# HIGH-SPEED UNIPOLAR DETECTION TYPE HALL IC

Rev.1.0_00

The S-57B1 Series, developed by CMOS technology, is a high-accuracy Hall IC that operates with a high-sensitivity, a high-speed detection and low current consumption.

The output voltage changes when the S-57B1 Series detects the intensity level of flux density. Using the S-57B1 Series with a magnet makes it possible to detect the open / close and rotation state in various devices.

High-density mounting is possible by using the small SOT-23-3 package.

Due to its high-accuracy magnetic characteristics, the S-57B1 Series can make operation's dispersion in the system combined with magnet smaller.

**Caution** **This product is intended to use in general electronic devices such as consumer electronics, office equipment, and communications devices. Before using the product in medical equipment or automobile equipment including car audio, keyless entry and engine control unit, contact to SII is indispensable.**

## ■ Features

- Pole detection: Detection of south pole
- Detection logic for magnetism[*1]: Active "L", active "H"
- Output form[*1]: Nch open drain output, CMOS output
- Magnetic sensitivity: $B_{OP}$ = 3.0 mT typ.
- Operating cycle (current consumption): 50 μs (1400 μA) typ.
- Power supply voltage range: 2.7 V to 5.5 V
- Operation temperature range: Ta = −40°C to +125°C
- Lead-free (Sn 100%), halogen-free[*2]

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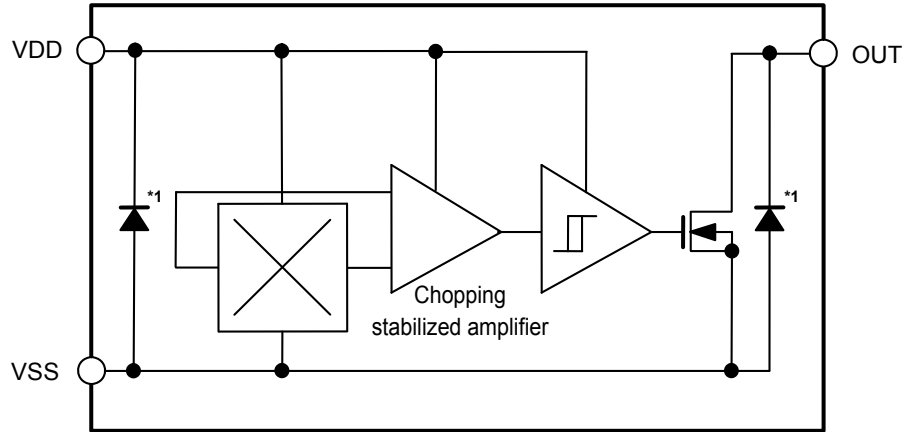
## ■ Applications

- Motor
- Housing equipment
- Industrial equipment
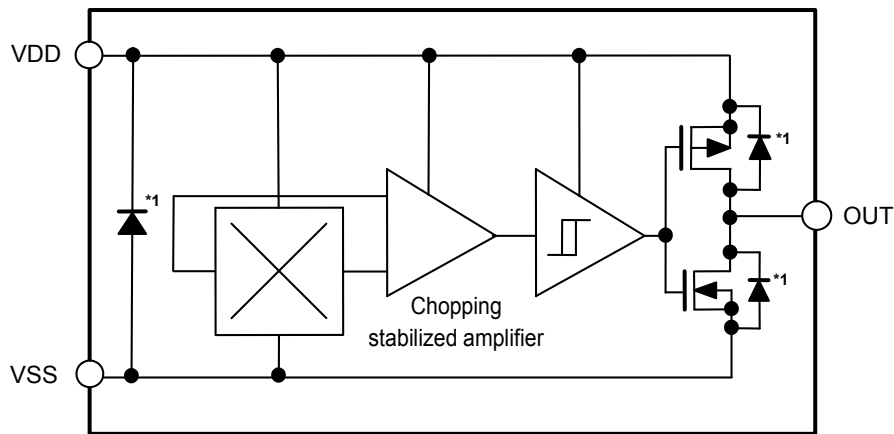
## ■ Package

