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HIGH-SPEED, BIPOLAR HALL EFFECT LATCH IC

Rev.2.0_00

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 level changes when this IC detects the intensity level of magnetic flux density and a polarity change. Using this IC 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 or the super-small SNT-4A 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 "magnetic simulation service" that provides the ideal combination of magnets and our Hall effect ICs for customer systems. Our magnetic 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 magnetic simulation service, contact our sales representatives.

■ Features

- Pole detection: Bipolar latch
- Output logic*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

***1.** The option can be selected.

■ Applications

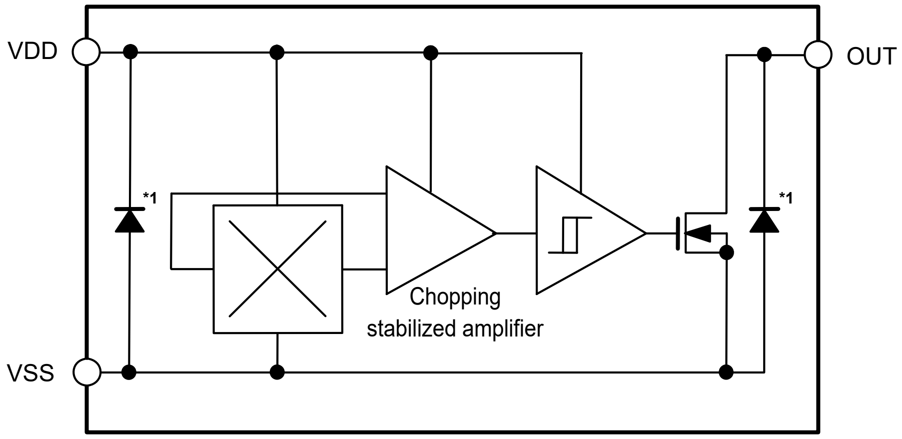
- Motor
- Housing equipment
- Industrial equipment

■ Packages

- SOT-23-3
- SNT-4A

■ Block Diagrams

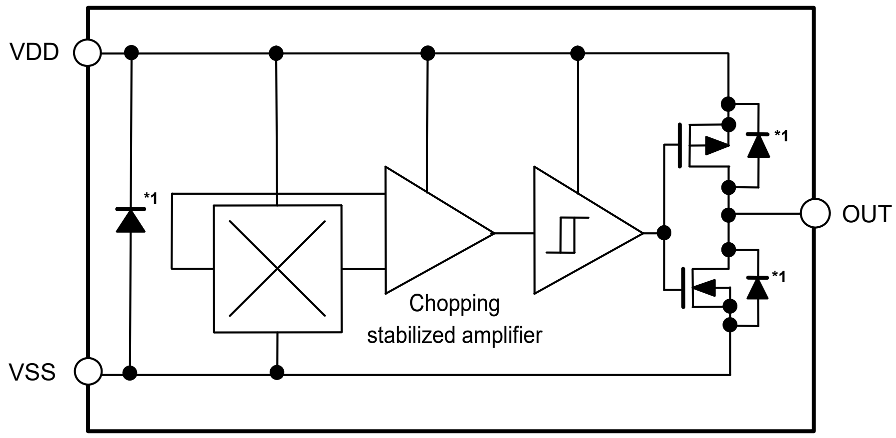
1. Nch open-drain output product



***1.** Parasitic diode

Figure 1

2. CMOS output product



***1.** Parasitic diode

Figure 2

■ Product Name Structure

1. Product name

S-57M1 x B x 1 B - xxxx U

- U — Environmental code
  - U: Lead-free (Sn 100%), halogen-free
- xxxx — Package name (abbreviation) and packing specifications*1
  - M3T1: SOT-23-3, Tape
  - I4T1: SNT-4A, Tape
- B — Operation temperature
  - B: Ta = −40°C to +125°C
- 1 — Magnetic sensitivity
  - 1: B_{OP} = 3.0 mT typ.
- x — Output logic
  - L: V_{OUT} = "L" at S pole detection
  - H: V_{OUT} = "H" at S pole detection
- B — Pole detection
  - B: Bipolar latch
- x — Output form
  - N: Nch open-drain output
  - C: CMOS output

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

2. Packages

Table 1 Package Drawing Codes

Package Name	Dimension	Tape	Reel	Land
SOT-23-3	MP003-C-P-SD	MP003-C-C-SD	MP003-Z-R-SD	–
SNT-4A	PF004A-P-SD	PF004-A-C-SD	PF004-A-R-SD	PF004-A-L-SD

3. Product name list

3. 1 SOT-23-3

Table 2

Product Name	Output Form	Pole Detection	Output Logic	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 representatives for products other than the above.

3. 2 SNT-4A

Table 3

Product Name	Output Form	Pole Detection	Output Logic	Magnetic Sensitivity (B_{OP})
S-57M1NBL1B-I4T1U	Nch open-drain output	Bipolar latch	V_{OUT} = "L" at S pole detection	3.0 mT typ.

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

■ Pin Configurations

1. SOT-23-3

Top view

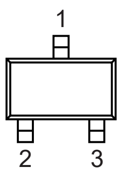


Figure 3

Table 4

Pin No.	Symbol	Description
1	VSS	GND pin
2	VDD	Power supply pin
3	OUT	Output pin

2. SNT-4A

Top view

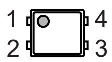


Figure 4

Table 5

Pin No.	Symbol	Description
1	VDD	Power supply pin
2	VSS	GND pin
3	NC*1	No connection
4	OUT	Output pin

***1.** The NC pin is electrically open.
The NC pin can be connected to the VDD pin or the VSS pin.

■ Absolute Maximum Ratings

Table 6

(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.

