

HIGH-SPEED BIPOLAR HALL EFFECT LATCH

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Rev.1.2_00

The S-57M1 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-57M1 Series detects the intensity level of magnetic flux density and a polarity change. Using the S-57M1 Series with a magnet makes it possible to detect the rotation status 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-57M1 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: | Bipolar latch |
| • Detection logic for magnetism ^{*1} : | $V_{OUT} = "L"$ at S pole detection |
| | $V_{OUT} = "H"$ at S pole detection |
| • Output form ^{*1} : | Nch open-drain output, CMOS output |
| • Magnetic sensitivity: | $B_{OP} = 3.0 \text{ mT typ.}$ |
| • Operation cycle (current consumption): | $t_{CYCLE} = 50 \mu\text{s} (1400 \mu\text{A}) \text{ typ.}$ |
| • Power supply voltage range: | $V_{DD} = 2.7 \text{ V to } 5.5 \text{ V}$ |
| • Operation temperature range: | $T_a = -40^\circ\text{C to } +125^\circ\text{C}$ |
| • Lead-free (Sn 100%), halogen-free ^{*2} | |

*1. The option can be selected.

*2. Refer to "■ Product Name Structure" for details.

■ Applications

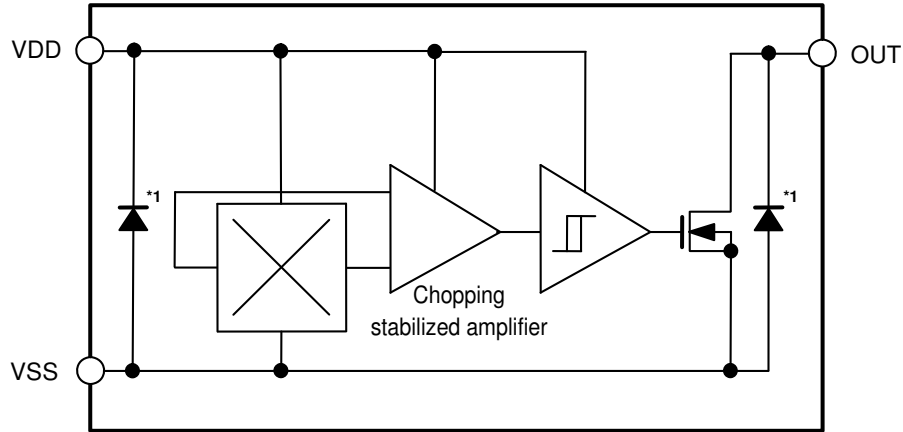
- Motor
- Housing equipment
- Industrial equipment

