S-57B1 Series

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125°C OPERATION HIGH-SPEED UNIPOLAR DETECTION TYPE HALL IC

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Rev.3.0_01

This IC, 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 this IC detects the intensity level of flux density. Using this IC 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, this IC can make operation's dispersion in the system combined with magnet smaller.

ABLIC Inc. offers a "magnetism simulation service" that provides the ideal combination of magnets and our Hall ICs for customer systems. Our magnetism simulation service will reduce prototype production, development period and development costs. In addition, it will contribute to optimization of parts to realize high cost performance.
For more information regarding our magnetism simulation service, contact our sales office.

■ Features

- Pole detection: Detection of S 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.
  B_{OP} = 4.5 mT typ.
  B_{OP} = 7.0 mT typ.
- Operating cycle: t_{CYCLE} = 50 μs 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

***1**. The Option can be selected.

■ Applications

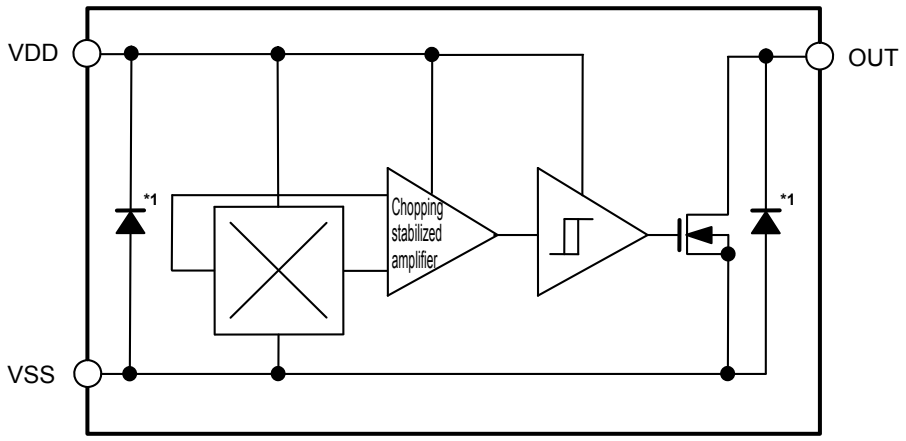
- Motor
- Housing equipment
- Industrial equipment

