

FOR AUTOMOTIVE 125°C OPERATION HIGH-WITHSTAND VOLTAGE HIGH-SPEED BIPOLAR HALL EFFECT LATCH

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Rev.1.5_00

The S-57K1 A Series, developed by CMOS technology, is a high-accuracy Hall IC that operates with high temperature and high-withstand voltage.

The output voltage changes when the S-57K1 A Series detects the intensity level of magnetic flux density and a polarity change. Using the S-57K1 A Series with a magnet makes it possible to detect the rotation status in various devices.

The S-57K1 A Series includes a reverse voltage protection circuit and an output current limit circuit.

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

Due to its high-accuracy magnetic characteristics, the S-57K1 A Series can make operation's dispersion in the system combined with magnet smaller.

Caution This product can be used in vehicle equipment and in-vehicle equipment. Before using the product in the purpose, 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, Nch driver + built-in pull-up resistor |
| • Magnetic sensitivity ^{*1} : | $B_{OP} = 3.0 \text{ mT typ.}$, $B_{OP} = 6.0 \text{ mT typ.}$ |
| • Operating cycle: | $t_{CYCLE} = 8.0 \mu\text{s typ.}$ |
| • Power supply voltage range: | $V_{DD} = 3.5 \text{ V to } 26.0 \text{ V}$ |
| • Built-in regulator | |
| • Built-in reverse voltage protection circuit | |
| • Built-in output current limit circuit | |
| • Operation temperature range: | $T_a = -40^\circ\text{C to } +125^\circ\text{C}$ |
| • Lead-free (Sn 100%), halogen-free | |
| • AEC-Q100 in process ^{*2} | |

*1. The option can be selected.

*2. Contact our sales office for details.

■ Applications

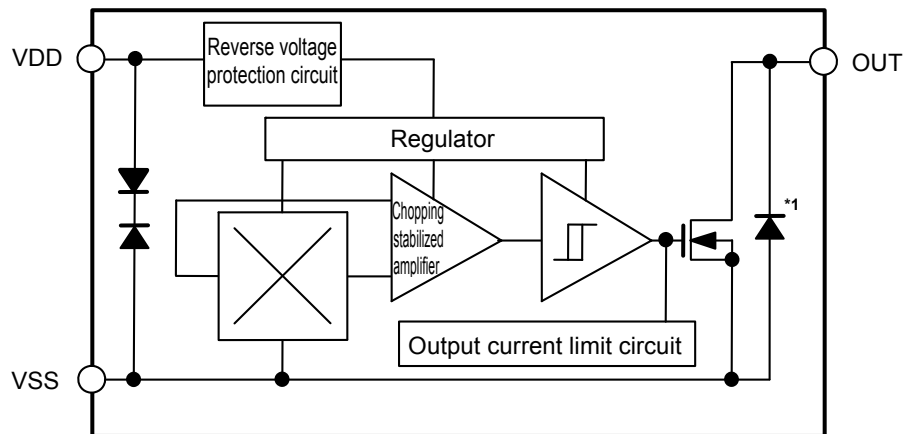
- Automobile equipment
- Home appliance
- DC brushless motor
- Housing equipment
- Industrial equipment