- SOT-23-3

# ■ Block Diagrams

### 1. Nch open drain output product



**\*1.** Parasitic diode
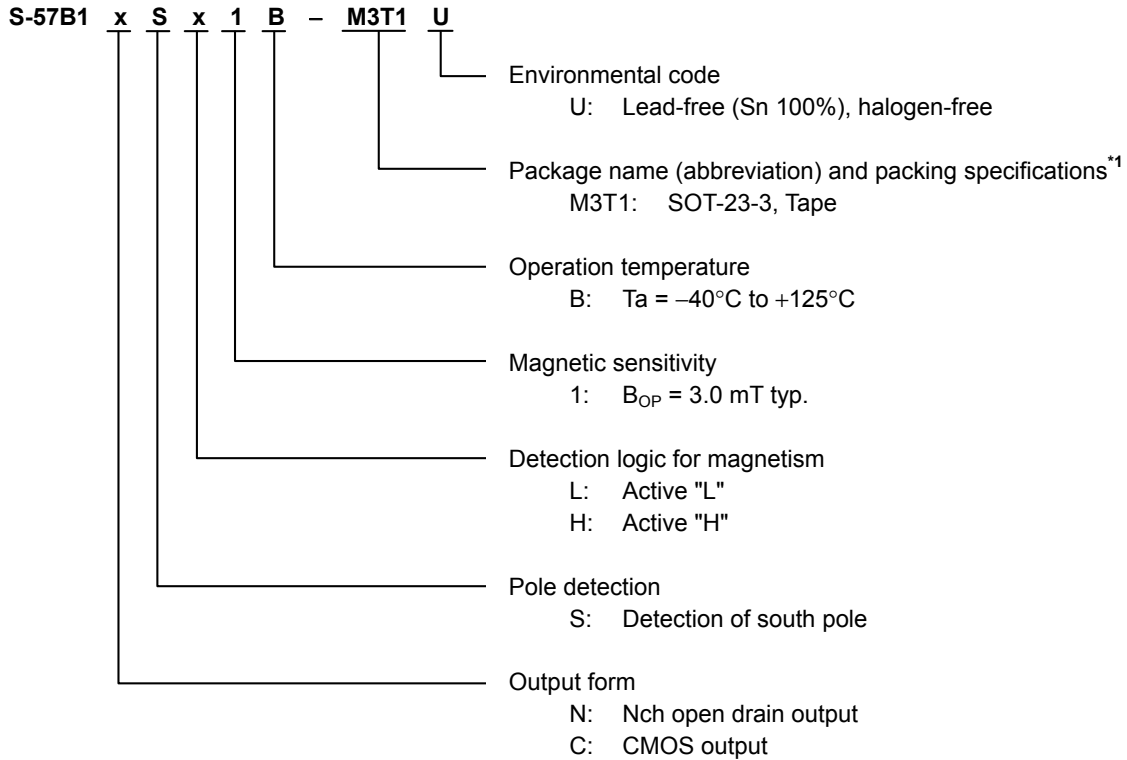
**Figure 1**

### 2. CMOS output product



**\*1.** Parasitic diode

**Figure 2**

# ■ Product Name Structure

## 1. Product name

S-57B1  x  S  x  1  B  –  M3T1  U

— Environmental code
    U:  Lead-free (Sn 100%), halogen-free

— Package name (abbreviation) and packing specifications[1]
    M3T1:  SOT-23-3, Tape

— Operation temperature
    B:  $Ta = -40°C$ to $+125°C$

— Magnetic sensitivity
    1:  $B_{OP} = 3.0$ mT typ.

— Detection logic for magnetism
    L:  Active "L"
    H:  Active "H"

— Pole detection
    S:  Detection of south pole

— Output form
    N:  Nch open drain output
    C:  CMOS output

**[1].** Refer to the tape drawing.

## 2. Package

**Table 1   Package Drawing Codes**

| Package Name | Dimension | Tape | Reel |
|---|---|---|---|
| SOT-23-3 | MP003-C-P-SD | MP003-C-C-SD | MP003-Z-R-SD |

## 3. Product name list

**Table 2**

| Product Name | Output Form | Pole Detection | Detection Logic for Magnetism | Magnetic Sensitivity ($B_{OP}$) | Operation temperature (Ta) |
|---|---|---|---|---|---|
| S-57B1NSL1B-M3T1U | Nch open drain output | South pole | Active "L" | 3.0 mT typ. | $-40°C$ to $+125°C$ |

