S-57M1 Series

HIGH-SPEED BIPOLAR HALL EFFECT LATCH

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Rev.1.2_02

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 ABLIC Inc. 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 mT typ.
- Operation cycle (current consumption): t_{CYCLE} = 50 μs (1400 μA) typ.
- Power supply voltage range: V_{DD} = 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

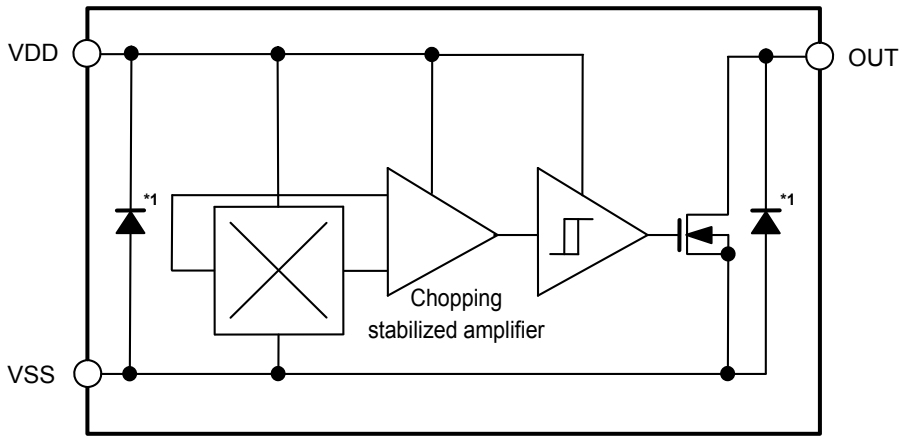
- Motor
- Housing equipment
- Industrial equipment

