

## HIGH-WITHSTAND VOLTAGE HIGH-SPEED BIPOLAR HALL EFFECT LATCH

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Rev.1.1\_01

The S-5741 Series, developed by CMOS technology, is a bipolar Hall effect latch with high-withstand voltage, high-speed detection and high-accuracy magnetic characteristics.

The output voltage changes when the S-5741 Series detects the intensity level of magnetic flux density and a polarity change. Using the S-5741 Series with a magnet makes it possible to detect the rotation status in various devices.

The S-5741 Series includes 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-5741 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 Semiconductor Corporation is indispensable.

### ■ Features

- |   |   |
|---|---|
| • Pole detection:                       | Bipolar latch   |
| • Detection logic for magnetism*1:      | V <sub>OUT</sub> = "L" at S pole detection<br>V <sub>OUT</sub> = "H" at S pole detection        |
| • Output form*1:                        | Nch open-drain output<br>Nch driver + built-in pull-up resistor                                 |
| • Magnetic sensitivity*1:               | B <sub>OP</sub> = 1.8 mT typ.<br>B <sub>OP</sub> = 3.0 mT typ.<br>B <sub>OP</sub> = 6.0 mT typ. |
| • Operating cycle:                      | t <sub>CYCLE</sub> = 8.0 μs typ.  |
| • Power supply voltage range:           | V <sub>DD</sub> = 3.5 V to 26.0 V   |
| • Built-in regulator                    |   |
| • Built-in output current limit circuit |   |
| • Operation temperature range:          | T <sub>a</sub> = -40°C to +85°C   |
| • Lead-free (Sn 100%), halogen-free     |   |

\*1. The option can be selected.

### ■ Applications

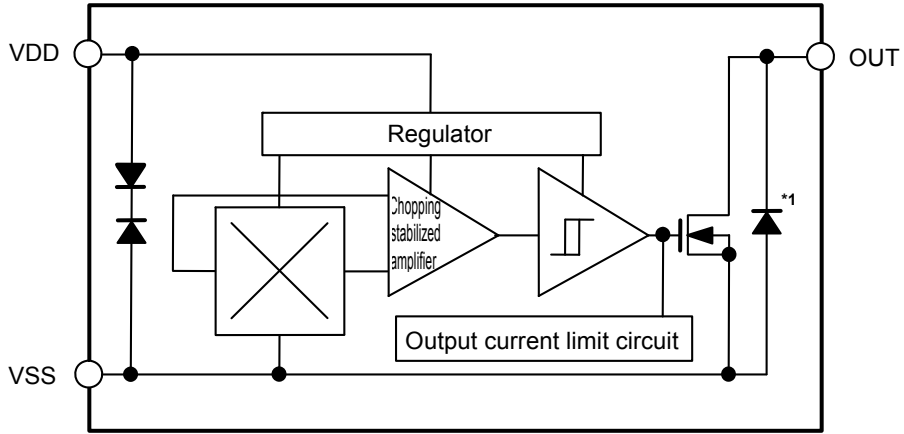
- Home appliance
- DC brushless motor
- Housing equipment
- Industrial equipment