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

## ■ Pin Configuration
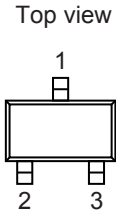
### 1. SOT-23-3

Top view



**Figure 3**

**Table 3**

| Pin No. | Symbol | 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 | | $I_{OUT}$ | $\pm 2.0$ | mA |
| Output voltage | Nch open drain output product | $V_{OUT}$ | $V_{SS} - 0.3$ to $V_{SS} + 7.0$ | V |
| | CMOS output product | | $V_{SS} - 0.3$ to $V_{DD} + 0.3$ | V |
| Power dissipation | | $P_D$ | 430[*1] | mW |
| Operating ambient temperature | | $T_{opr}$ | −40 to +125 | °C |
| Storage temperature | | $T_{stg}$ | −40 to +150 | °C |

***1.** When mounted on board
  **[Mounted board]**
  (1) Board size:    114.3 mm $\times$ 76.2 mm $\times$ 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.**

Seiko Instruments Inc.

## ■ Electrical Characteristics

**Table 5**

(Ta = +25°C, $V_{DD}$ = 5.0 V, $V_{SS}$ = 0 V unless otherwise specified)

| Item | Symbol | Condition | | Min. | Typ. | Max. | Unit | Test Circuit |
|---|---|---|---|---|---|---|---|---|
| Power supply voltage | $V_{DD}$ | – | | 2.7 | 5.0 | 5.5 | V | – |
| Current consumption | $I_{DD}$ | Average value | | – | 1400 | 2000 | μA | 1 |
| Output voltage | $V_{OUT}$ | Nch open drain output product | Output transistor Nch, $I_{OUT}$ = 2 mA | – | – | 0.4 | V | 2 |
| | | CMOS output product | Output transistor Nch, $I_{OUT}$ = 2 mA | – | – | 0.4 | V | 2 |
| | | | Output transistor Pch, $I_{OUT}$ = −2 mA | $V_{DD}$ − 0.4 | – | – | V | 3 |
| Leakage current | $I_{LEAK}$ | Nch open drain output product Output transistor Nch, $V_{OUT}$ = 5.5 V | | – | – | 1 | μA | 4 |
| Operating cycle | $t_{CYCLE}$ | – | | – | 50 | 100 | μs | – |

## ■ Magnetic Characteristics

**Table 6**

(Ta = +25°C, $V_{DD}$ = 5.0 V, $V_{SS}$ = 0 V unless otherwise specified)

| Item | | Symbol | Condition | 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 |

**[*1].** $B_{OPS}$: Operating point

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-57B1 Series by the magnet (south pole) is increased (the magnet is moved closer).
Even when the magnetic flux density exceeds $B_{OPS}$, $V_{OUT}$ retains the status.

**[*2].** $B_{RPS}$: 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-57B1 Series by the magnet (south pole) is decreased (the magnet is moved further away).
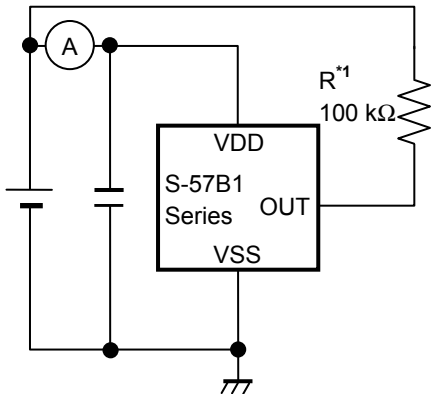Even when the magnetic flux density falls below $B_{RPS}$, $V_{OUT}$ retains the status.

**[*3].** $B_{HYSS}$: Hysteresis widths

$B_{HYSS}$ is the difference of magnetic flux density between $B_{OPS}$ and $B_{RPS}$.