■ Package

- SOT-23-3

■ Block Diagrams

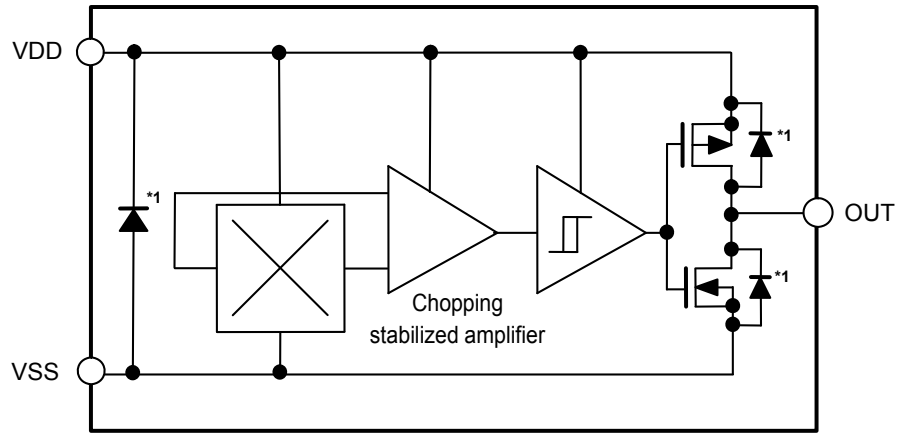
1. Nch open-drain output product



1. Parasitic diode

Figure 1

2. CMOS output product

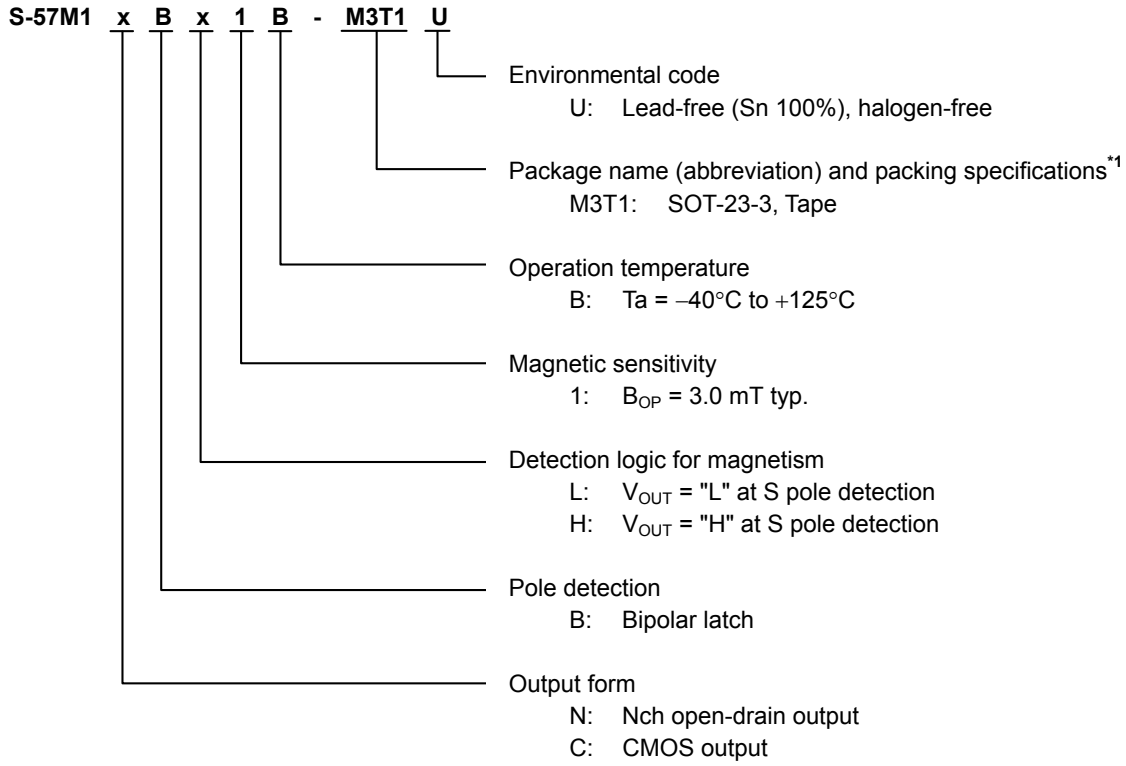


1. Parasitic diode

Figure 2

■ Product Name Structure

1. Product name



***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

Top view

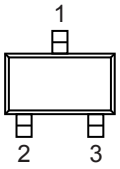


Figure 3

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}	±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

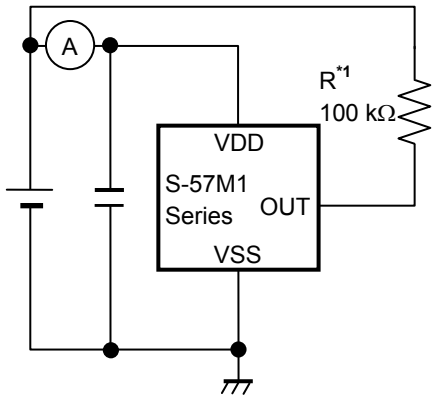
***1.** B_{OP}: Operation point
B_{OP} is the value of magnetic flux density when the output voltage (V_{OUT}) changes after the magnetic flux density applied to the S-57M1 Series by the magnet (S pole) is increased (by moving the magnet closer).
V_{OUT} retains the status until a magnetic flux density 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