■ Package

- SOT-23-3

■ **Block Diagrams**

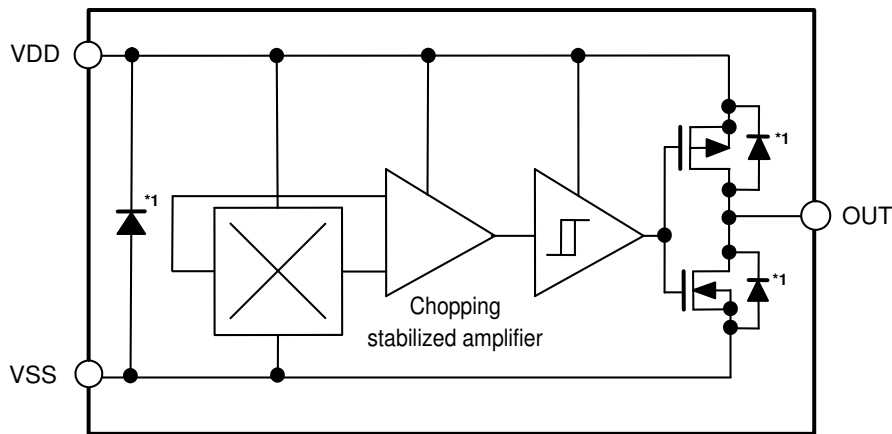
1. **Nch open-drain output product**



*1. Parasitic diode

Figure 1

2. **CMOS output product**

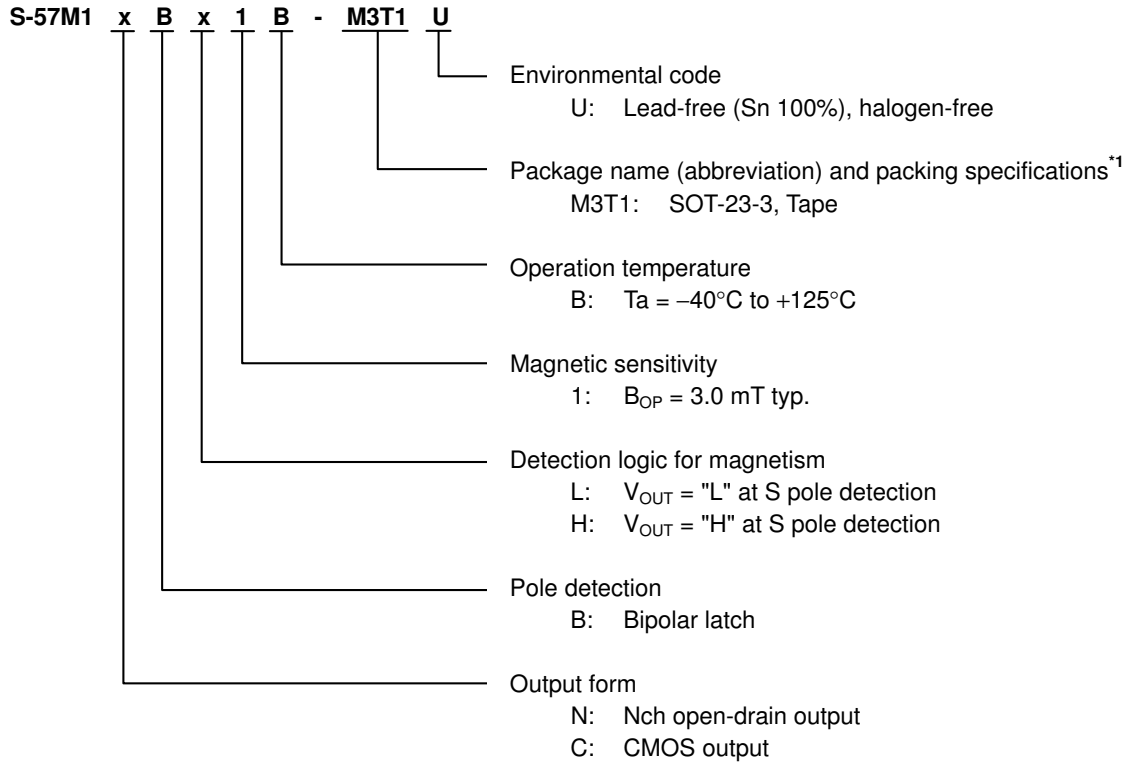


*1. Parasitic diode

Figure 2

■ Product Name Structure

1. Product name



*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}) |
|-------------------|-----------------------|----------------|--|---|
| S-57M1NBL1B-M3T1U | Nch open-drain output | Bipolar latch | V _{OUT} = "L" at S pole detection | 3.0 mT typ. |
| S-57M1NBH1B-M3T1U | Nch open-drain output | Bipolar latch | V _{OUT} = "H" at S pole detection | 3.0 mT typ. |
| S-57M1CBH1B-M3T1U | CMOS output | Bipolar latch | V _{OUT} = "H" at S pole detection | 3.0 mT typ. |

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

■ **Pin Configuration**

1. SOT-23-3

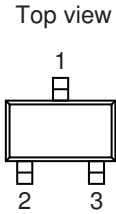


Figure 3

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} | ± 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 |
| Operation 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 × 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.

■ 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 | |
| Operation 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 | |
|--------------------------------|------------------|--|------|------|------|------|--------------|---|
| Operation point ^{*1} | S pole | B _{OP} | – | 1.4 | 3.0 | 4.0 | mT | 5 |
| Release point ^{*2} | N pole | B _{RP} | – | –4.0 | –3.0 | –1.4 | mT | 5 |
| Hysteresis width ^{*3} | B _{HYS} | B _{HYS} = B _{OP} – B _{RP} | – | 6.0 | – | mT | 5 | |

*1. B_{OP}: Operation point

B_{OP} is the value of magnetic flux density when the output voltage (V_{OUT}) changes after the magnetic flux density applied to the S-57M1 Series by the magnet (S pole) is increased (by moving the magnet closer).