■ Electrical Characteristics

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
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 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
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

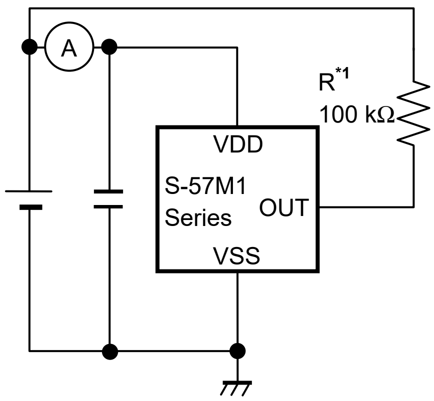
***1.** B_{OP}: Operation point
B_{OP} is the value of magnetic flux density when the output voltage (V_{OUT}) changes after the magnetic flux density applied to this IC by the magnet (S pole) is increased (by moving the magnet closer).
V_{OUT} retains the status until a magnetic flux density of the 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 this IC 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 5 Test Circuit 1

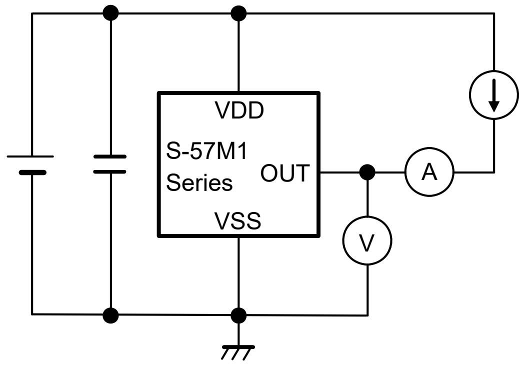


Figure 6 Test Circuit 2

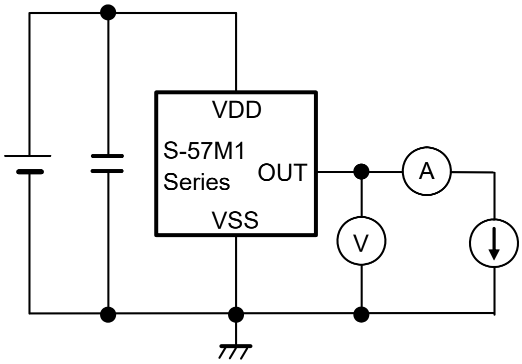


Figure 7 Test Circuit 3

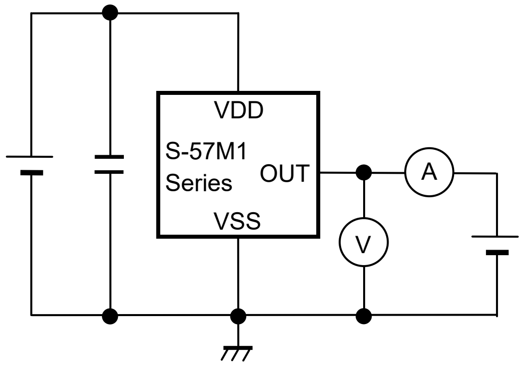
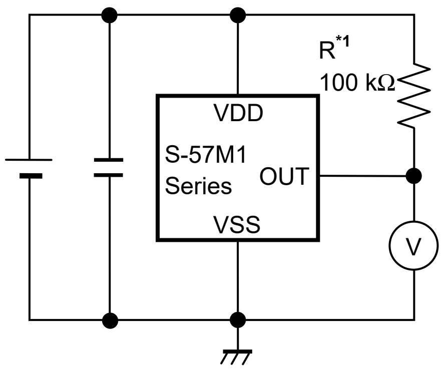


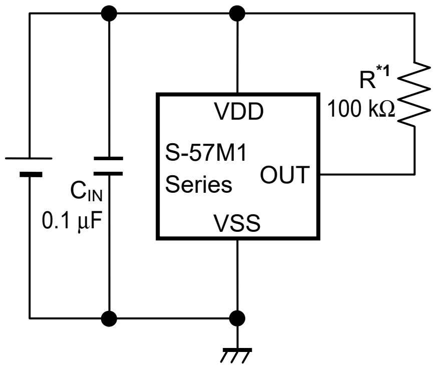
Figure 8 Test Circuit 4



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

Figure 9 Test Circuit 5

■ Standard Circuit



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

Figure 10

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.
Figure 11 and **Figure 12** show the direction in which magnetic flux is being applied.

1. 1 SOT-23-3

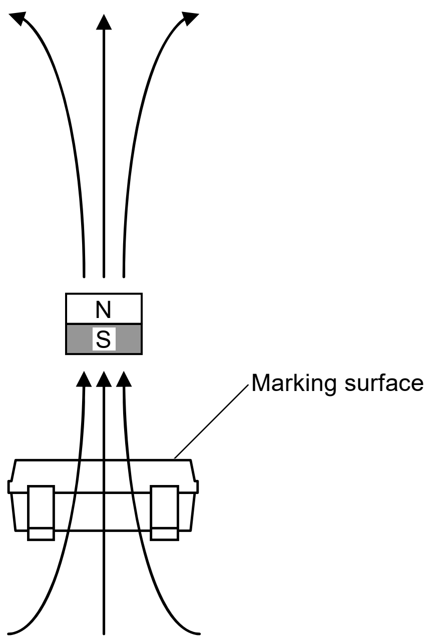


Figure 11

1. 2 SNT-4A

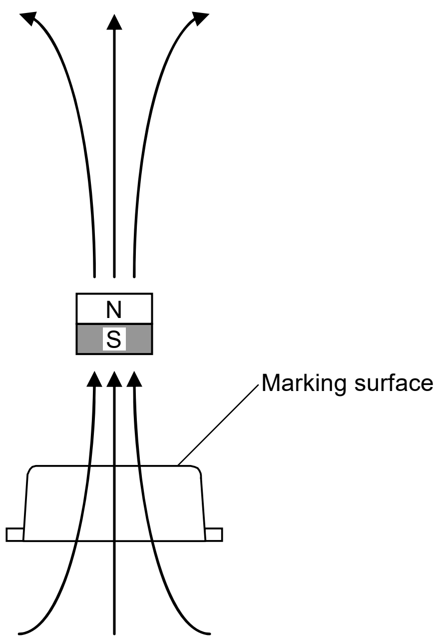


Figure 12

2. Position of Hall sensor

Figure 13 and **Figure 14** show 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.