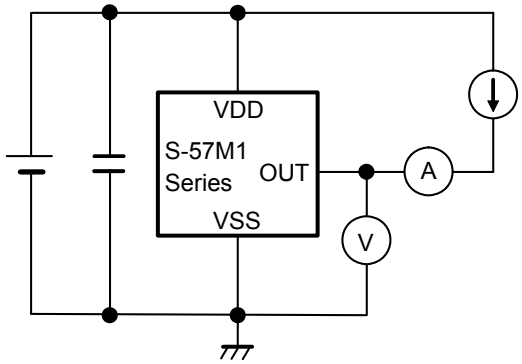


Figure 5 Test Circuit 2

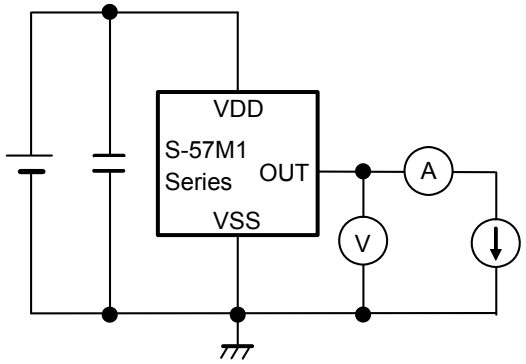


Figure 6 Test Circuit 3

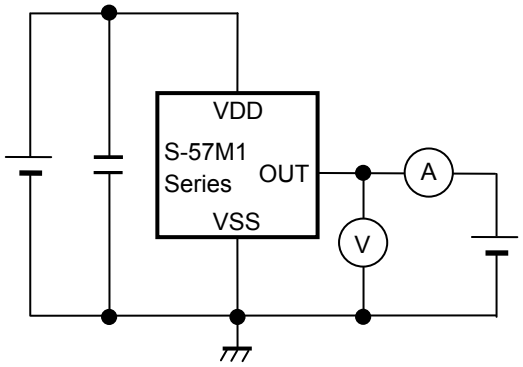
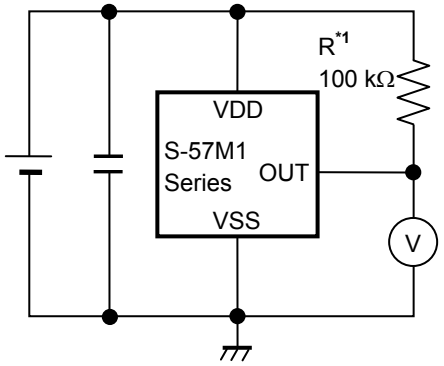


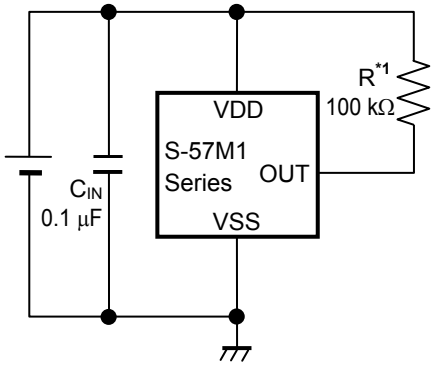
Figure 7 Test Circuit 4



***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 t horough 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.

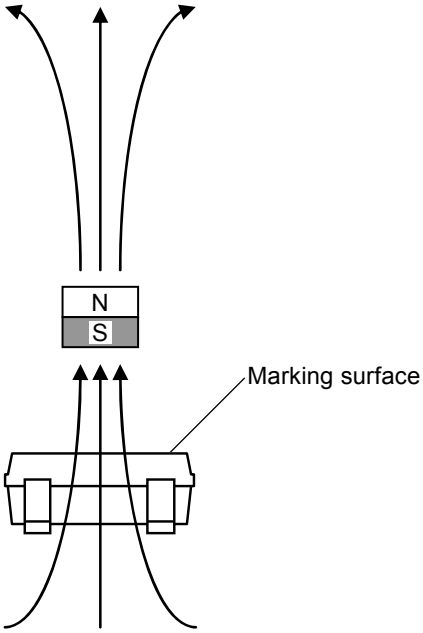


Figure 10

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.

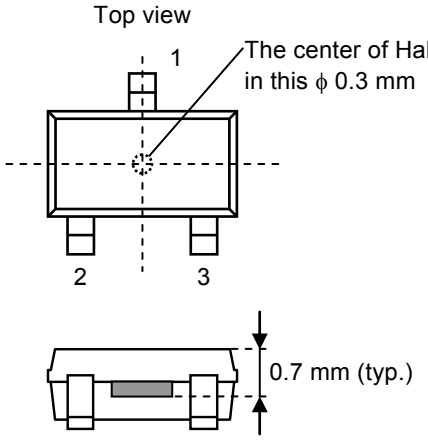


Figure 11

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}.

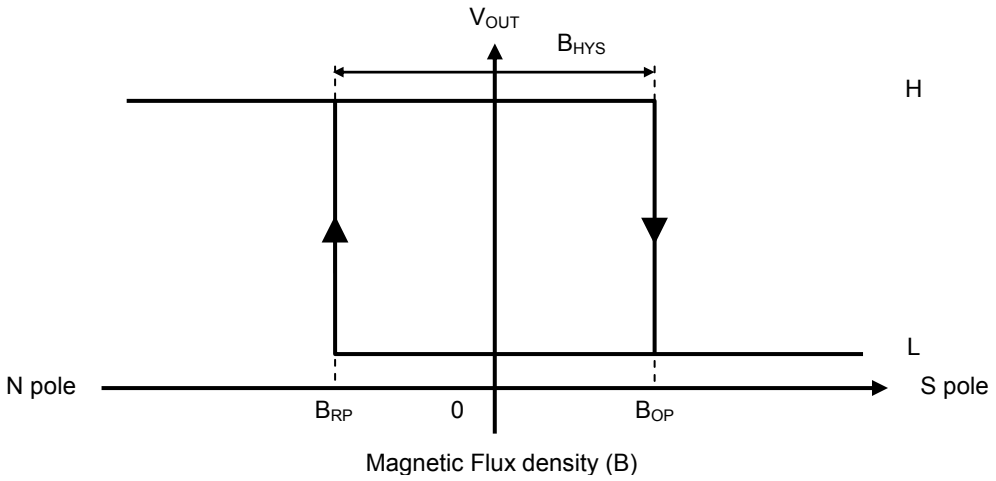


Figure 12

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}.