V_{OUT} retains the status until a magnetic flux density of the N pole higher than B_{RP} is applied.

*2. B_{RP}: Release point

B_{RP} is the value of magnetic flux density when the output voltage (V_{OUT}) changes after the magnetic flux density applied to the S-57M1 Series by the magnet (N pole) is increased (by moving the magnet closer).

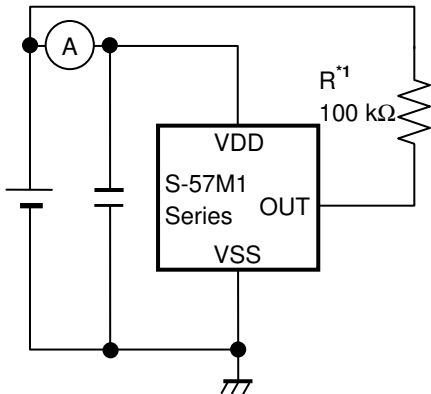
V_{OUT} retains the status until a magnetic flux density of the S pole higher than B_{OP} is applied.

*3. B_{HYS}: Hysteresis width

B_{HYS} is the difference of magnetic flux density between B_{OP} and B_{RP}.

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

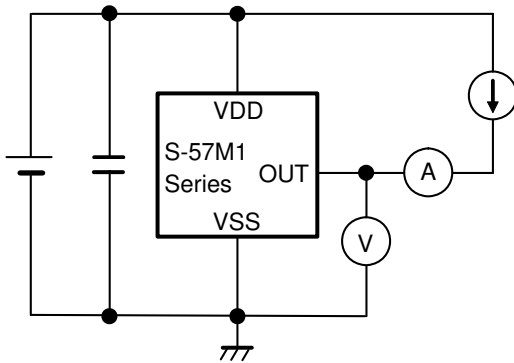


Figure 5 Test Circuit 2

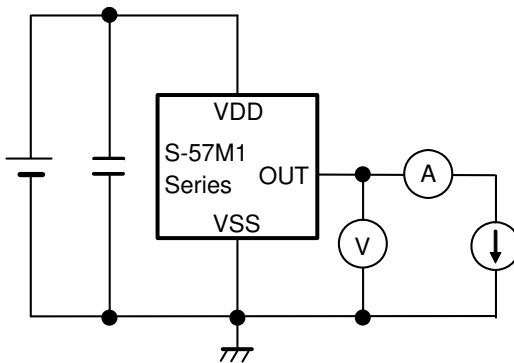


Figure 6 Test Circuit 3

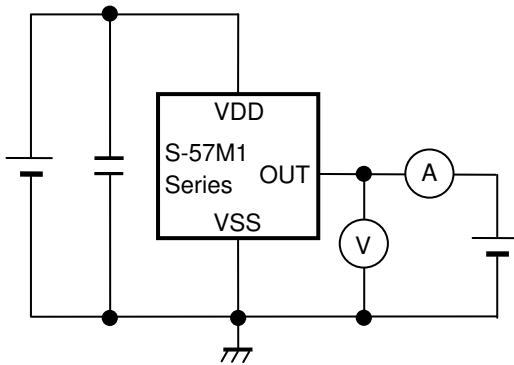
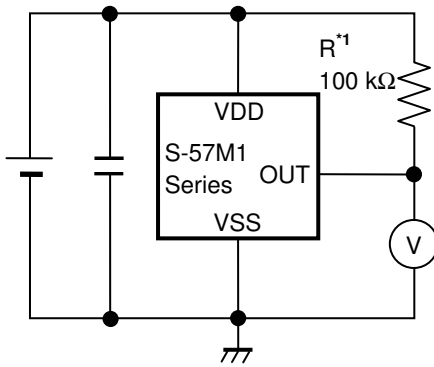


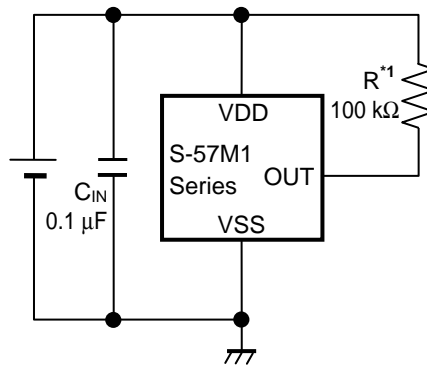
Figure 7 Test Circuit 4



*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-57M1 Series detects the magnetic flux density which is vertical to the marking surface.
Figure 10 shows the direction in which magnetic flux is being applied.