2. 1 SOT-23-3

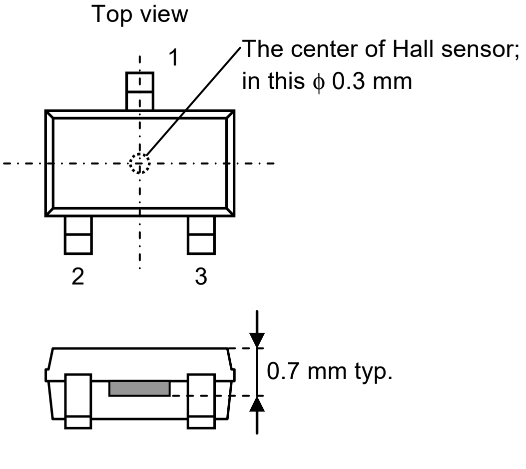


Figure 13

2. 2 SNT-4A

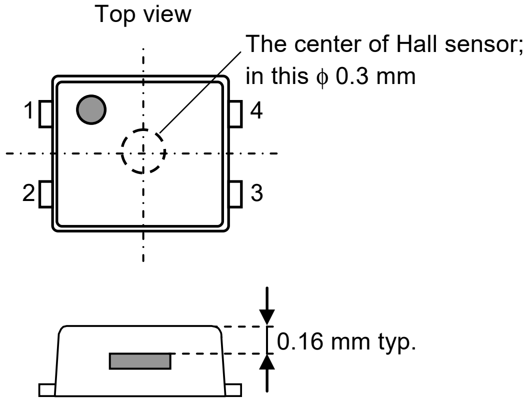


Figure 14

3. Basic operation

This IC 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 this IC, V_{OUT} changes from "H" to "L". When the N pole of a magnet is moved closer to the marking surface of this IC 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 15 shows the relationship between the magnetic flux density and V_{OUT}.

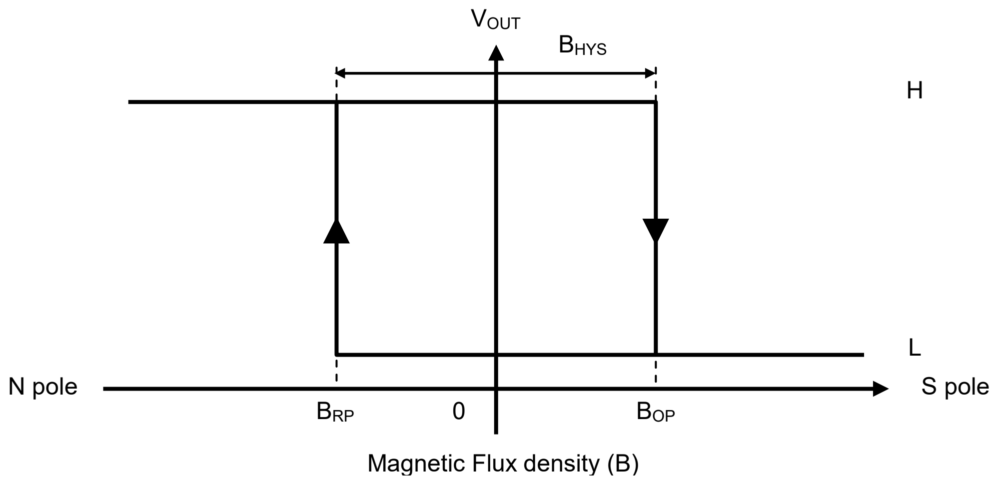


Figure 15

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 this IC, V_{OUT} changes from "L" to "H". When the N pole of a magnet is moved closer to the marking surface of this IC 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 16 shows the relationship between the magnetic flux density and V_{OUT}.

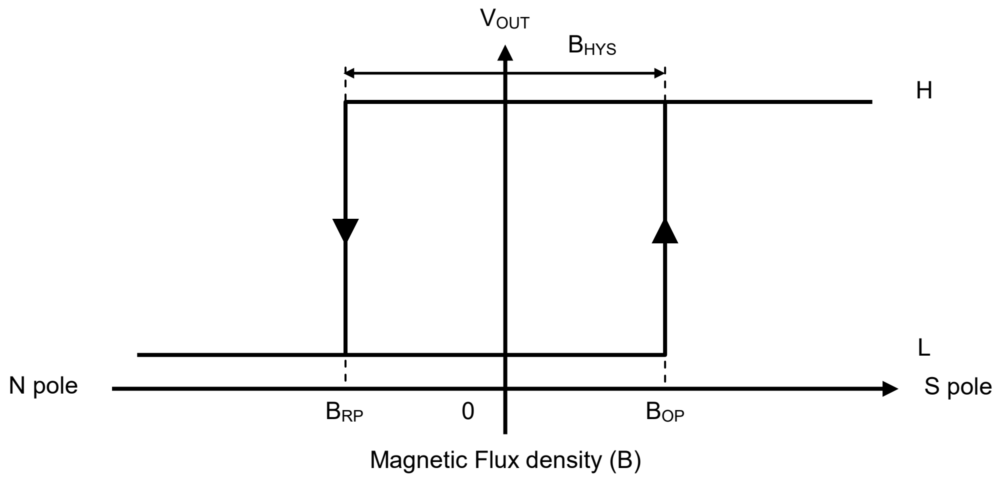


Figure 16

4. Timing chart

Figure 17 shows the operation timing of this IC.