■ Package

- SOT-23-3

■ Block Diagrams

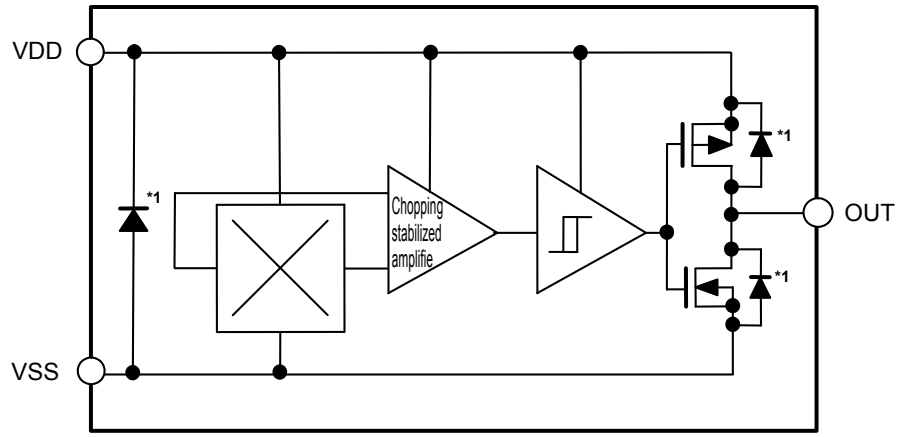
1. Nch open drain output product



***1.** Parasitic diode

Figure 1

2. CMOS output product

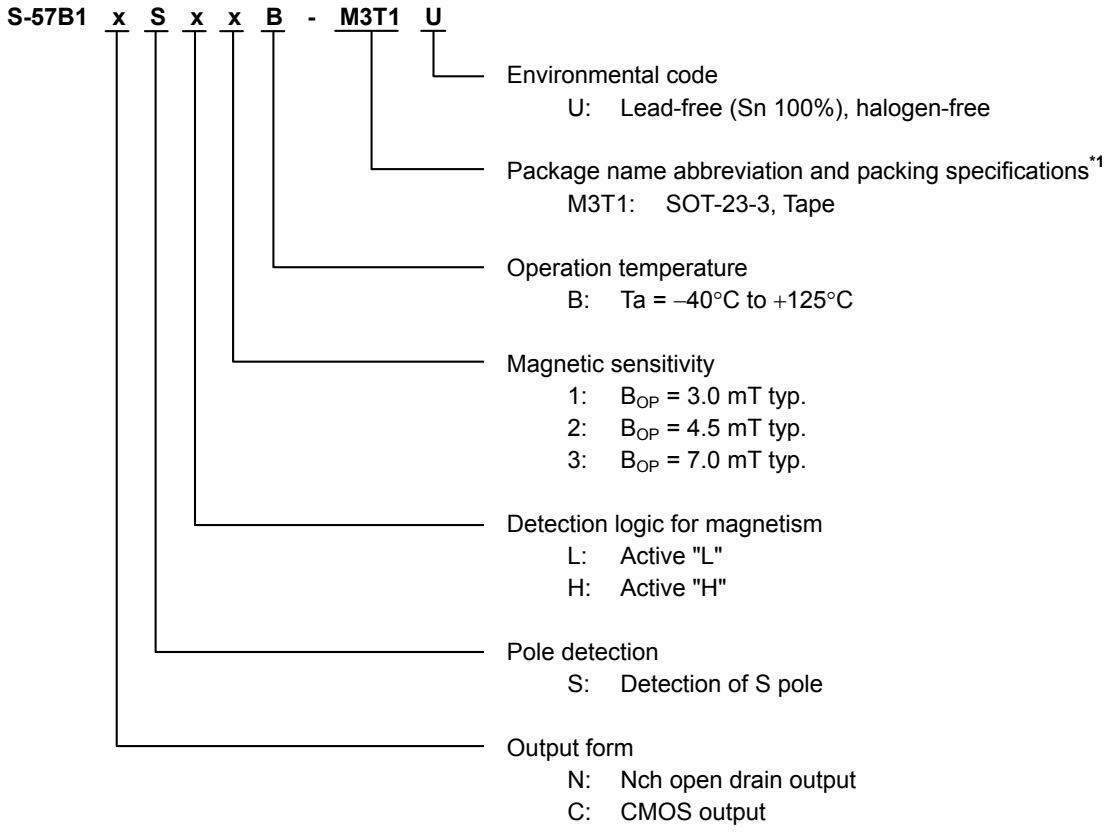


***1.** Parasitic diode

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-57B1NSL1B-M3T1U	Nch open drain output	S pole	Active "L"	3.0 mT typ.
S-57B1CSL3B-M3T1U	CMOS output	S pole	Active "L"	7.0 mT typ.

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

■ Pin Configuration

1. SOT-23-3

Top view

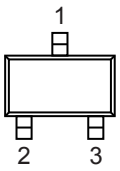


Figure 3

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
Operation ambient temperature		T_{opr}	−40 to +125	°C
Storage temperature		T_{stg}	−40 to +150	°C

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.

■ Thermal Resistance Value

Table 5

Item	Symbol	Condition		Min.	Typ.	Max.	Unit
Junction-to-ambient thermal resistance*1	θ_{JA}	SOT-23-3	Board 1	−	200	−	°C/W
			Board 2	−	165	−	°C/W

***1.** Test environment: compliance with JEDEC STANDARD JESD51-2A

Remark Refer to "■ **Thermal Characteristics**" for details of power dissipation and test board.

■ Electrical 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
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

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

Table 7

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

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

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

Table 8

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

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

3. Product with B_{OP} = 7.0 mT typ.

Table 9

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

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Test Circuit
Operating point*1	S pole	B_{OPS}	–	5.0	7.0	8.5	mT	5
Release point*2	S pole	B_{RPS}	–	3.7	5.2	7.2	mT	5
Hysteresis width*3	S pole	B_{HYSS}	$B_{HYSS} = B_{OPS} - B_{RPS}$	–	1.8	–	mT	5

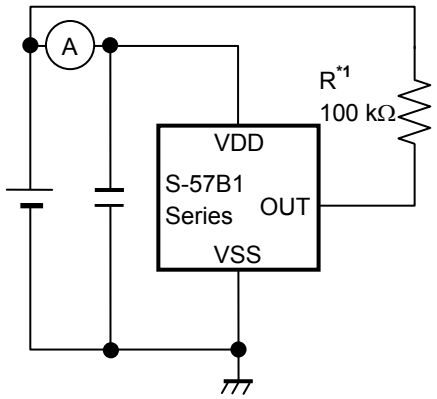
***1.** B_{OPS}: Operating point
B_{OPS} is the value of magnetic flux density when the output voltage (V_{OUT}) changes after the magnetic flux density applied to this IC by the magnet (S pole) is increased (the magnet is moved closer).
Even when the magnetic flux density exceeds B_{OPS}, V_{OUT} retains the status.

***2.** B_{RPS}: Release point
B_{RPS} is the value of magnetic flux density when the output voltage (V_{OUT}) changes after the magnetic flux density applied to this IC by the magnet (S 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 width
B_{HYSS} is the difference of magnetic flux density between B_{OPS} and B_{RPS}.