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

■ **Test Circuits**



**\*1.** Resistor (R) is unnecessary for the CMOS output product.
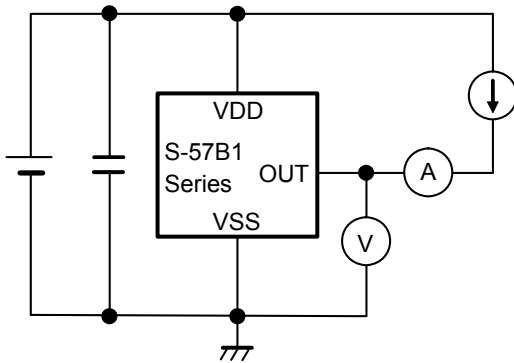
**Figure 4  Test Circuit 1**
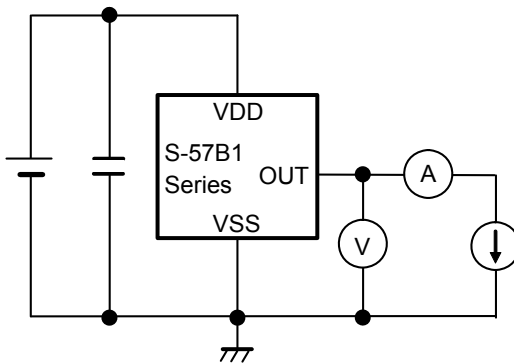


**Figure 5  Test Circuit 2**
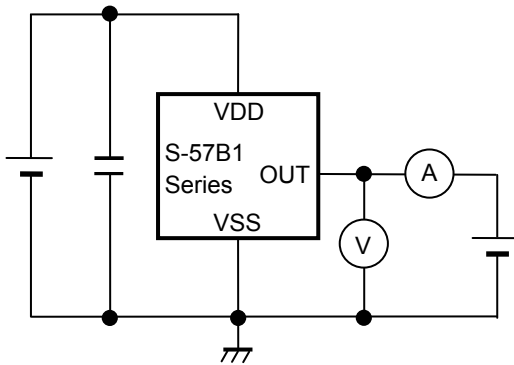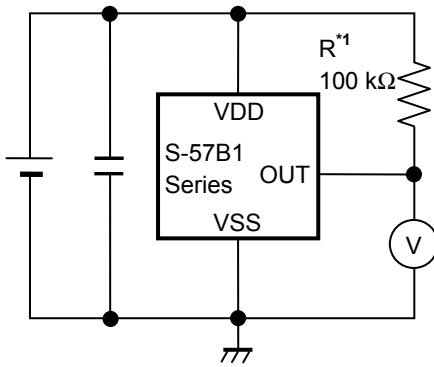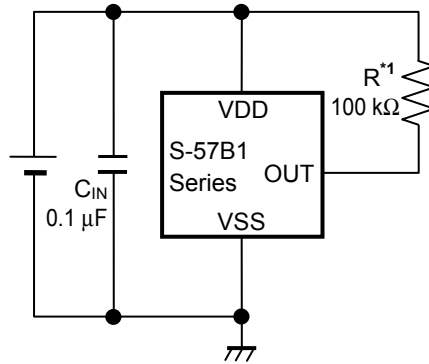


**Figure 6  Test Circuit 3**

**Figure 7 Test Circuit 4**

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

**Figure 8  Test Circuit 5**

■ **Standard Circuit**



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

**Figure 9**

**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-57B1 Series detects the magnetic flux density which is vertical to the marking surface.
The output voltage ($V_{OUT}$) is inverted when the south pole is moved closer to the marking surface.
**Figure 10** shows the direction in which magnetic flux is being applied.