■ Package

- SOT-23-3

■ Block Diagrams

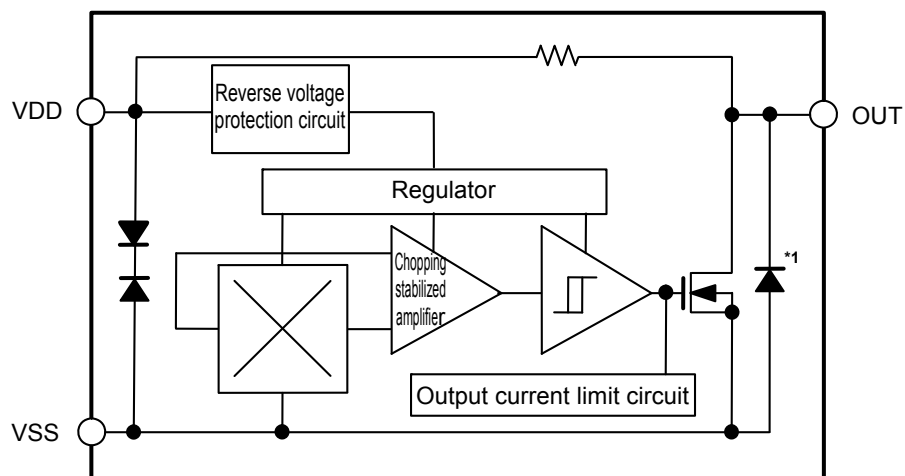
1. Nch open-drain output product



*1. Parasitic diode

Figure 1

2. Nch driver + built-in pull-up resistor product



*1. Parasitic diode

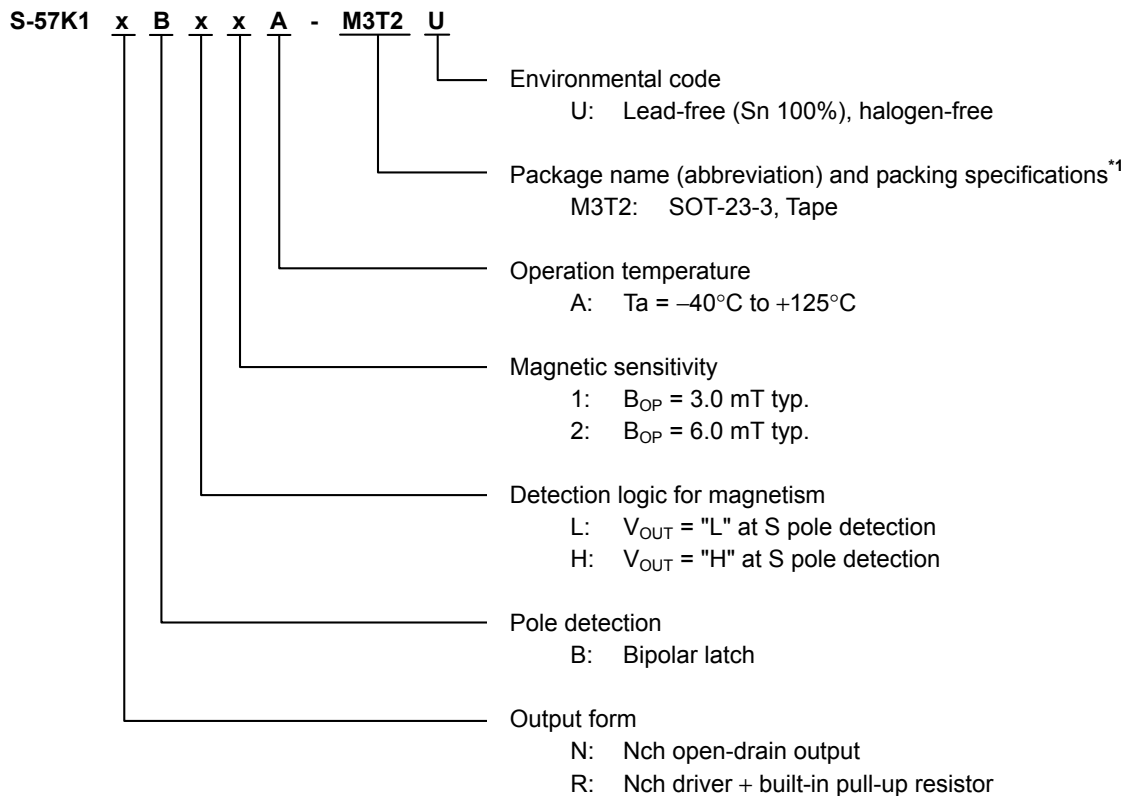
Figure 2

■ AEC-Q100 in Process

Contact our sales office for details of AEC-Q100 reliability specification.