Remark The unit of magnetic flux 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

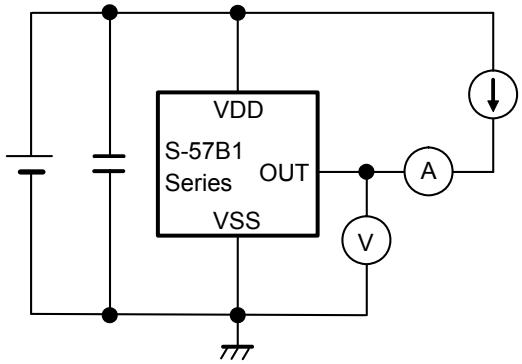


Figure 5 Test Circuit 2

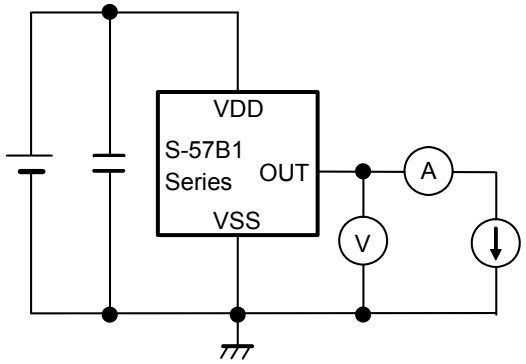


Figure 6 Test Circuit 3

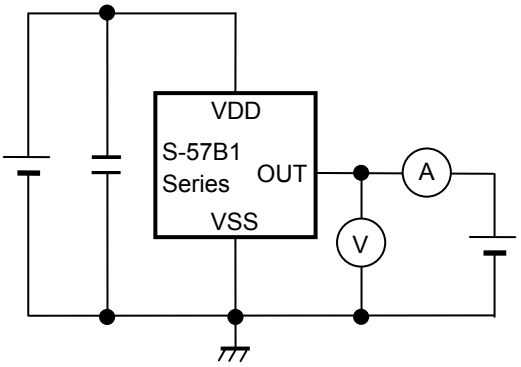
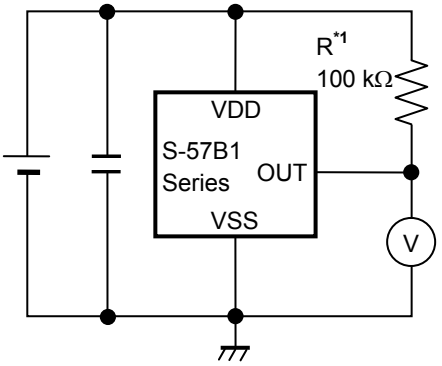


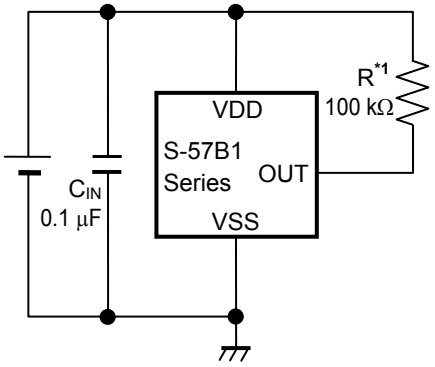
Figure 7 Test Circuit 4



***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

This IC detects the magnetic flux density which is vertical to the marking surface.
The output voltage (V_{OUT}) is inverted when the S pole is moved closer to the marking surface.
Figure 10 shows the direction in which magnetic flux is being applied.

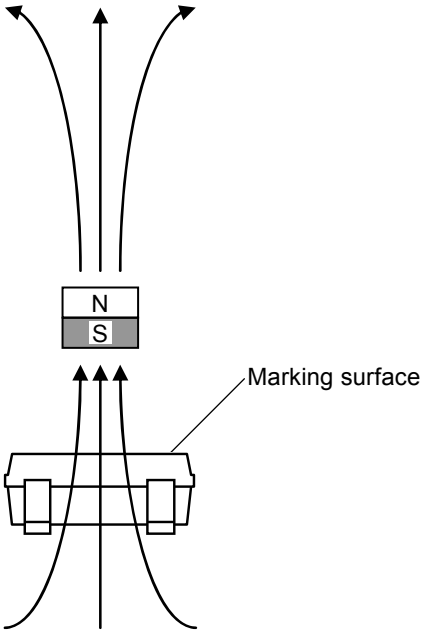


Figure 10

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.

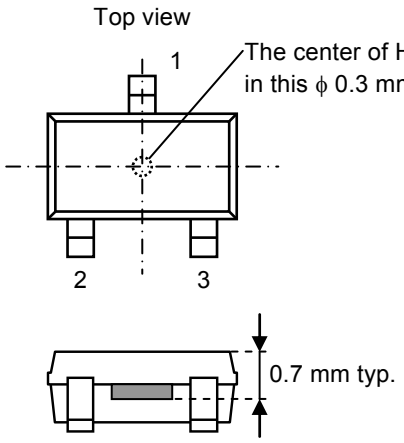


Figure 11

3. Basic operation

This IC changes the output voltage level (V_{OUT}) according to the level of the magnetic flux density (S 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 the operation point (B_{OPS}) after the south pole of a magnet is moved closer to the marking surface of this IC, V_{OUT} changes from "H" to "L". When the south pole of a magnet is moved further away from the marking surface of this IC and the magnetic flux density is lower than the release point (B_{RPS}), V_{OUT} changes from "L" to "H".
Figure 12 shows the relationship between the magnetic flux density and V_{OUT}.