Marking surface
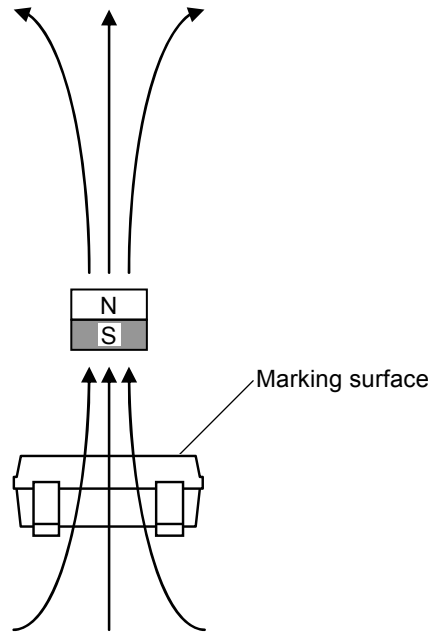
**Figure 10**

### 2. Position of Hall sensor

**Figure 11** shows 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.

Top view

The center of Hall sensor;
in this $\phi$ 0.3 mm

0.7 mm (typ.)
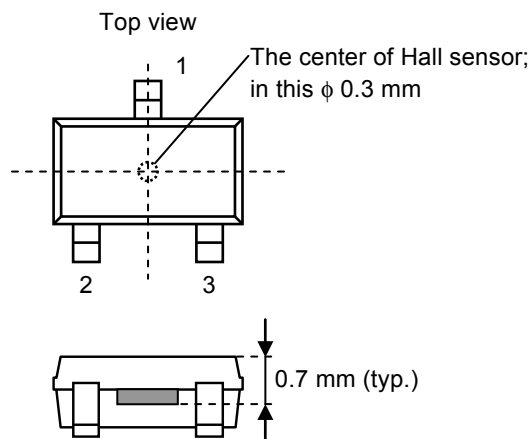
**Figure 11**

### 3. Basic operation

The S-57B1 Series changes the output voltage level ($V_{OUT}$) according to the level of the magnetic flux density (south pole) applied by a magnet.
The following explains the operation when the magnetism detection logic is active "L".

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-57B1 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-57B1 Series and the magnetic flux density is lower than $B_{RPS}$, $V_{OUT}$ changes from "L" to "H".
**Figure 12** shows the relationship between the magnetic flux density and $V_{OUT}$.
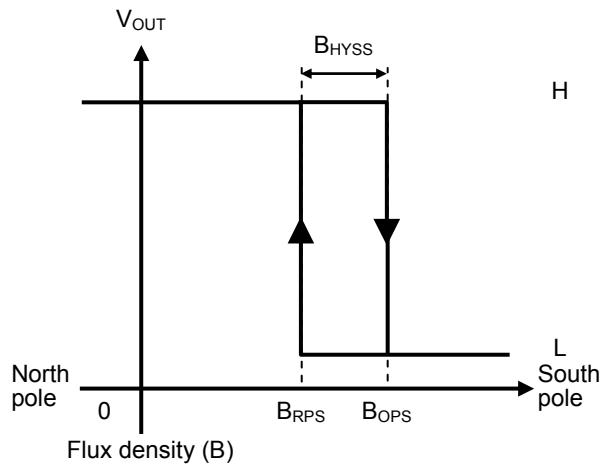
**Figure 12**

■ **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 Specification

### 1. SOT-23-3

Top view
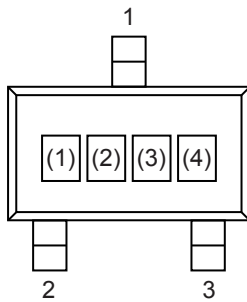


(1) to (3) : Product code (Refer to **Product name vs. Product code**.)
(4) : Lot number

**Product name vs. Product code**

| Product Name | Product Code | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| S-57B1NSL1B-M3T1U | W | 6 | A |
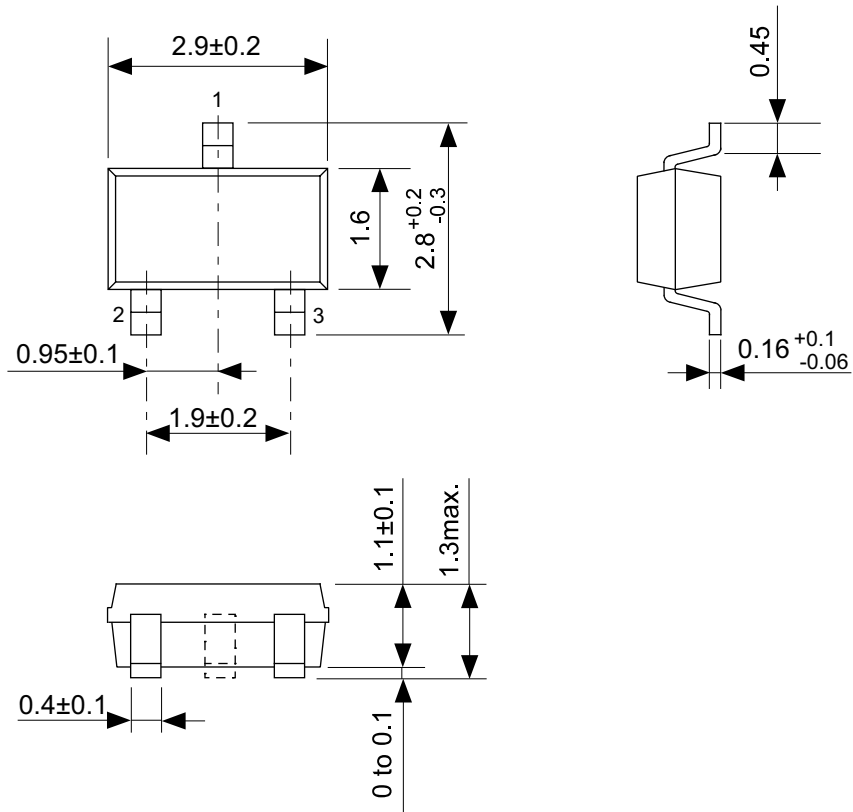
No. MP003-C-P-SD-1.0