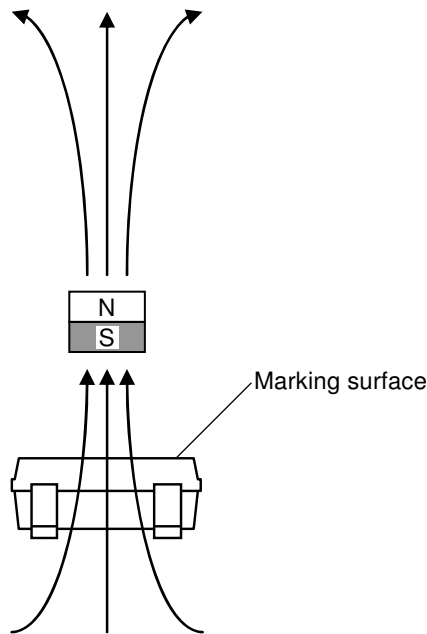


Figure 10

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.

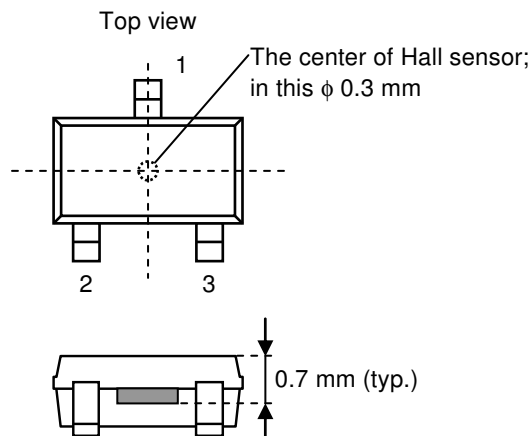


Figure 11

3. Basic operation

The S-57M1 Series changes the output voltage (V_{OUT}) according to the level of the magnetic flux density and a polarity change (N pole or S pole) applied by a magnet. Definition of the magnetic field is performed every operation cycle indicated in "■ Electrical Characteristics".

3.1 Product with $V_{OUT} = "L"$ at S pole detection

When the magnetic flux density of the S pole perpendicular to the marking surface exceeds the operation point (B_{OP}) after the S pole of a magnet is moved closer to the marking surface of the S-57M1 Series, V_{OUT} changes from "H" to "L". When the N pole of a magnet is moved closer to the marking surface of the S-57M1 Series and the magnetic flux density of the N pole is higher than the release point (B_{RP}), V_{OUT} changes from "L" to "H". In case of $B_{RP} < B < B_{OP}$, V_{OUT} retains the status.

Figure 12 shows the relationship between the magnetic flux density and V_{OUT} .