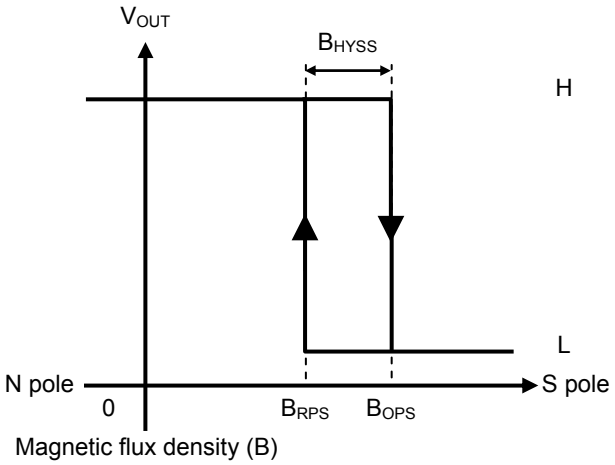


Figure 12

4. Timing chart

Figure 13 shows the operation timing of this IC. This IC always operates on awake mode. V_{OUT} is refreshed to the level according to the result of the magnetic flux density judgment for each period the operating cycle (t_{CYCLE}) elapses.

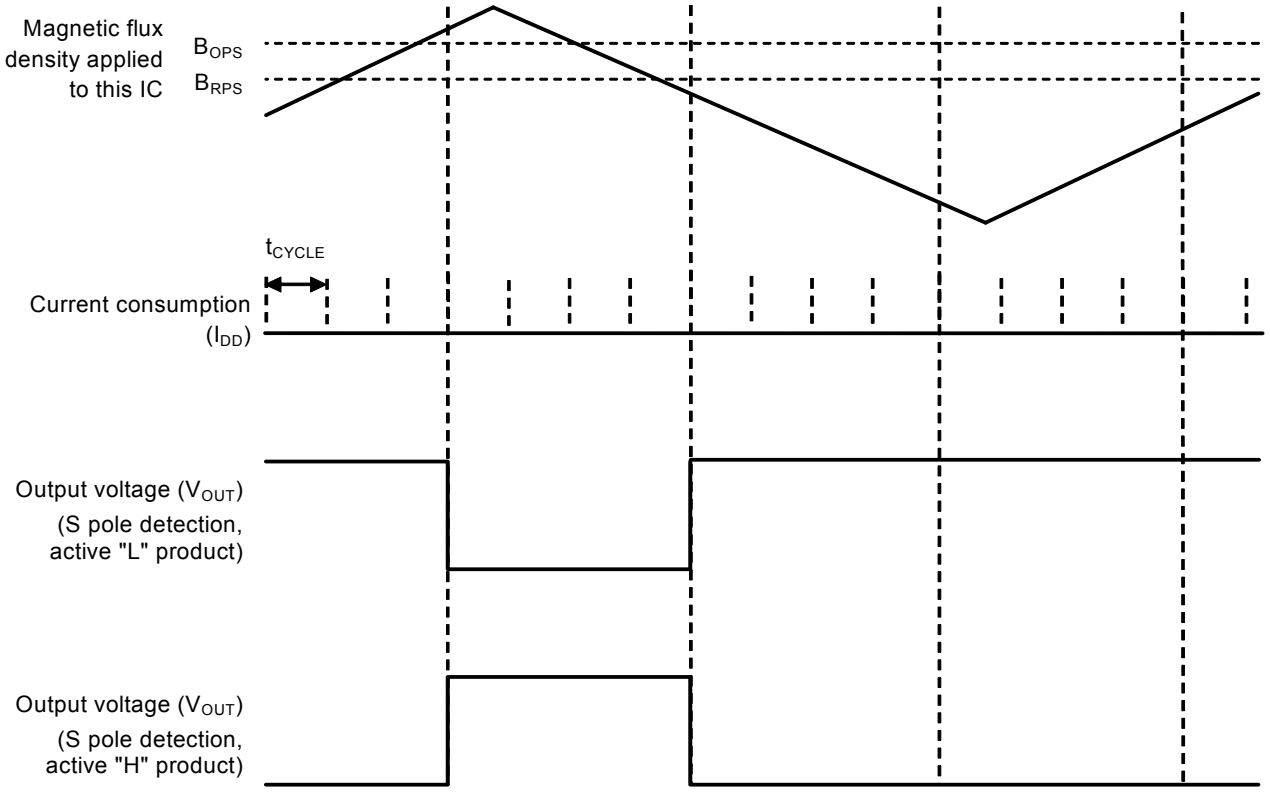


Figure 13

5. Start-up response

Figure 14, Figure15 show the start-up response of this IC. After rising of V_{DD} for this IC, V_{OUT} changes to the level according to the result of the magnetic flux density judgment after 80 μs typ. is elapsed.
Thereafter V_{OUT} is refreshed to the level according to the result of the magnetic flux density judgment for each period the t_{CYCLE} elapses.