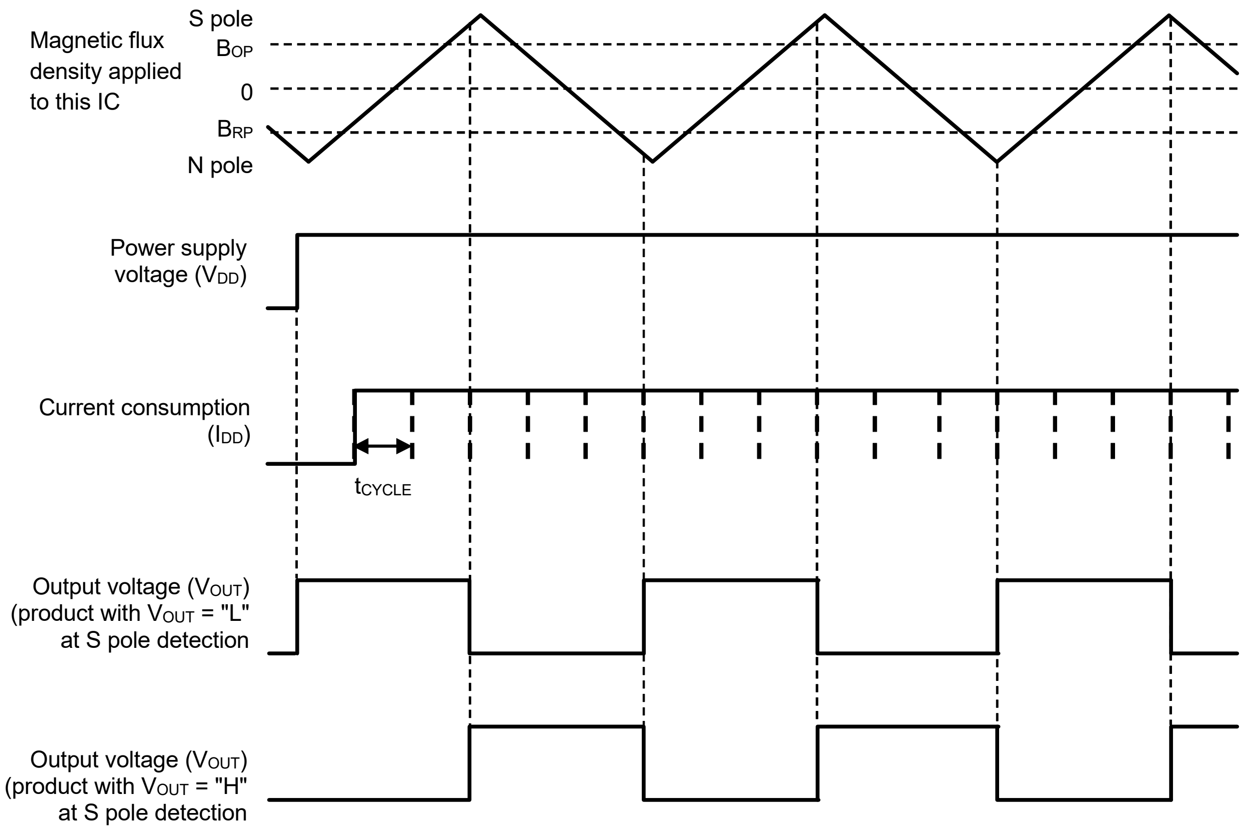


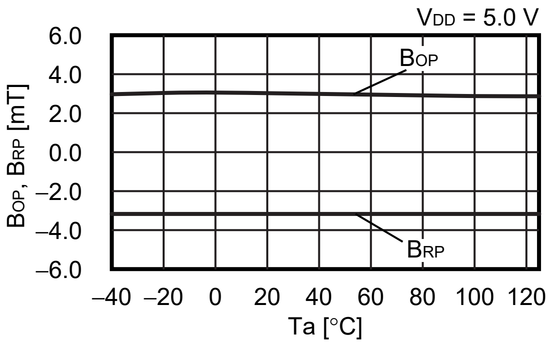
Figure 17

■ Precautions

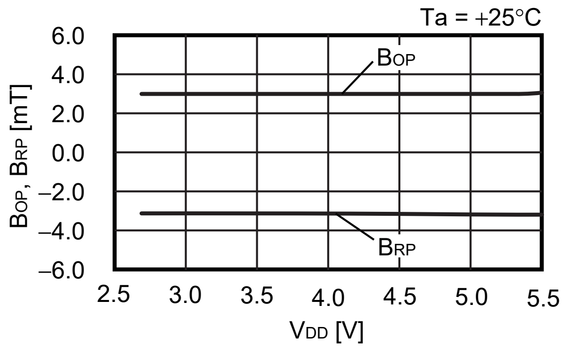
- If the impedance of the power supply is high, the IC may malfunction due to a supply voltage drop caused by feed-through current. Take care with the pattern wiring to ensure that the impedance of the power supply is low.
- Note that the IC may malfunction if the power supply voltage rapidly changes.
- 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 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.

■ Characteristics (Typical Data)

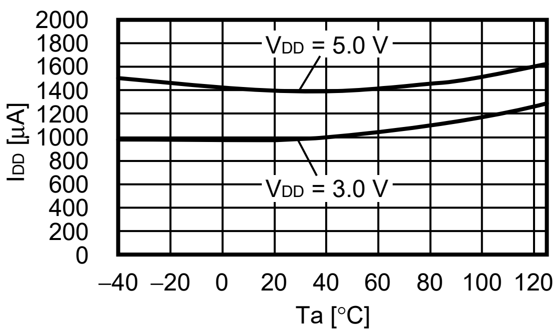
1. Operation point, release point (B_{OP}, B_{RP}) vs. Temperature (Ta)



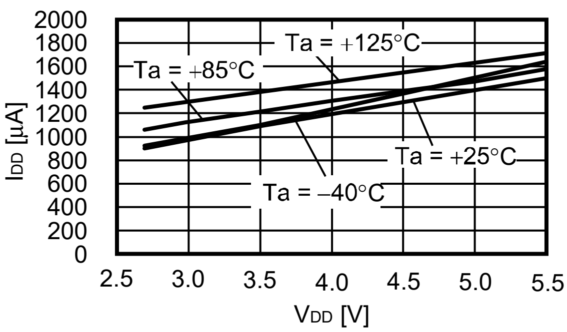
2. Operation point, release point (B_{OP}, B_{RP}) vs. Power supply voltage (V_{DD})



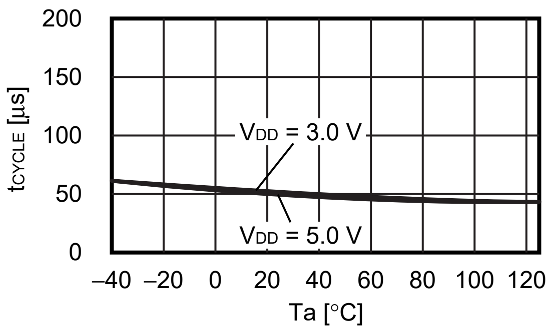
3. Current consumption (I_{DD}) vs. Temperature (Ta)



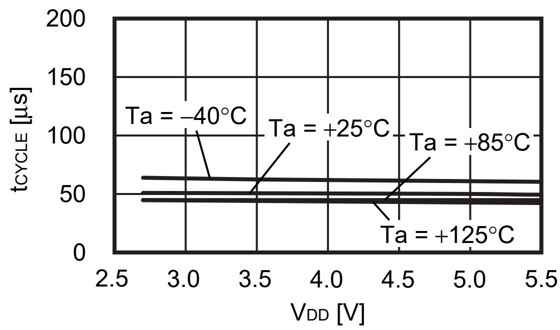
4. Current consumption (I_{DD}) vs. Power supply voltage (V_{DD})