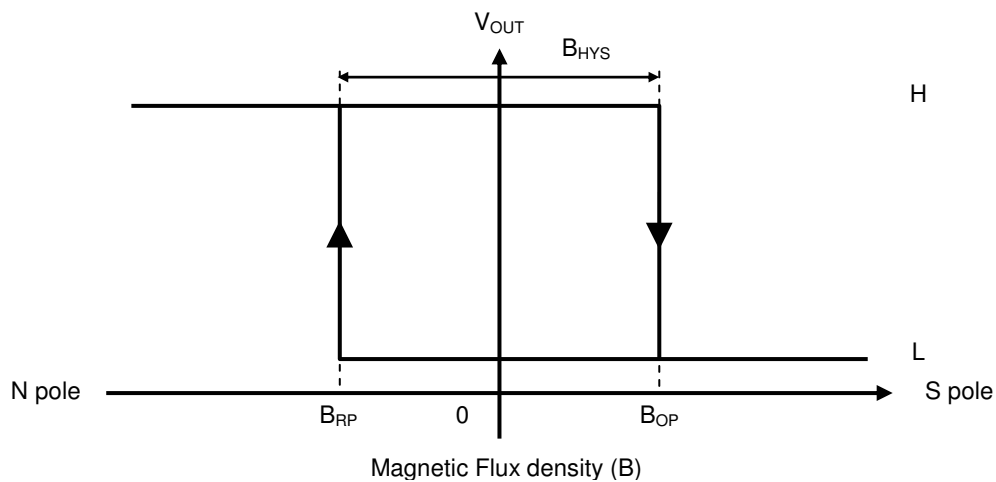


Figure 12

3.2 Product with $V_{OUT} = "H"$ at S pole detection

When the magnetic flux density of the S pole perpendicular to the marking surface exceeds B_{OP} after the S pole of a magnet is moved closer to the marking surface of the S-57M1 Series, V_{OUT} changes from "L" to "H". When the N pole of a magnet is moved closer to the marking surface of the S-57M1 Series and the magnetic flux density of the N pole is higher than B_{RP} , V_{OUT} changes from "H" to "L". In case of $B_{RP} < B < B_{OP}$, V_{OUT} retains the status.

Figure 13 shows the relationship between the magnetic flux density and V_{OUT} .

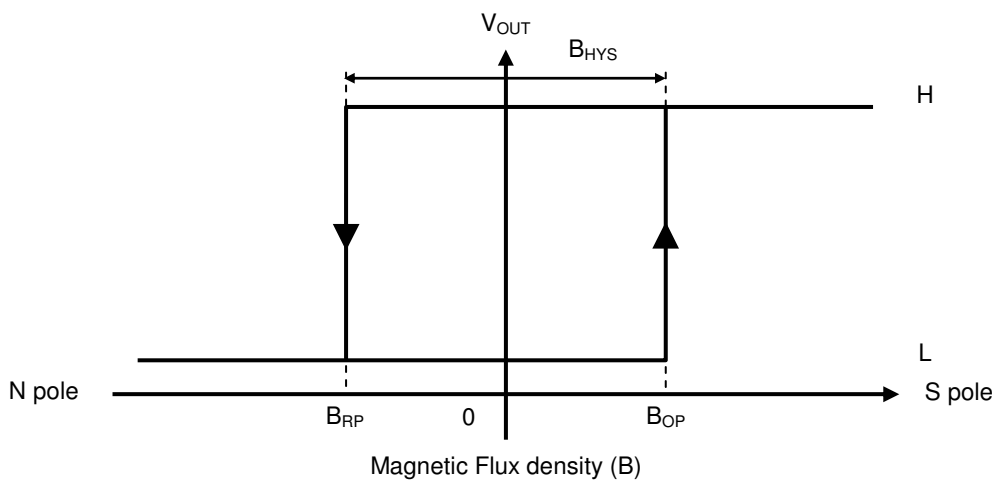


Figure 13

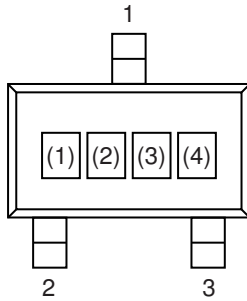
■ Precautions

- If the impedance of the power supply is high, the IC may malfunction due to a supply voltage drop caused by feed-through 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**