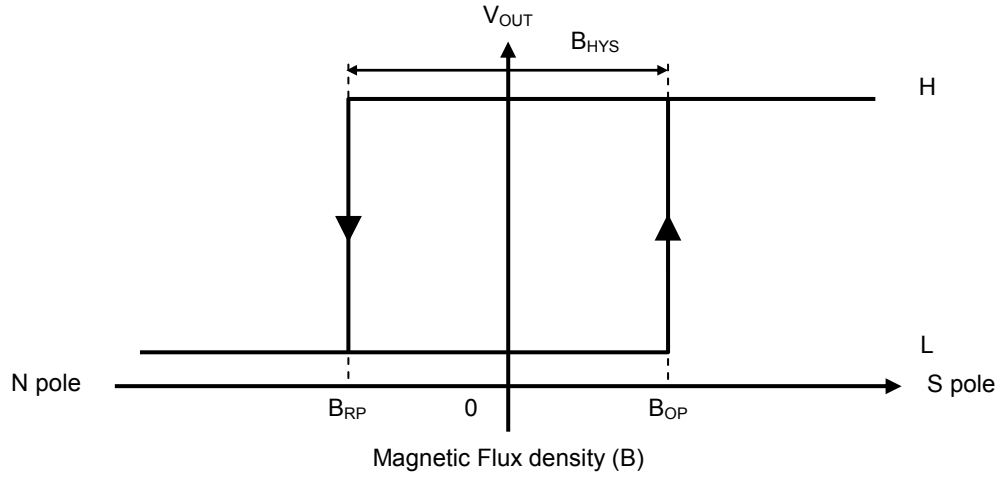


Figure 13

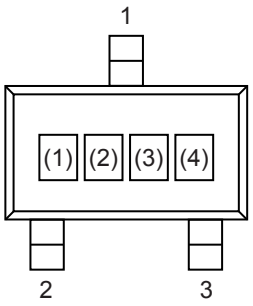
■ Precautions

- 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.
- ABLIC Inc. 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