5. 1 $B > B_{OPS}$

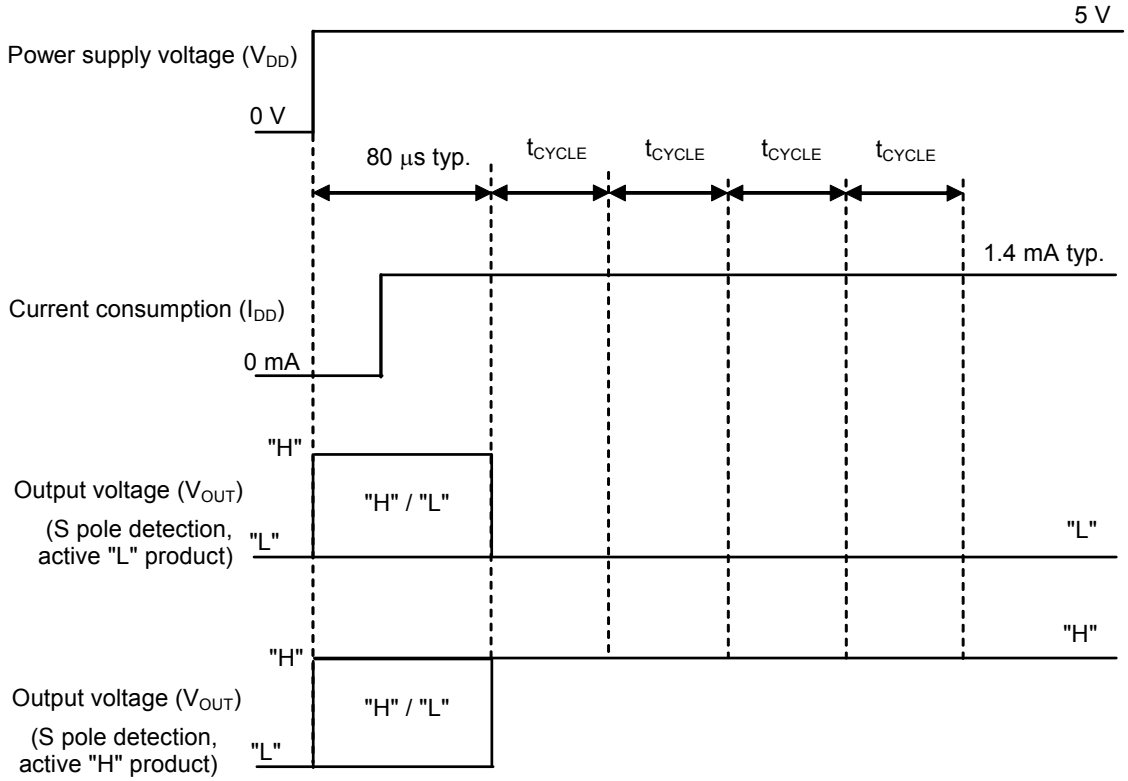


Figure 14

5. 2 $B < B_{RPS}$

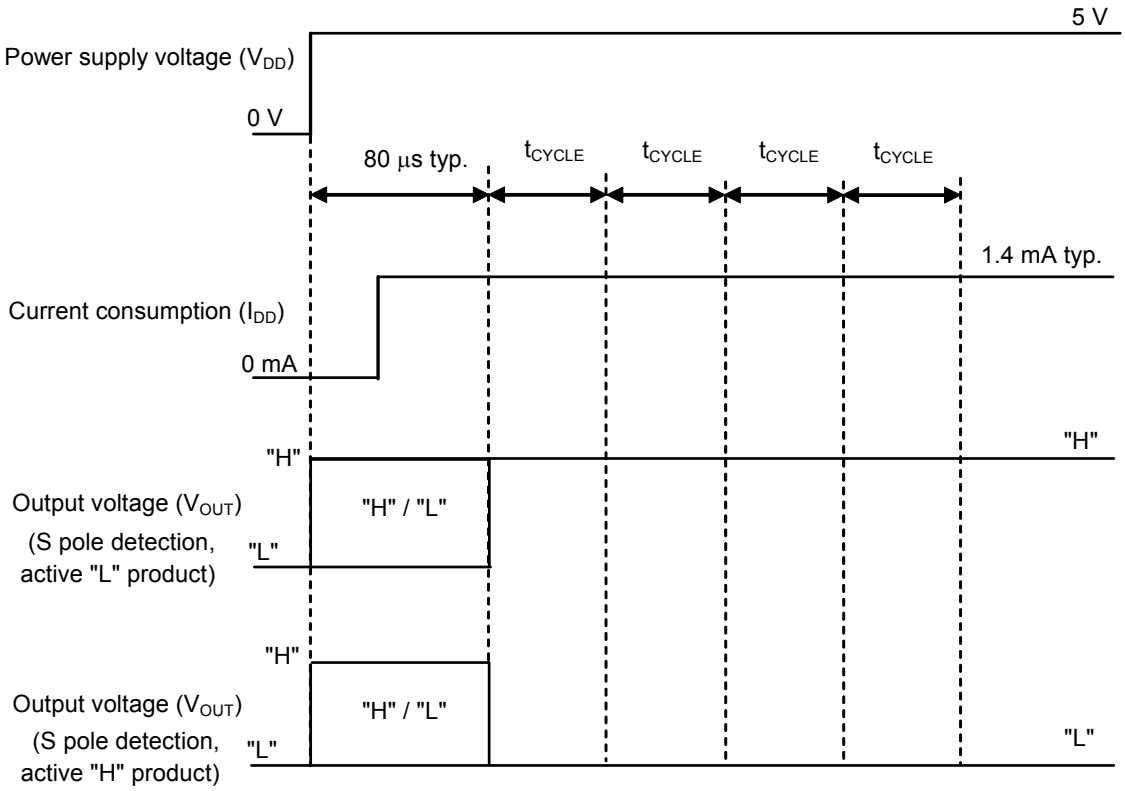


Figure 15

■ 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.
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■ Thermal Characteristics

1. SOT-23-3

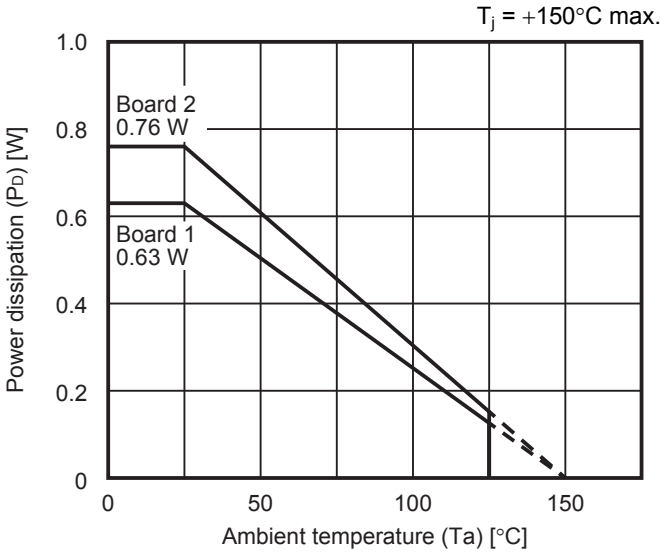


Figure 16 Power Dissipation of Package (When Mounted on Board)

1. 1 Board 1[*1]

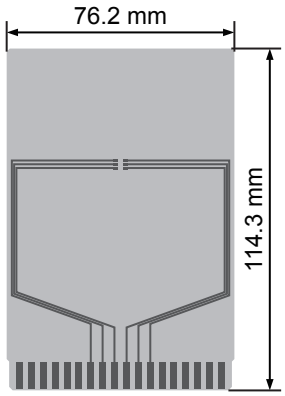


Figure 17

Table 10

Item		Specification
Thermal resistance value (θ_{ja})		200°C/W
Size		114.3 mm × 76.2 mm × t1.6 mm
Material		FR-4
Number of copper foil layer		2
Copper foil layer	1	Land pattern and wiring for testing: t0.070 mm
	2	–
	3	–
	4	74.2 mm × 74.2 mm × t0.070 mm
Thermal via		–

1. 2 Board 2[*1]