■ 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-57K1NBL1A-M3T2U	Nch open-drain output	Bipolar latch	V _{OUT} = "L" at S pole detection	3.0 mT typ.
S-57K1NBL2A-M3T2U	Nch open-drain output	Bipolar latch	V _{OUT} = "L" at S pole detection	6.0 mT typ.
S-57K1NBH1A-M3T2U	Nch open-drain output	Bipolar latch	V _{OUT} = "H" at S pole detection	3.0 mT typ.
S-57K1RBL1A-M3T2U	Nch driver + built-in pull-up resistor	Bipolar latch	V _{OUT} = "L" 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

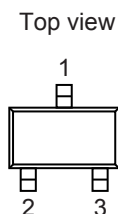


Figure 3

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}	$V_{SS} - 28.0$ to $V_{SS} + 28.0$	V
Output current		I_{OUT}	20	mA
Output voltage	Nch open-drain output product	V_{OUT}	$V_{SS} - 0.3$ to $V_{SS} + 28.0$	V
	Nch driver + built-in pull-up resistor product		$V_{SS} - 0.3$ to $V_{DD} + 0.3$	V
Power dissipation		P_D	650 ^{*1}	mW
Junction temperature		T_j	-40 to +150	°C
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) Board 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.

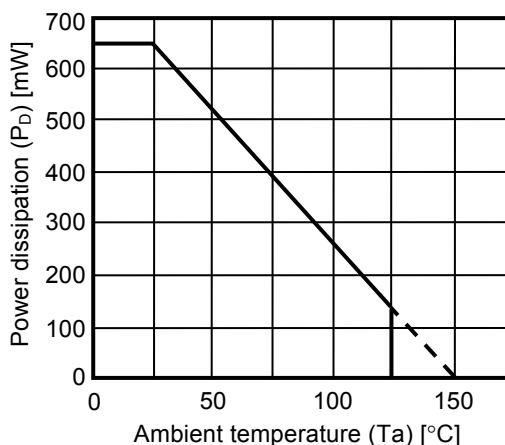


Figure 4 Power Dissipation of Package (When Mounted on Board)

■ Electrical Characteristics

Table 5

(Ta = +25°C, V_{DD} = 12.0 V, V_{SS} = 0 V unless otherwise specified)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Test Circuit
Power supply voltage	V _{DD}	—	3.5	12.0	26.0	V	—
Current consumption	I _{DD}	Nch open-drain output product Average value	—	3.0	4.0	mA	1
		Nch driver + built-in pull-up resistor product Average value, V _{OUT} = "H"	—	3.0	4.0	mA	1
Current consumption during reverse connection	I _{DDREV}	Nch open-drain output product V _{DD} = -26.0 V	-1	—	—	mA	1
		Nch driver + built-in pull-up resistor product V _{DD} = -26.0 V	-5	—	—	mA	1
Output voltage	V _{OUT}	Nch open-drain output product Output transistor Nch, V _{OUT} = "L", I _{OUT} = 10 mA	—	—	0.4	V	2
		Nch driver + built-in pull-up resistor product Output transistor Nch, V _{OUT} = "L", I _{OUT} = 10 mA	—	—	0.5	V	2
Output drop voltage	V _D	Nch driver + built-in pull-up resistor product V _{OUT} = "H", V _D = V _{DD} - V _{OUT}	—	—	20	mV	2
Leakage current	I _{LEAK}	Nch open-drain output product Output transistor Nch, V _{OUT} = "H" = 26.0 V	—	—	10	μA	3
Operating cycle	t _{CYCLE}	—	—	8.0	—	μs	—
Operating frequency	f _{CYCLE}	—	—	125	—	kHz	—
Output limit current	I _{OM}	V _{OUT} = 12.0 V	22	—	70	mA	3
Start up time	t _{PON}	—	—	20	—	μs	4
Pull-up resistor	R _L	Nch driver + built-in pull-up resistor product	7	10	13	kΩ	—

■ Magnetic Characteristics

1. Product with $B_{OP} = 3.0 \text{ mT typ.}$

Table 6

($T_a = +25^\circ\text{C}$, $V_{DD} = 12.0 \text{ V}$, $V_{SS} = 0 \text{ V}$ unless otherwise specified)

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Test Circuit
Operation point ^{*1}	S pole	B _{OP}	—	1.5	3.0	4.5	mT	4
Release point ^{*2}	N pole	B _{RP}	—	−4.5	−3.0	−1.5	mT	4
Hysteresis width ^{*3}		B _{HYS}	B _{HYS} = B _{OP} − B _{RP}	—	6.0	—	mT	4