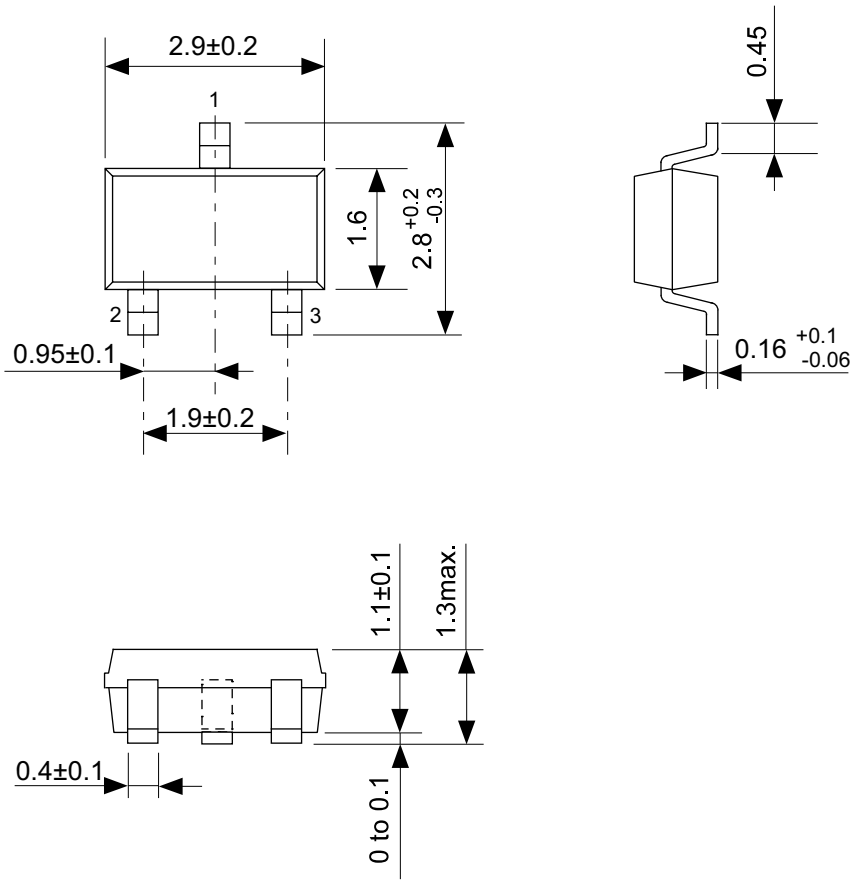
Top view



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

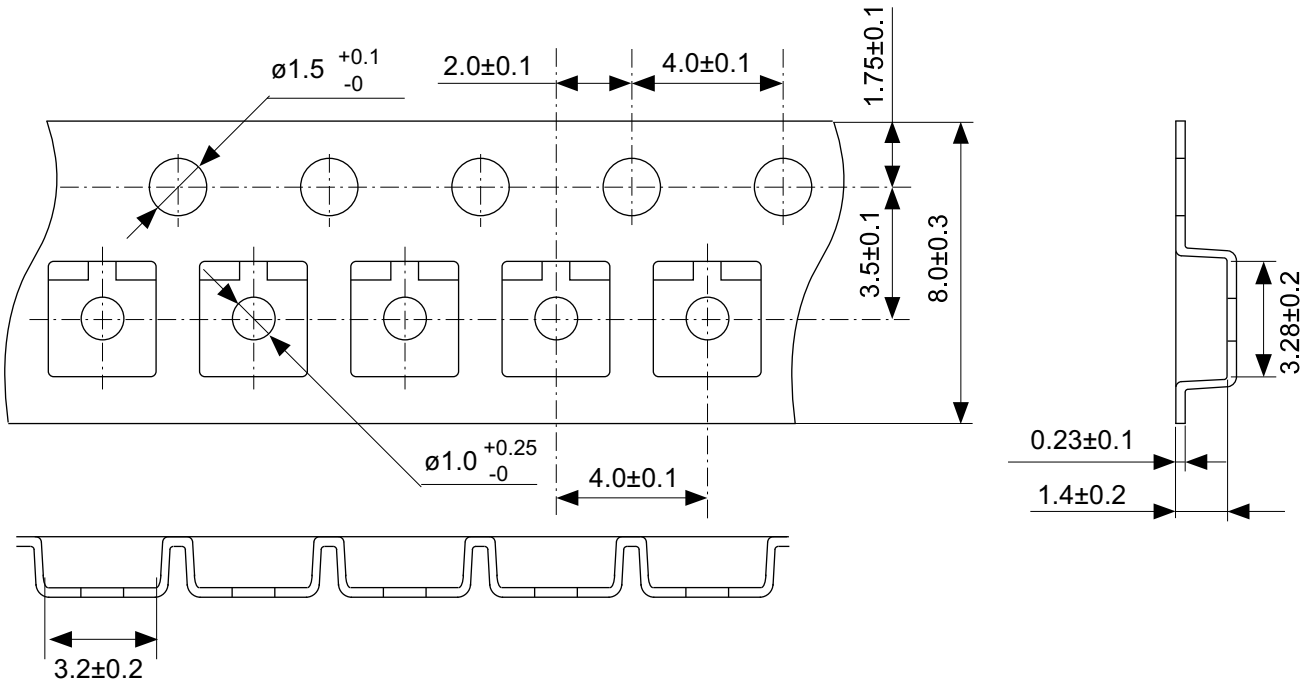
Product name vs. Product code

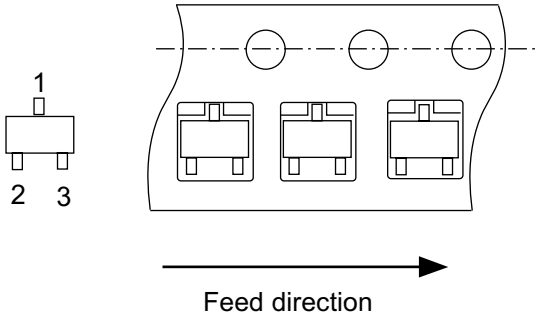
Product Name	Product Code		
	(1)	(2)	(3)
S-57M1NBL1B-M3T1U	W	7	A
S-57M1NBH1B-M3T1U	W	7	B
S-57M1CBH1B-M3T1U	W	7	C