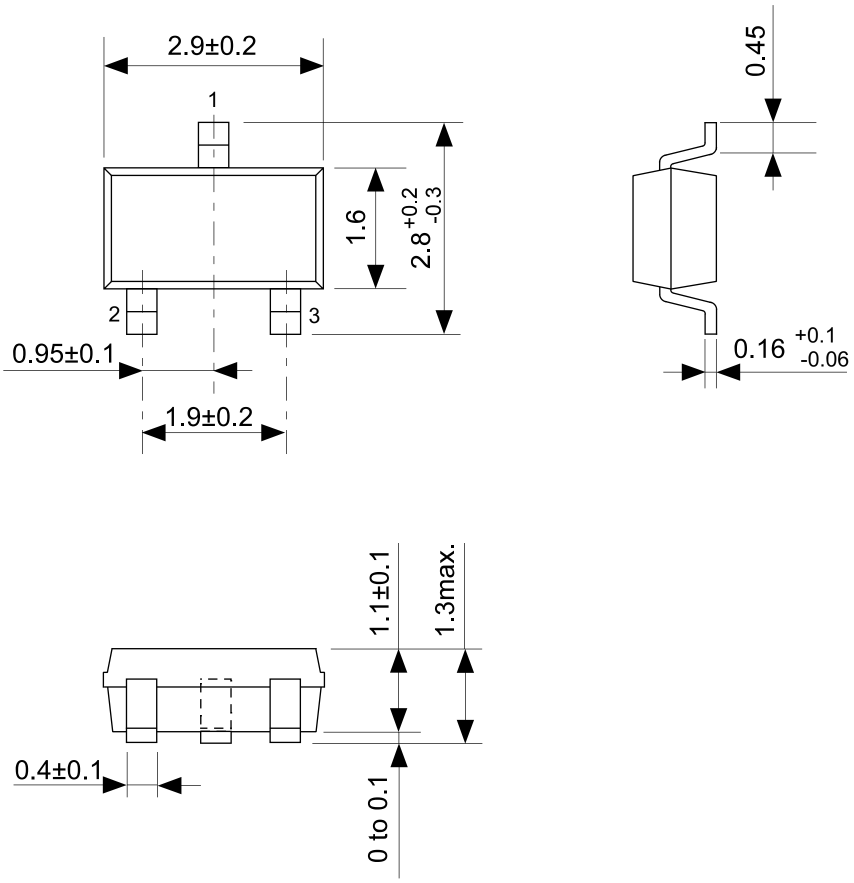


5. Operating cycle (t_{CYCLE}) vs. Temperature (Ta)



6. Operating cycle (t_{CYCLE}) vs. Power supply voltage (V_{DD})

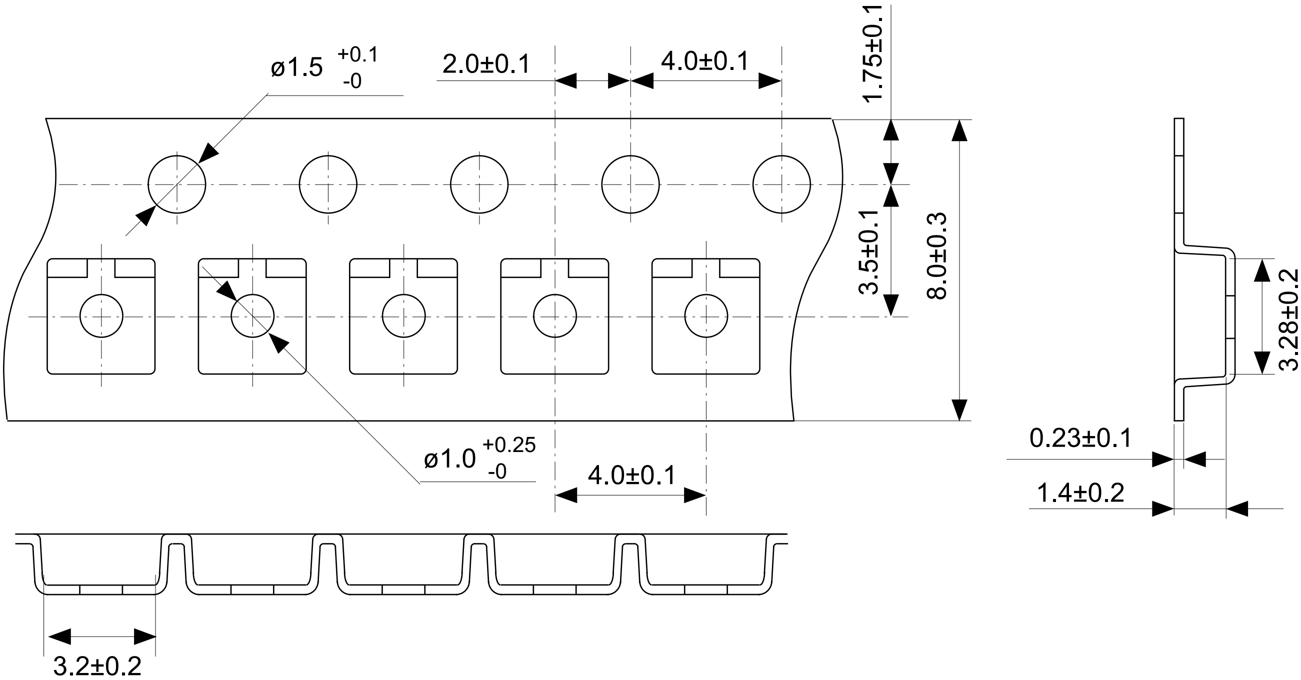


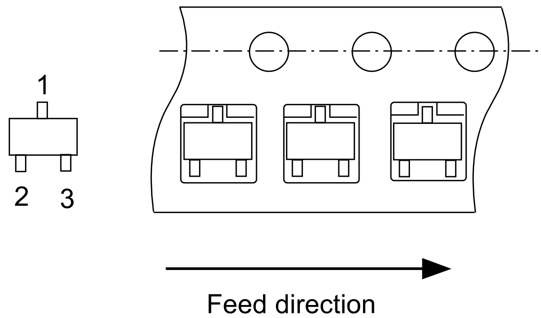


No. MP003-C-P-SD-1.1

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

ABLIC Inc.