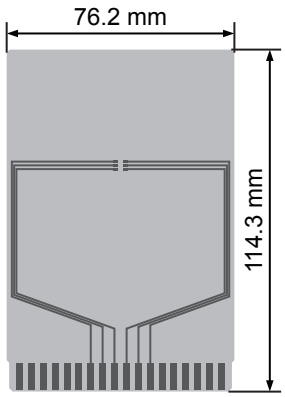
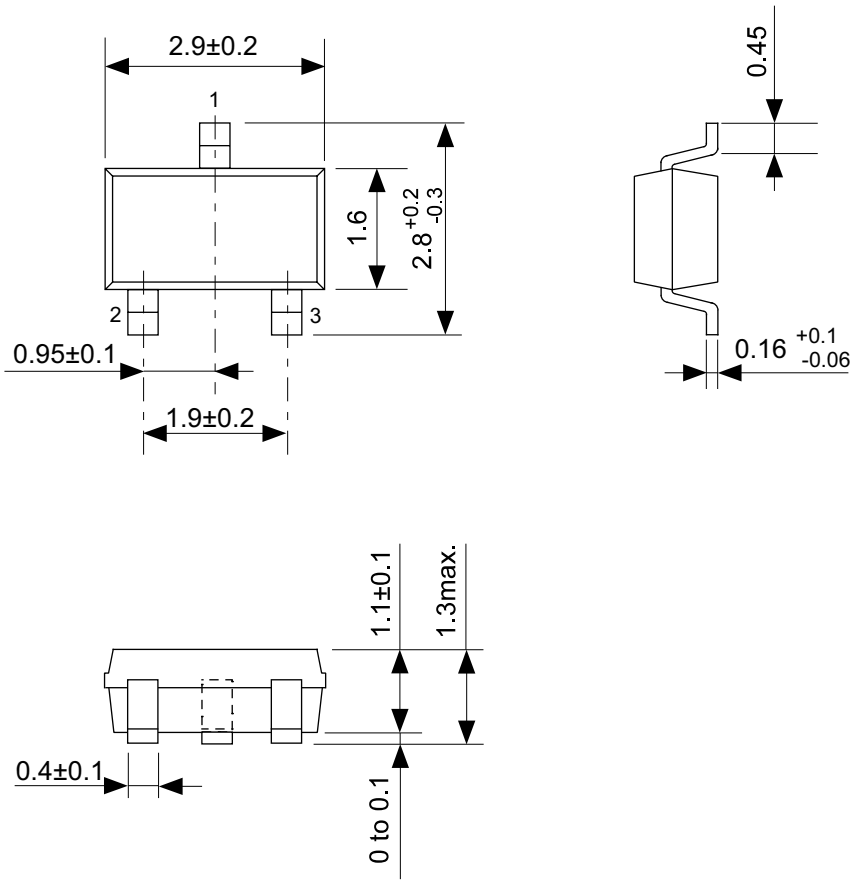


Figure 18

Table 11

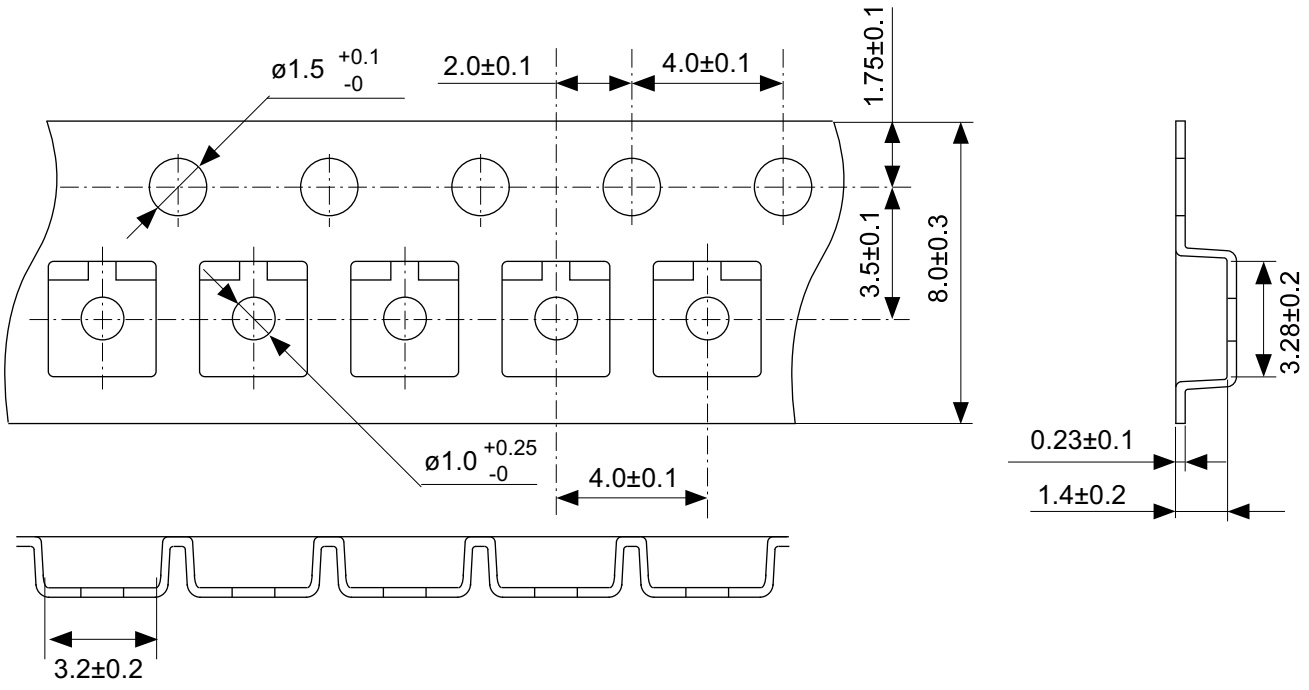
Item		Specification
Thermal resistance value (θ_{ja})		165°C/W
Size		114.3 mm × 76.2 mm × t1.6 mm
Material		FR-4
Number of copper foil layer		4
Copper foil layer	1	Land pattern and wiring for testing: t0.070 mm
	2	74.2 mm × 74.2 mm × t0.035 mm
	3	74.2 mm × 74.2 mm × t0.035 mm
	4	74.2 mm × 74.2 mm × t0.070 mm
Thermal via		–

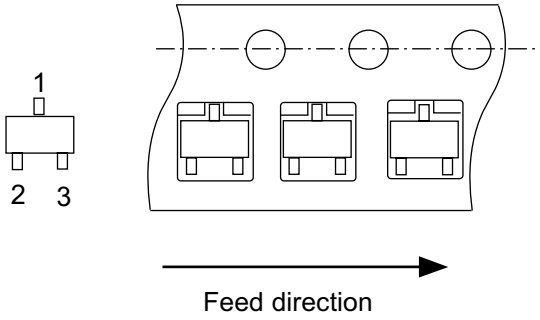
***1.** The board is same in SOT-23-3, SOT-23-5 and SOT-23-6.