2. Product with $B_{OP} = 6.0 \text{ mT typ.}$

Table 7

($T_a = +25^\circ\text{C}$, $V_{DD} = 12.0 \text{ V}$, $V_{SS} = 0 \text{ V}$ unless otherwise specified)

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Test Circuit
Operation point ^{*1}	S pole	B _{OP}	–	3.0	6.0	9.0	mT	4
Release point ^{*2}	N pole	B _{RP}	–	–9.0	–6.0	–3.0	mT	4
Hysteresis width ^{*3}		B _{HYS}	B _{HYS} = B _{OP} – B _{RP}	–	12.0	–	mT	4

***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-57K1 A 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-57K1 A Series by the magnet (N pole) is increased (by moving the magnet closer).

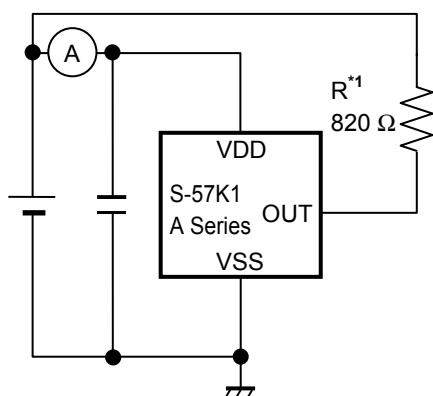
V_{OUT} retains the status until a magnetic flux density of the S pole higher than B_{OP} is applied.

***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 $1 \text{ mT} = 10 \text{ Gauss}$.

■ Test Circuits



*1. Resistor (R) is unnecessary for the pull-up resistor built-in product.

Figure 5 Test Circuit 1

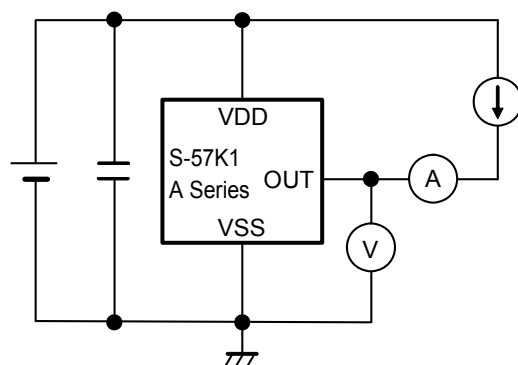


Figure 6 Test Circuit 2

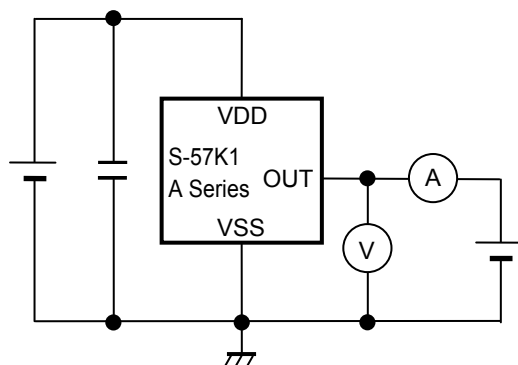
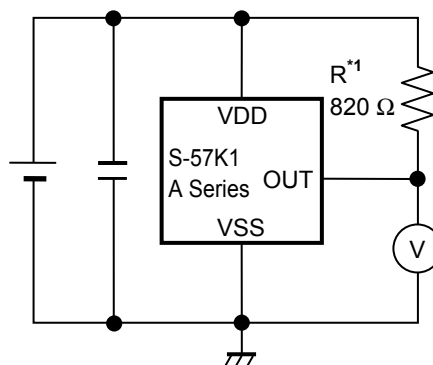


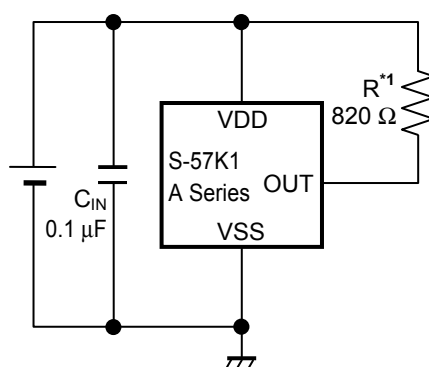
Figure 7 Test Circuit 3



*1. Resistor (R) is unnecessary for the pull-up resistor built-in product.