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

ø1.5 $^{+0.1}_{-0}$  2.0±0.1  4.0±0.1

1.75±0.1

3.5±0.1  8.0±0.3

3.28±0.2

ø1.0 $^{+0.25}_{-0}$  4.0±0.1

0.23±0.1

1.4±0.2

3.2±0.2

1

2  3

Feed direction
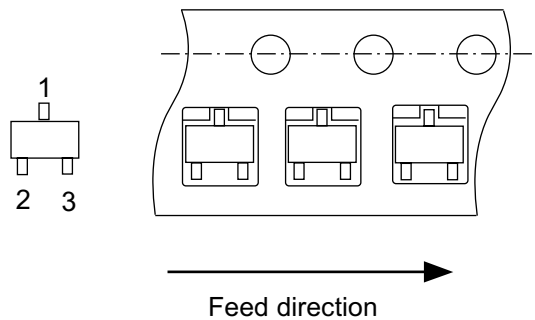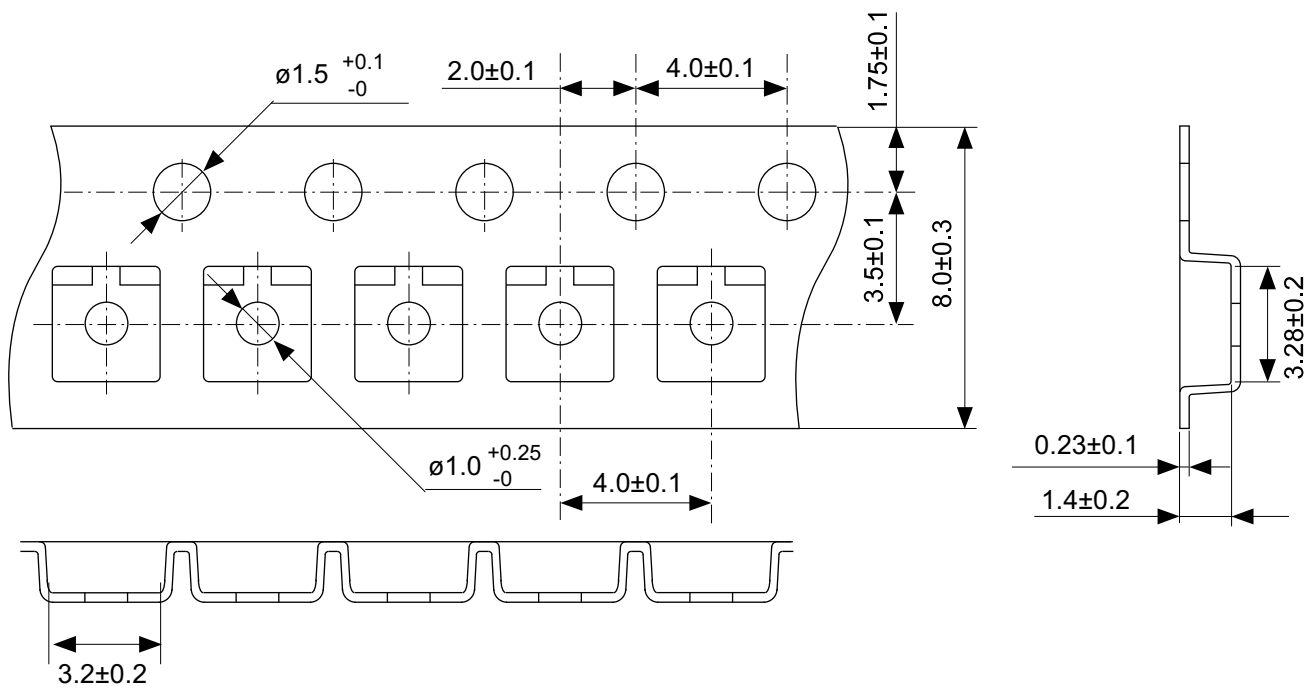
<u>No. MP003-C-C-SD-2.0</u>

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

12.5max.