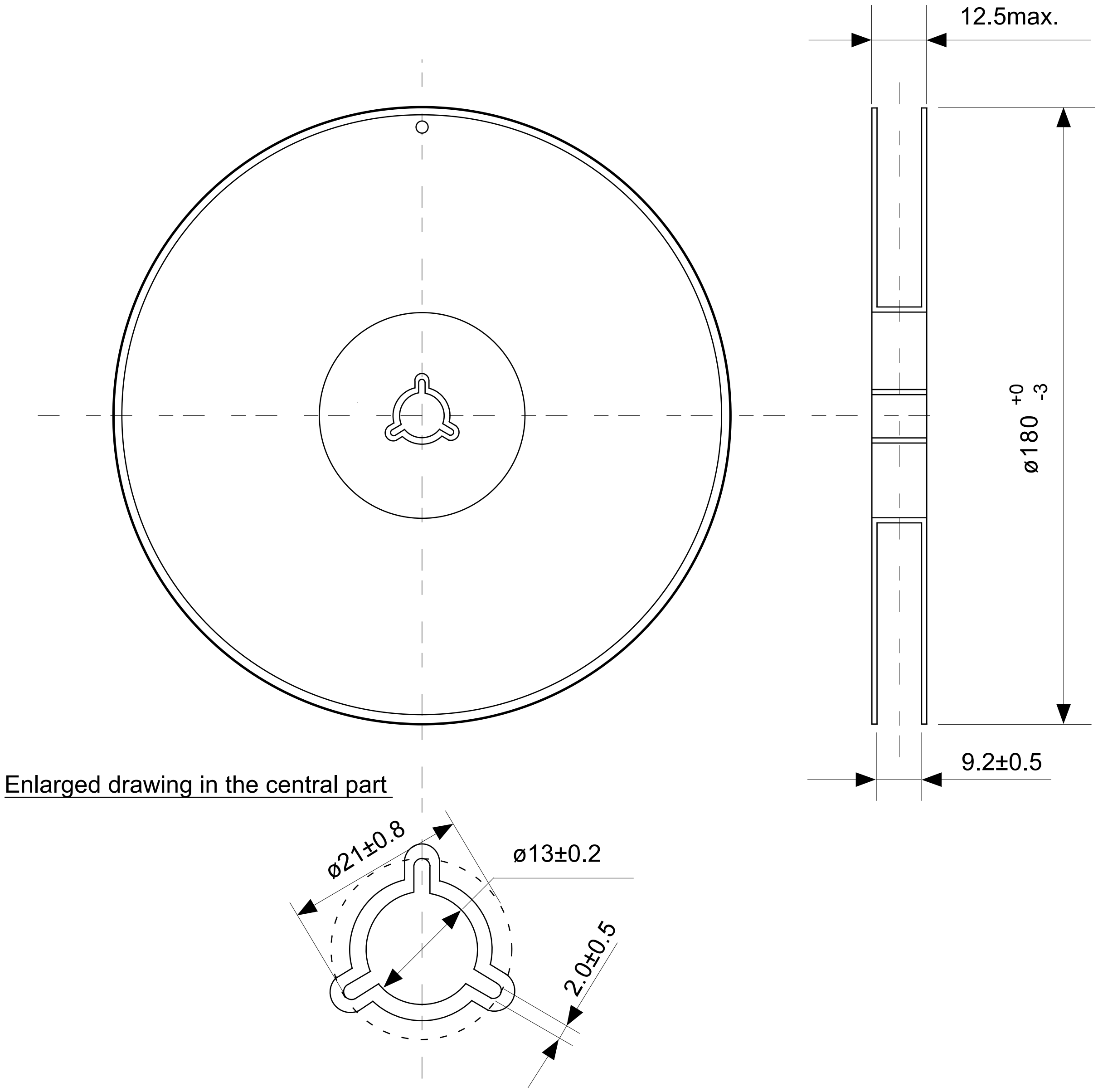




No. MP003-C-C-SD-2.0

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

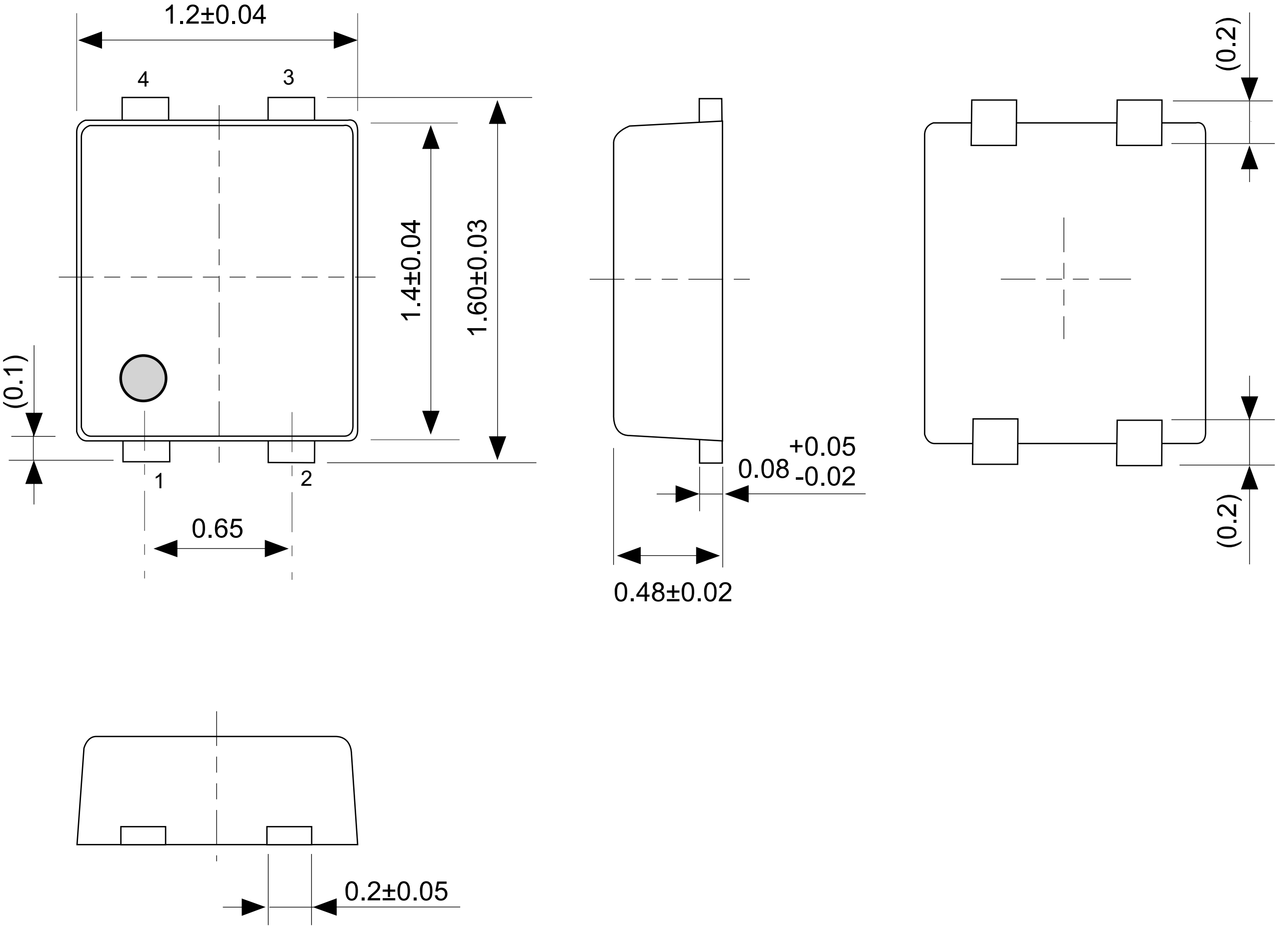
ABLIC Inc.