Figure 8 Test Circuit 4

■ Standard Circuit



*1. Resistor (R) is unnecessary for the pull-up resistor built-in 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-57K1 A 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.

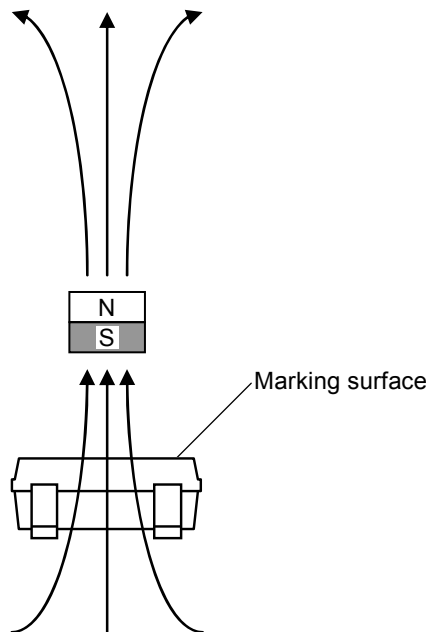


Figure 10

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.

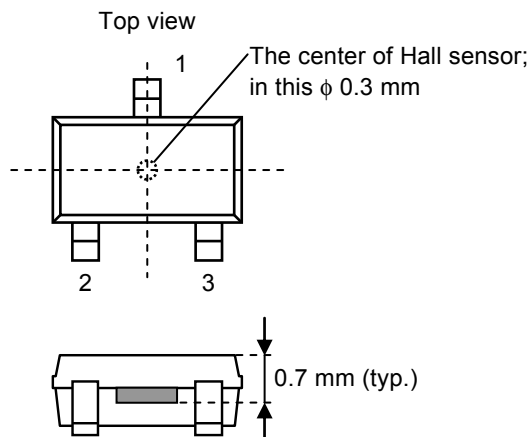


Figure 11

3. Basic operation

The S-57K1 A 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 operating 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-57K1 A 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-57K1 A 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} .

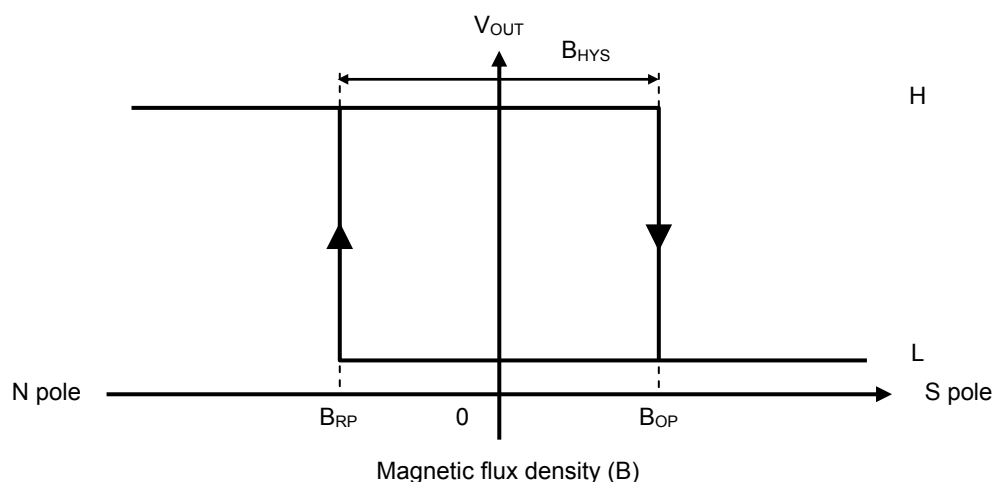


Figure 12

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-57K1 A 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-57K1 A 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} .