No. MP003-C-P-SD-1.1

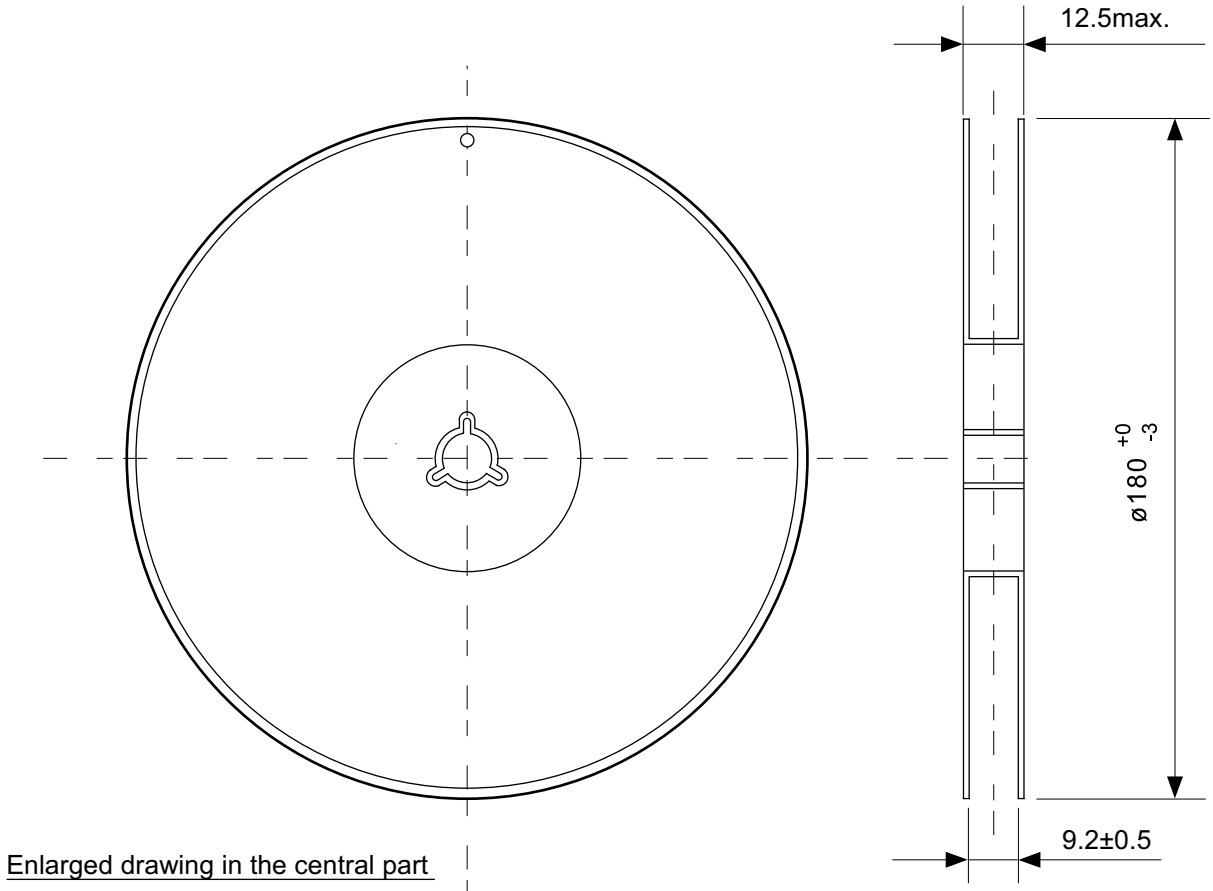
TITLE	SOT233-C-PKG Dimensions
No.	MP003-C-P-SD-1.1
ANGLE	
UNIT	mm
ABLIC Inc.	



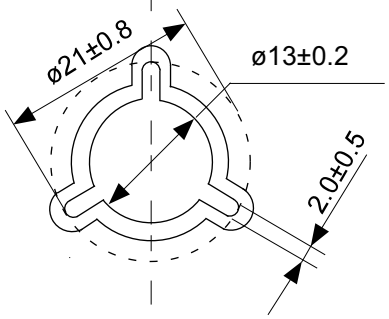


No. MP003-C-C-SD-2.0

TITLE	SOT233-C-Carrier Tape
No.	MP003-C-C-SD-2.0
ANGLE	
UNIT	mm
ABLIC Inc.	



Enlargement drawing in the central part



No. MP003-Z-R-SD-1.0

TITLE	SOT233-C-Reel		
No.	MP003-Z-R-SD-1.0		
ANGLE		QTY.	3,000
UNIT	mm		
ABLIC Inc.			

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