No. MP003-Z-R-SD-1.0

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

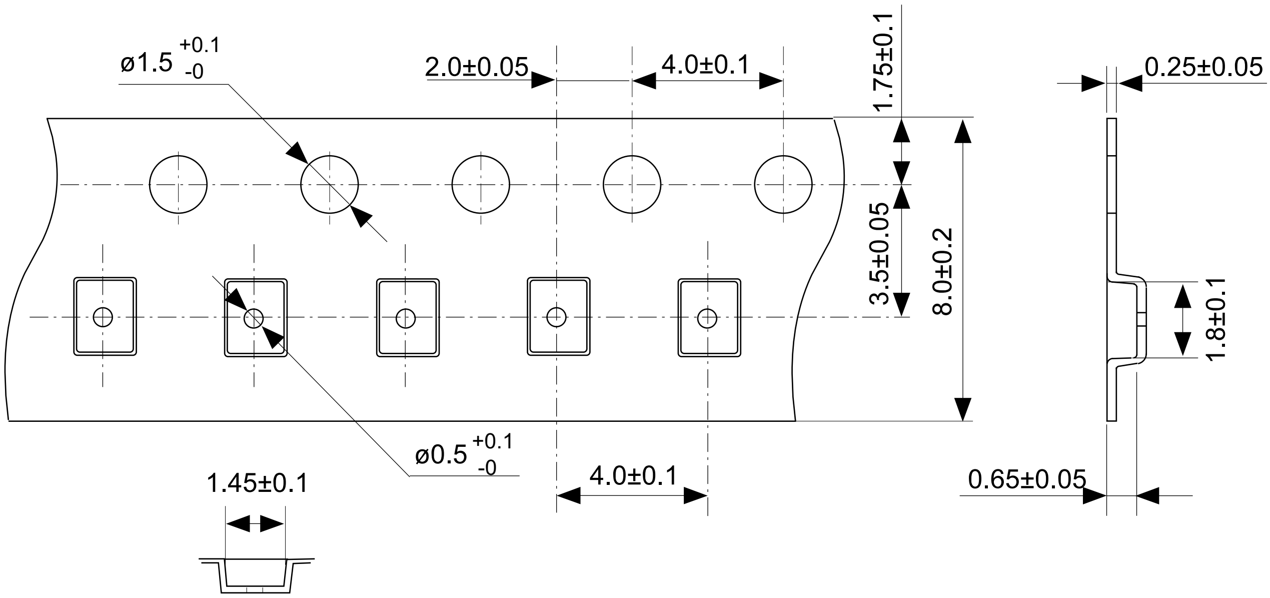
ABLIC Inc.

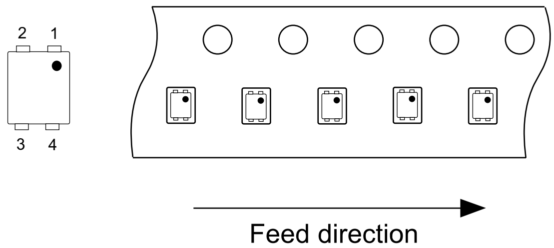


No. PF004-A-P-SD-6.0

TITLE	SNT-4A-A-PKG Dimensions
No.	PF004-A-P-SD-6.0
ANGLE	
UNIT	mm

ABLIC Inc.