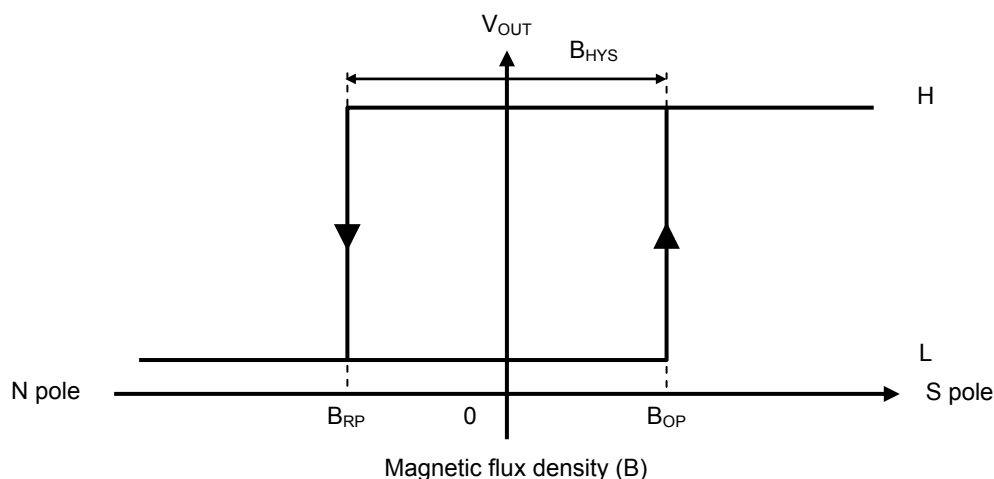
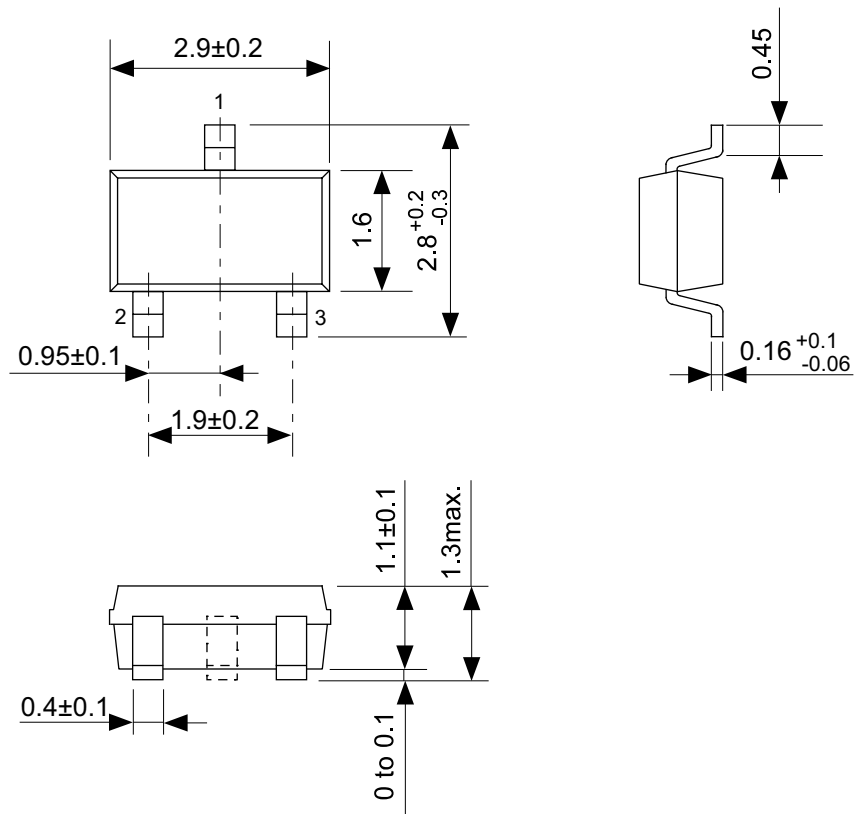


