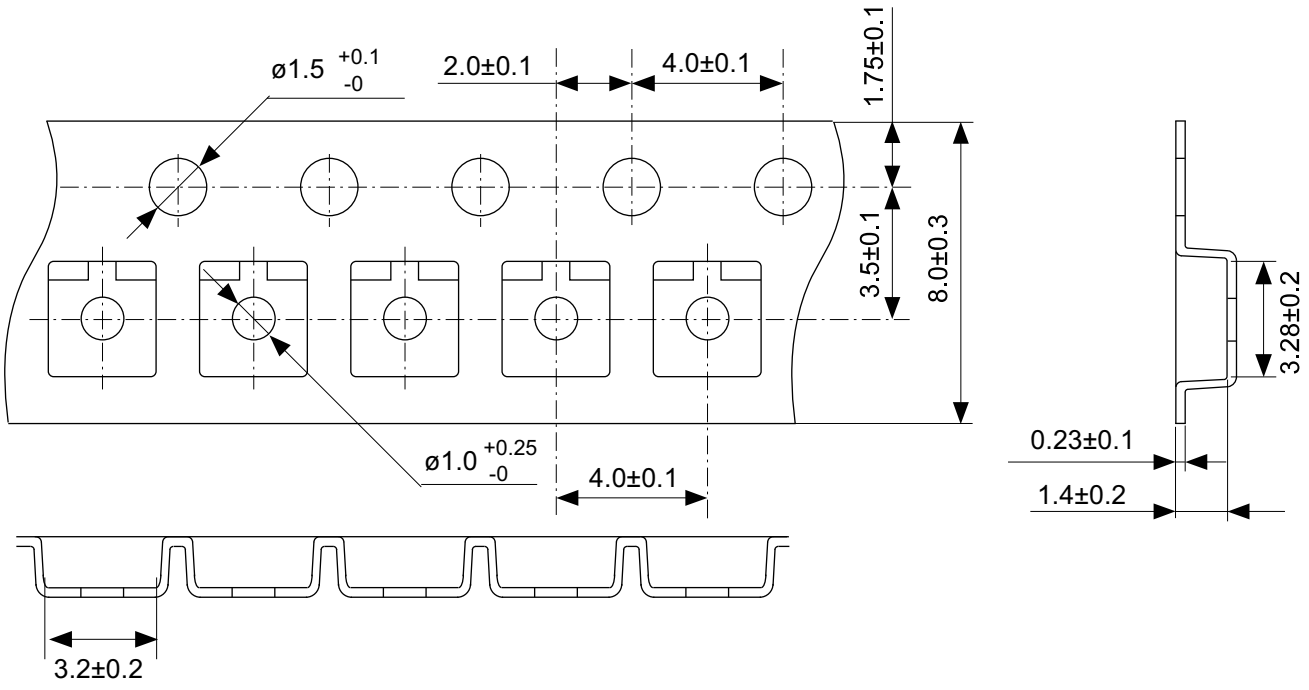
No. PF004-A-L-SD-3.0

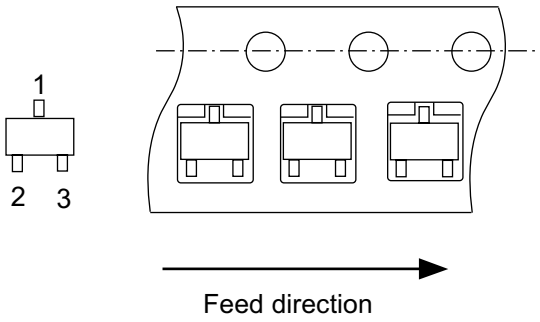
TITLE	SNT-4A-A-Land Recommendation
No.	PF004-A-L-SD-3.0
SCALE	
UNIT	mm
Seiko Instruments Inc.	