ø180 +0 -3

9.2±0.5
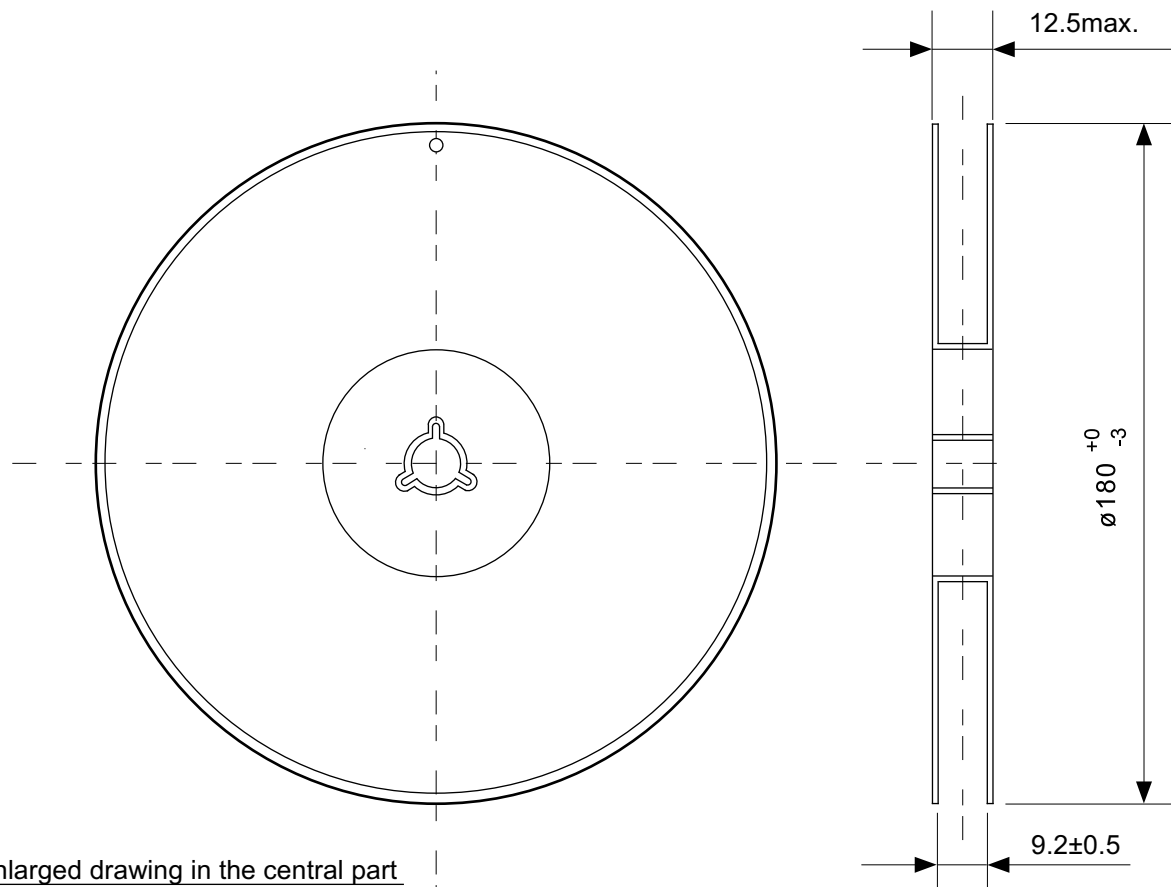
Enlarged drawing in the central part

ø21±0.8

ø13±0.2

2.0±0.5
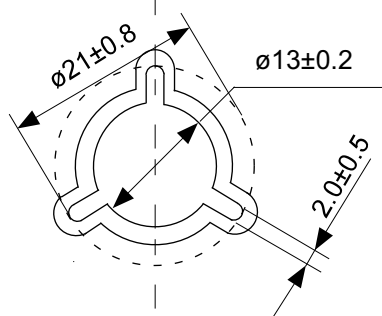
No. MP003-Z-R-SD-1.0

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

# SII 
Seiko Instruments Inc.
**www.sii-ic.com**