Figure 13

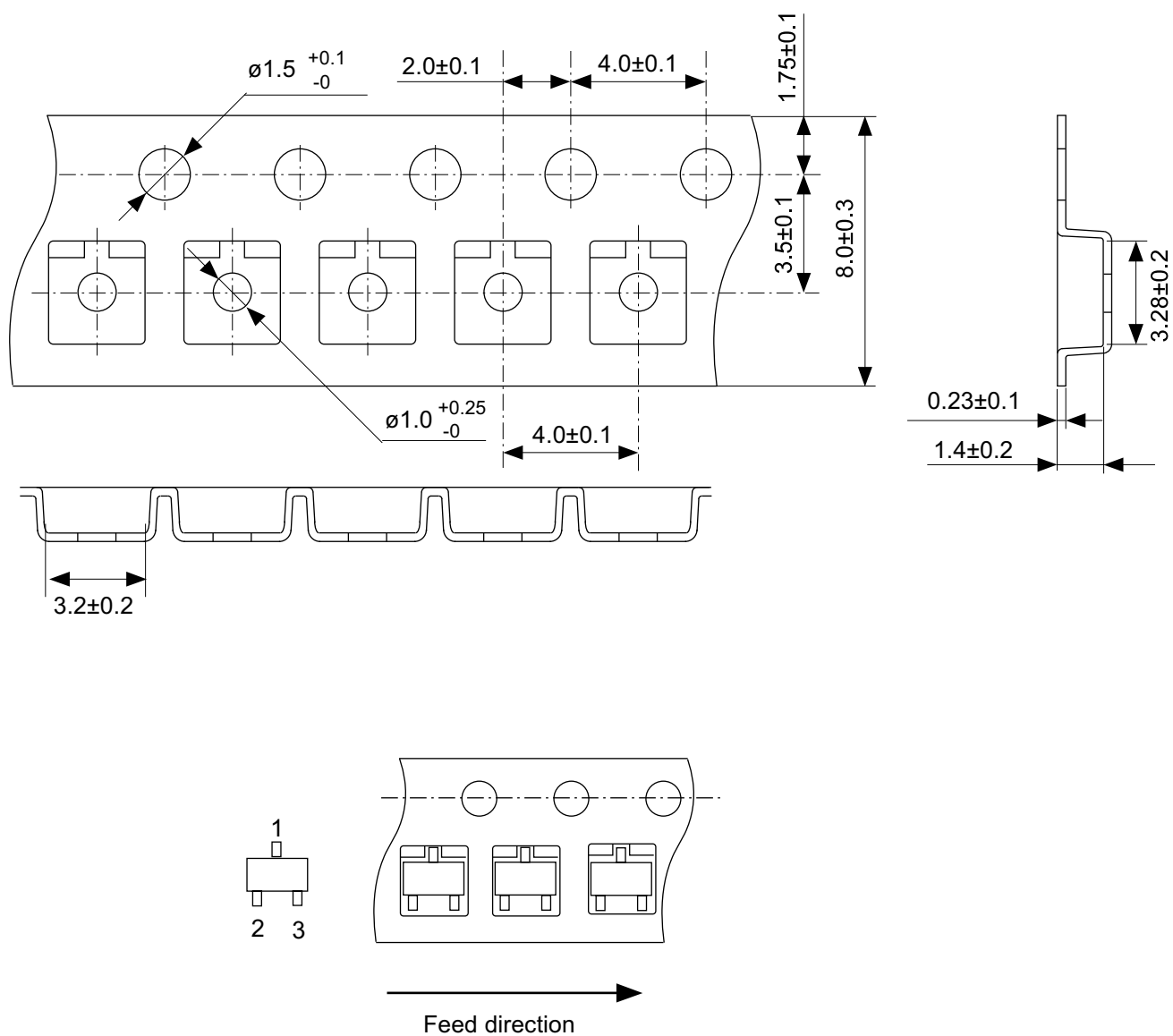
■ Precautions

- 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. When the IC is used under the environment where the power supply voltage rapidly changes, it is recommended to judge the output voltage of the IC by reading it multiple times.
- Do not apply an electrostatic discharge to this IC that exceeds the performance ratings of the built-in electrostatic protection circuit.
- Although this IC has a built-in output current limit circuit, it may suffer physical damage such as product deterioration under the environment where the absolute maximum ratings are exceeded.