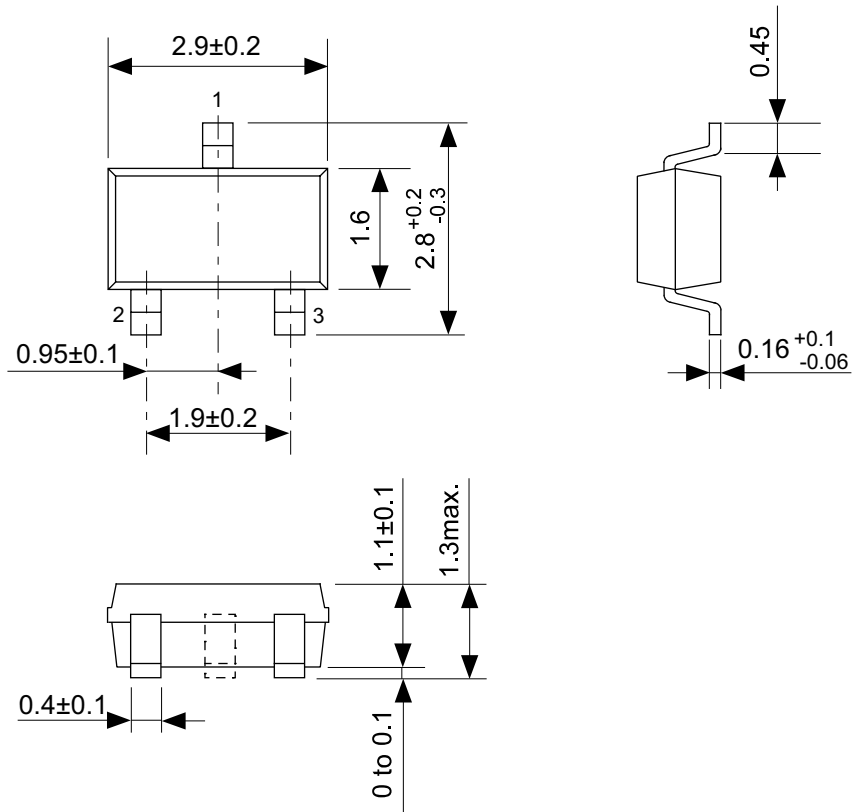
Top view



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

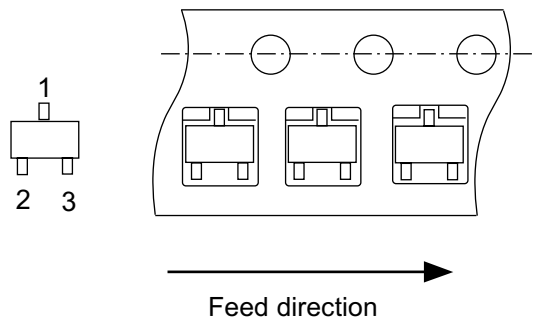
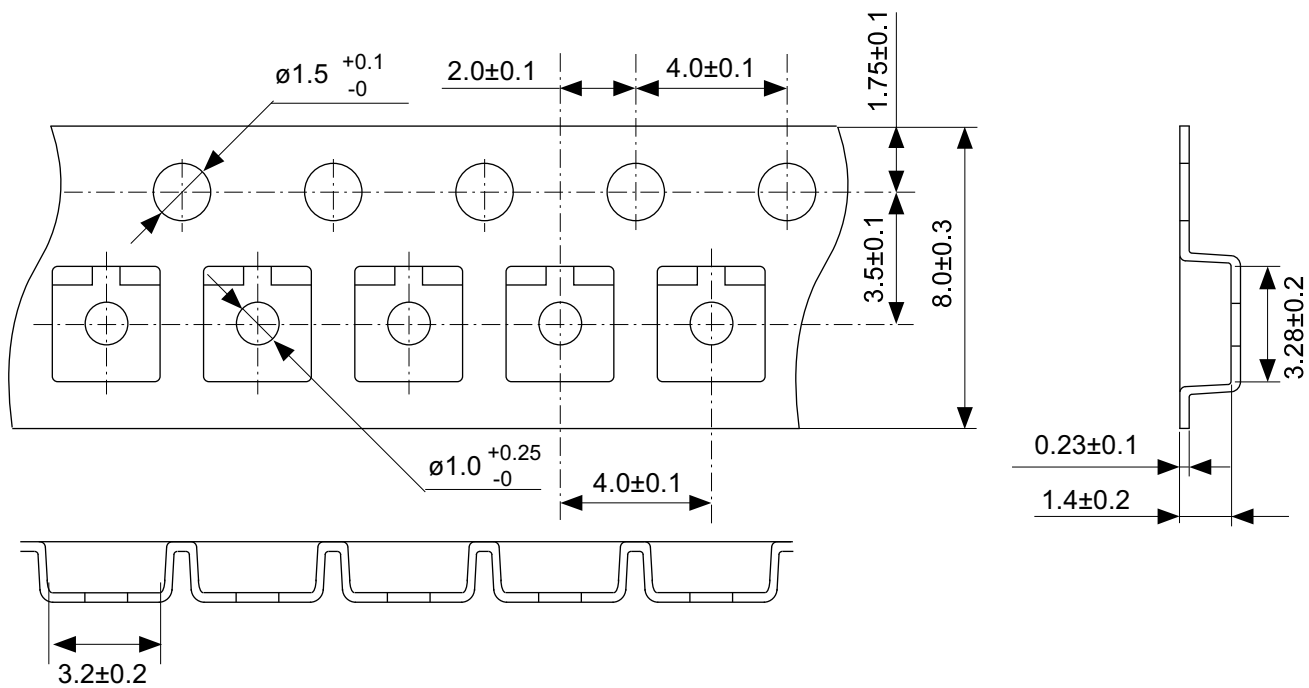
Product name vs. Product code

| Product Name | Product Code | | |
|-------------------|--------------|-----|-----|
| | (1) | (2) | (3) |
| S-57M1NBL1B-M3T1U | W | 7 | A |
| S-57M1NBH1B-M3T1U | W | 7 | B |
| S-57M1CBH1B-M3T1U | W | 7 | C |