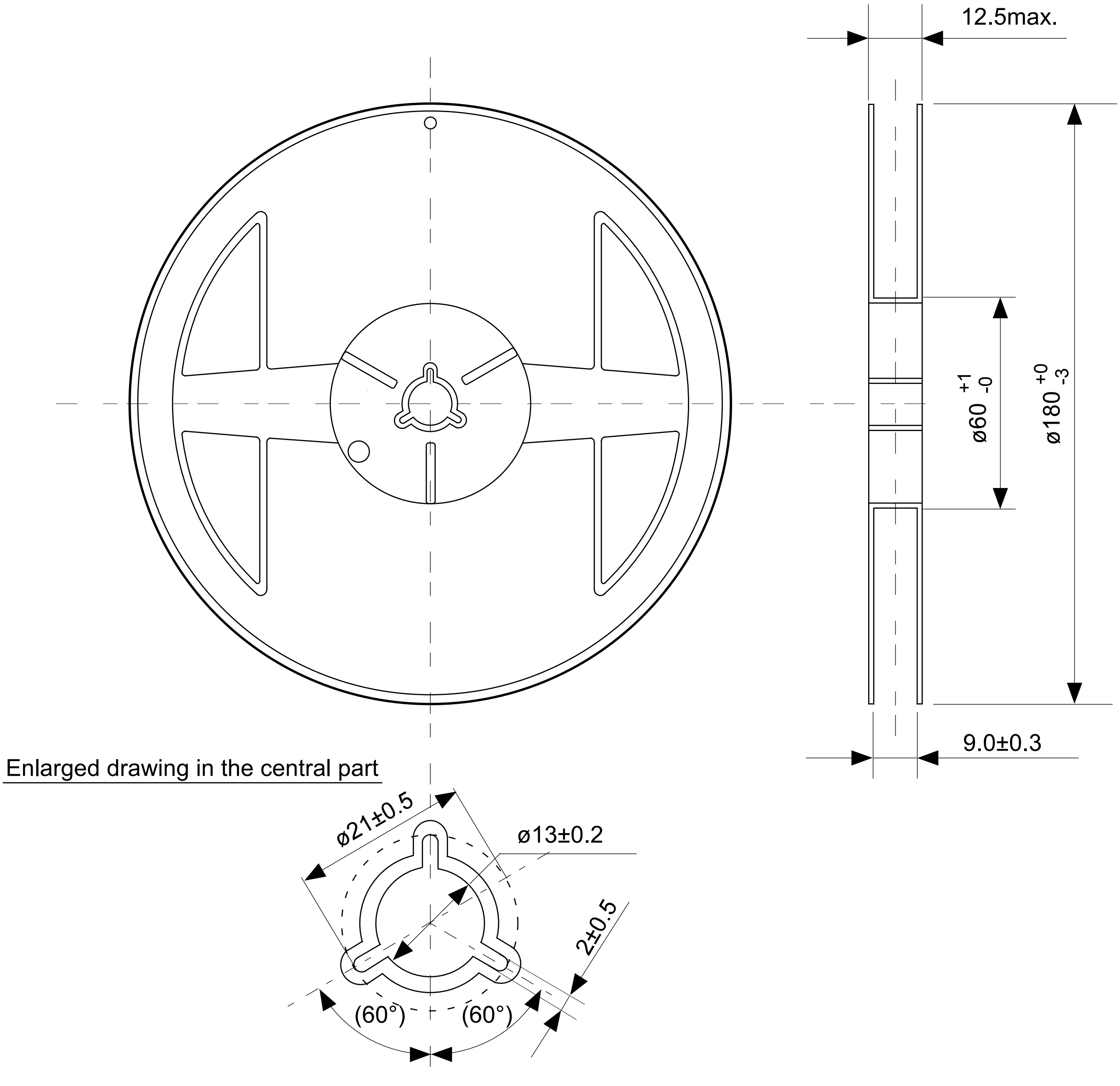




No. PF004-A-C-SD-2.0

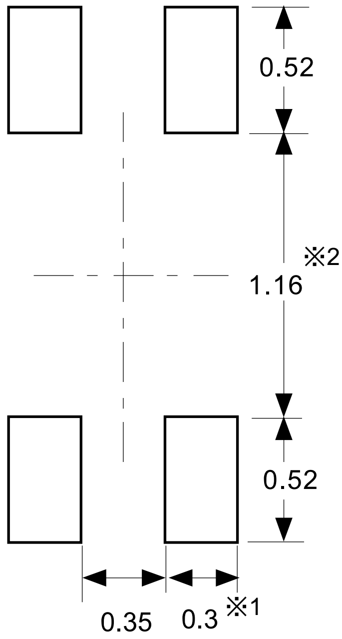
TITLE	SNT-4A-A-Carrier Tape
No.	PF004-A-C-SD-2.0
ANGLE	
UNIT	mm

ABLIC Inc.



No. PF004-A-R-SD-1.0

TITLE	SNT-4A-A-Reel		
No.	PF004-A-R-SD-1.0		
ANGLE		QTY.	5,000
UNIT	mm		
ABLIC Inc.			



※1. ランドパターンの幅に注意してください (0.25 mm min. / 0.30 mm typ.)。
※2. パッケージ中央にランドパターンを広げないでください (1.10 mm ~ 1.20 mm)。

注意 1. **パッケージのモールド樹脂下にシルク印刷やハンダ印刷などしないでください。**
2. **パッケージ下の配線上のソルダーレジストなどの厚みをランドパターン表面から0.03 mm 以下にしてください。**
3. **マスク開口サイズと開口位置はランドパターンと合わせてください。**
4. **詳細は "SNTパッケージ活用の手引き" を参照してください。**

※1. Pay attention to the land pattern width (0.25 mm min. / 0.30 mm typ.).
※2. Do not widen the land pattern to the center of the package (1.10 mm to 1.20 mm).

Caution 1. Do not do silkscreen printing and solder printing under the mold resin of the package.
2. The thickness of the solder resist on the wire pattern under the package should be 0.03 mm or less from the land pattern surface.
3. Match the mask aperture size and aperture position with the land pattern.
4. Refer to "SNT Package User's Guide" for details.

※1. 请注意焊盘模式的宽度 (0.25 mm min. / 0.30 mm typ.)。
※2. 请勿向封装中间扩展焊盘模式 (1.10 mm ~ 1.20 mm)。

注意 1. 请勿在树脂型封装的下面印刷丝网、焊锡。
2. 在封装下、布线上的阻焊膜厚度 (从焊盘模式表面起) 请控制在 0.03 mm 以下。
3. 钢网的开口尺寸和开口位置请与焊盘模式对齐。
4. 详细内容请参阅 "SNT 封装的应用指南"。

No. PF004-A-L-SD-4.1

TITLE	SNT-4A-A -Land Recommendation
No.	PF004-A-L-SD-4.1
ANGLE	
UNIT	mm

ABLIC Inc.

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10. The products are not designed to be radiation-proof. The necessary radiation measures should be taken in the product design by the customer depending on the intended use.
11. The products do not affect human health under normal use. However, they contain chemical substances and heavy metals and should therefore not be put in the mouth. The fracture surfaces of wafers and chips may be sharp. Be careful when handling these with the bare hands to prevent injuries, etc.
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