- Although this IC has a built-in reverse voltage protection circuit, it may suffer physical damage such as product deterioration under the environment where the absolute maximum ratings are exceeded.
- The application conditions for the power supply voltage, the pull-up voltage, and the pull-up resistor should not exceed the package power dissipation.
- 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.
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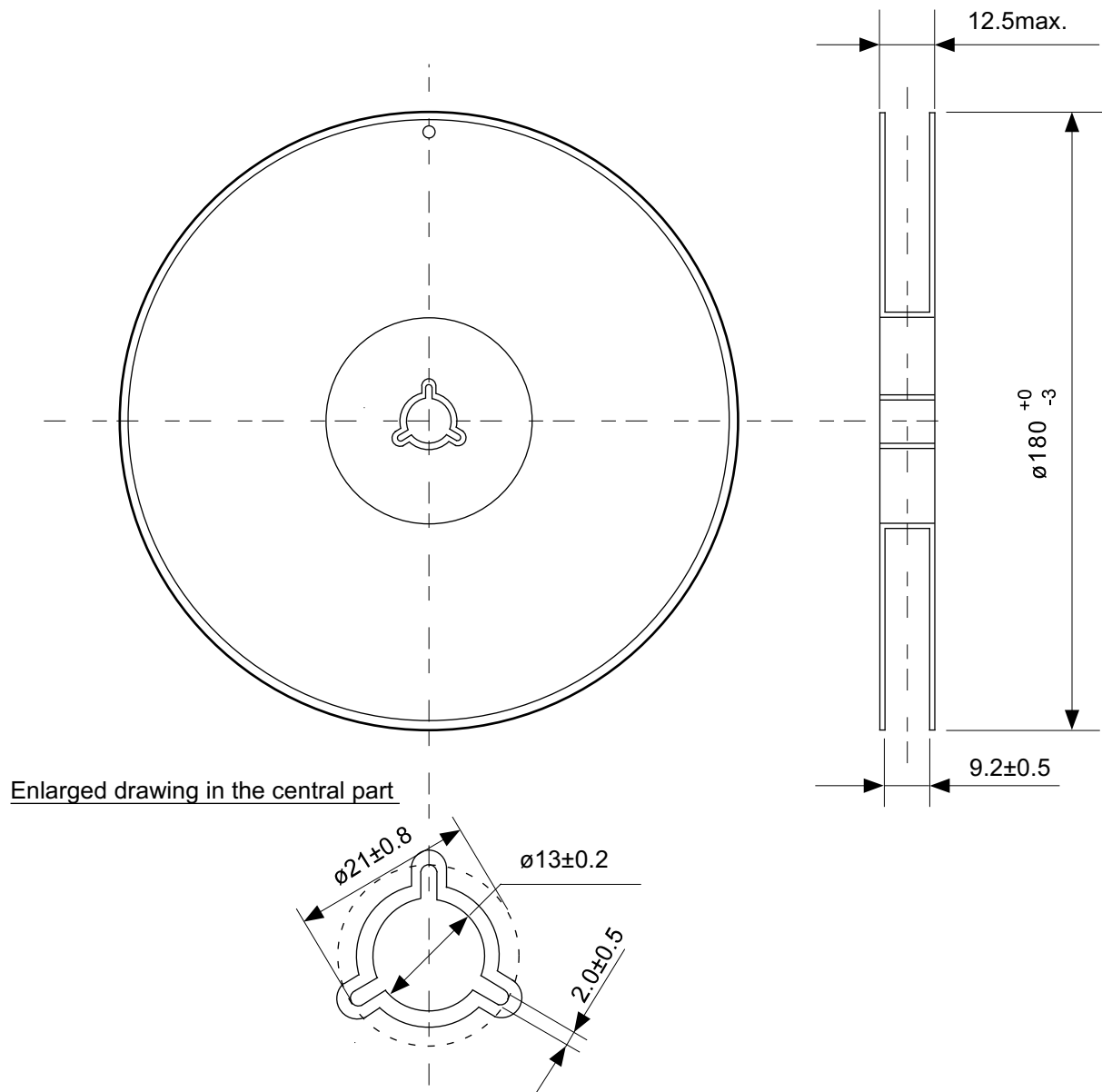
No. MP003-C-P-SD-1.0

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.	



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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