No. MP003-C-P-SD-1.1

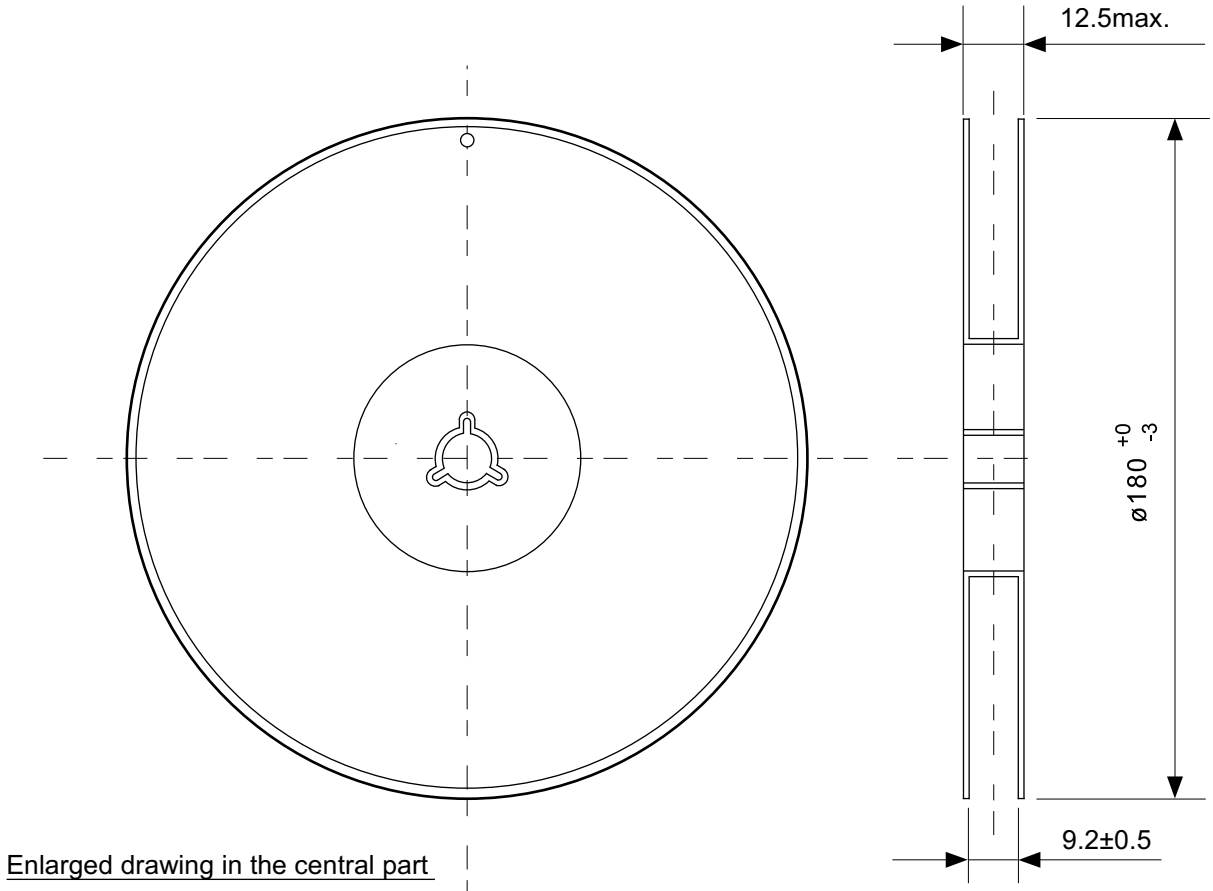
TITLE	SOT233-C-PKG Dimensions
No.	MP003-C-P-SD-1.1
ANGLE	
UNIT	mm
ABLIC Inc.	



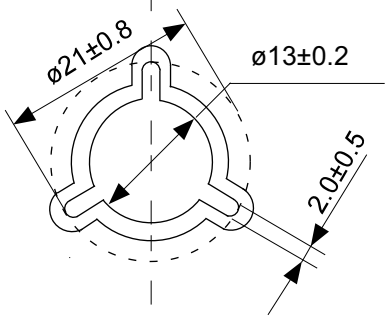


No. MP003-C-C-SD-2.0

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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