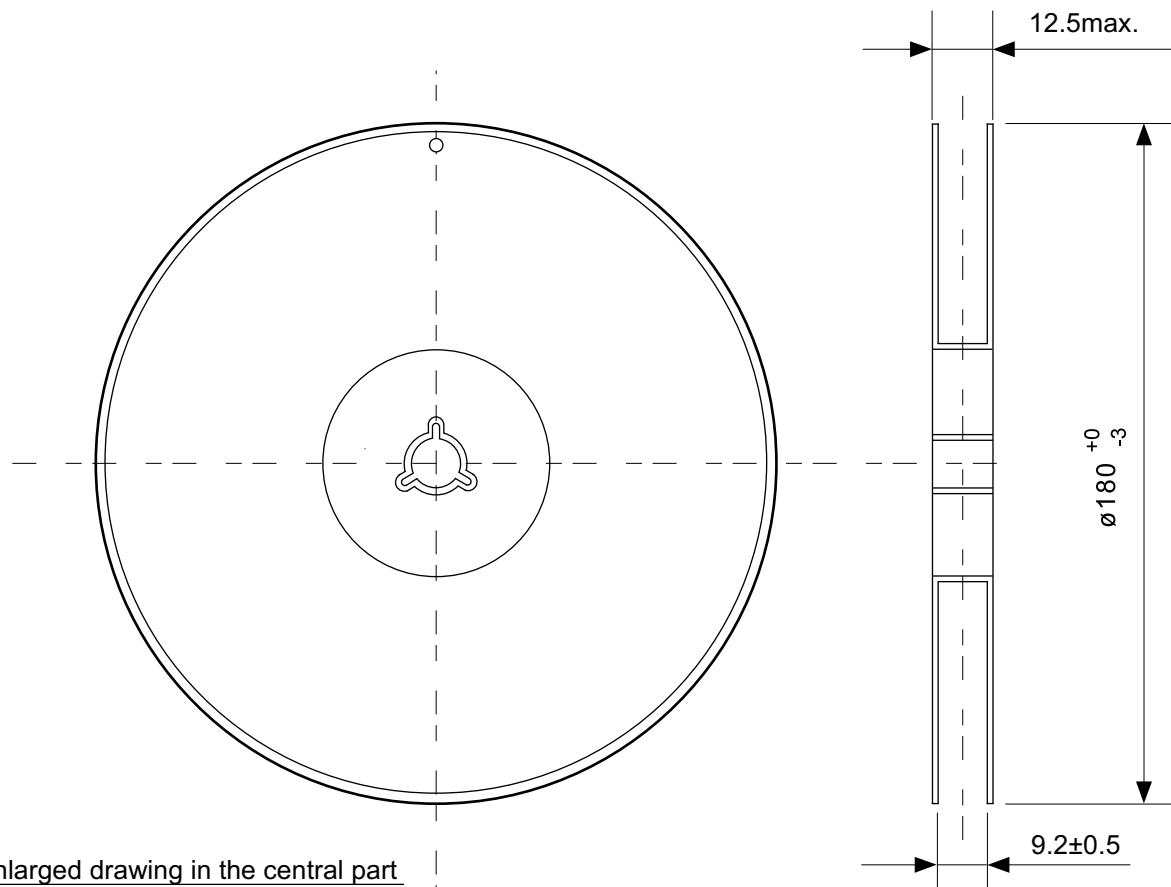
No. MP003-C-P-SD-1.0

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

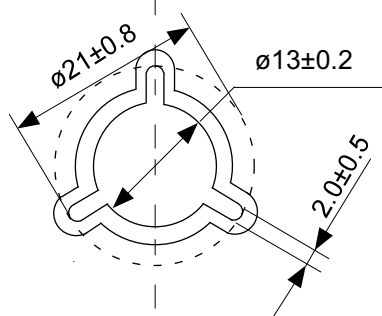


No. MP003-C-C-SD-2.0

| | |
|------------------------|-----------------------|
| 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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