No. MP003-C-P-SD-1.0

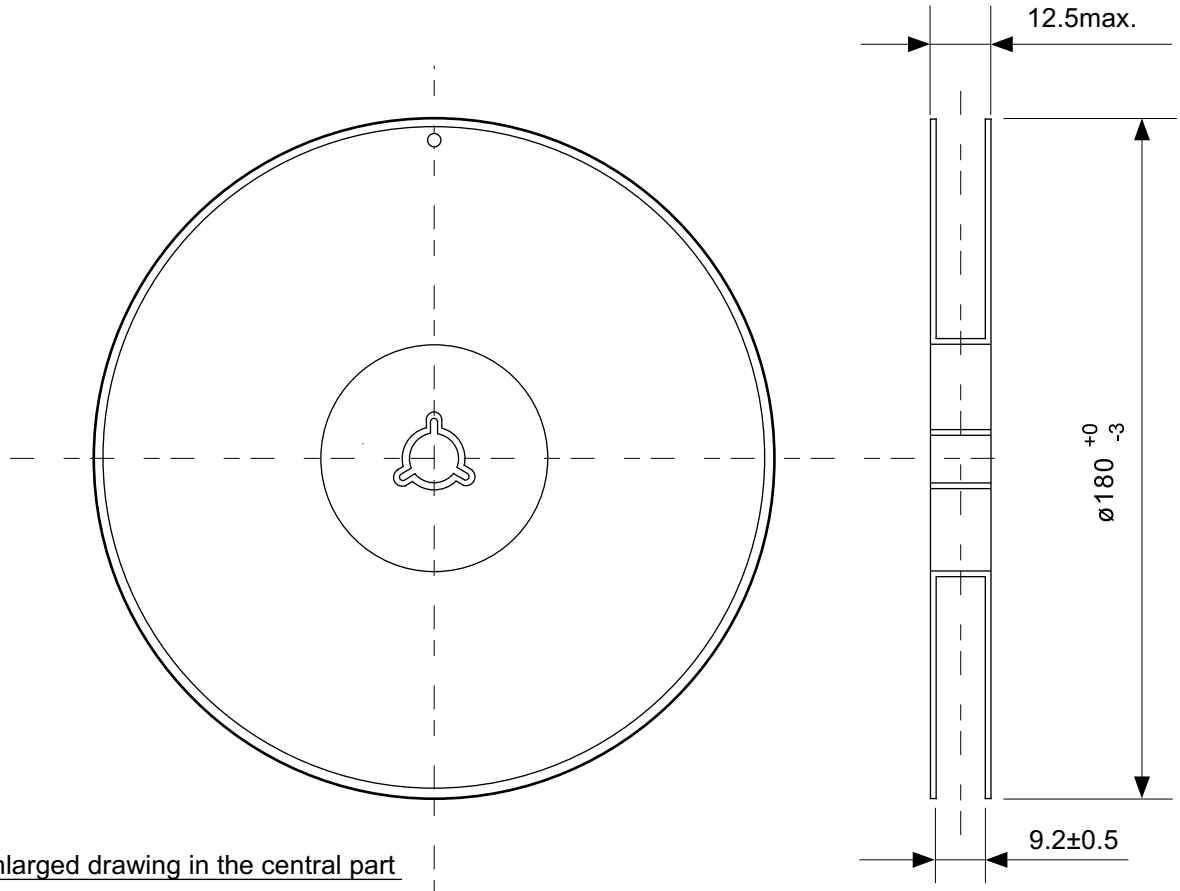
TITLE	SOT233-C-PKG Dimensions
No.	MP003-C-P-SD-1.0
SCALE	
UNIT	mm
Seiko Instruments Inc.	



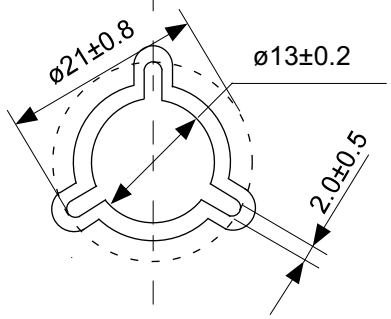


No. MP003-C-C-SD-2.0

TITLE	SOT233-C-Carrier Tape
No.	MP003-C-C-SD-2.0
SCALE	
UNIT	mm
Seiko Instruments Inc.	



Enlarged drawing in the central part



No. MP003-Z-R-SD-1.0

TITLE	SOT233-C-Reel		
No.	MP003-Z-R-SD-1.0		
SCALE		QTY.	3,000
UNIT	mm		
Seiko Instruments Inc.			

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