### ■ Package

- SOT-23-3

■ **Block Diagrams**

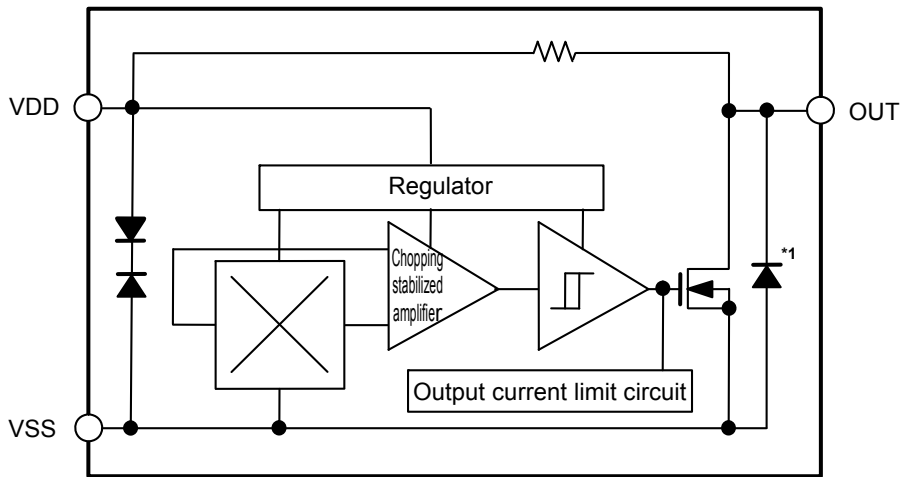
1. **Nch open-drain output product**



\*1. Parasitic diode

**Figure 1**

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

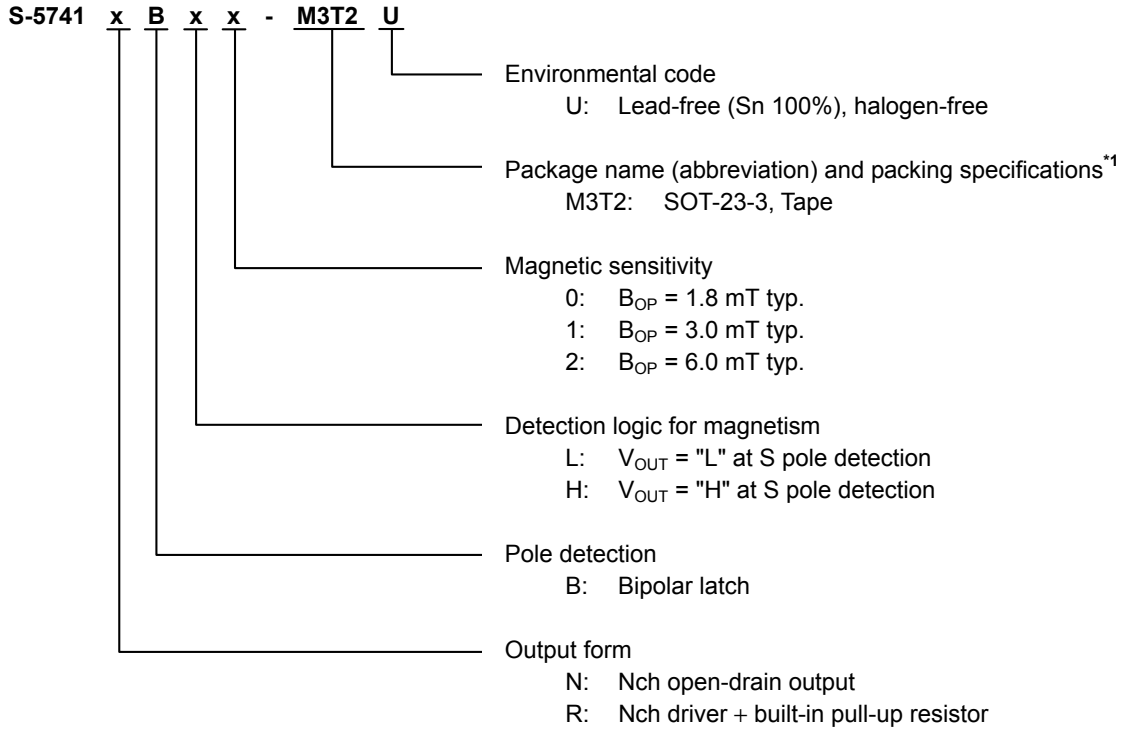


\*1. Parasitic diode

**Figure 2**

**■ 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**

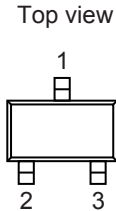
**Table 2**

Product Name	Output Form	Pole Detection	Detection Logic for Magnetism	Magnetic Sensitivity ( $B_{OP}$ )
S-5741NBL1-M3T2U	Nch open-drain output	Bipolar latch	$V_{OUT} = "L"$ at S pole detection	3.0 mT typ.
S-5741NBL2-M3T2U	Nch open-drain output	Bipolar latch	$V_{OUT} = "L"$ at S pole detection	6.0 mT typ.
S-5741RBL0-M3T2U	Nch driver + built-in pull-up resistor	Bipolar latch	$V_{OUT} = "L"$ at S pole detection	1.8 mT typ.
S-5741RBL1-M3T2U	Nch driver + built-in pull-up resistor	Bipolar latch	$V_{OUT} = "L"$ at S pole detection	3.0 mT typ.
S-5741RBH1-M3T2U	Nch driver + built-in pull-up resistor	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



**Table 3**

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

**Figure 3**

■ **Absolute Maximum Ratings**

**Table 4**

(Ta = +25°C unless otherwise specified)

Item	Symbol	Absolute Maximum Rating	Unit
Power supply voltage	V <sub>DD</sub>	V <sub>SS</sub> – 0.3 to V <sub>SS</sub> + 28.0	V
Output current	I <sub>OUT</sub>	20	mA
Output voltage	Nch open-drain output product	V <sub>OUT</sub>	V <sub>SS</sub> – 0.3 to V <sub>SS</sub> + 28.0
	Nch driver + built-in pull-up resistor product		V <sub>SS</sub> – 0.3 to V <sub>DD</sub> + 0.3
Power dissipation	P <sub>D</sub>	430*1	mW
Operation ambient temperature	T <sub>opr</sub>	–40 to +85	°C
Storage temperature	T <sub>stg</sub>	–40 to +125	°C

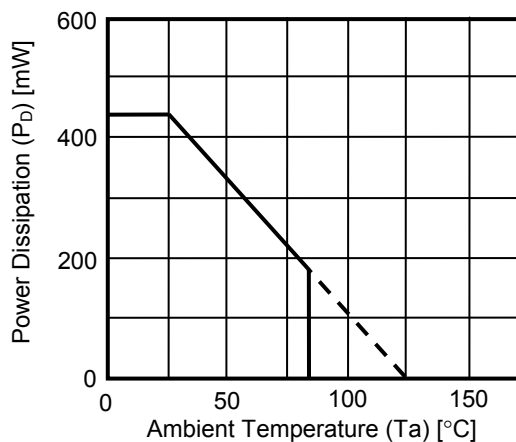
\*1. When mounted on board

[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<sub>DD</sub> = 12.0 V, V<sub>SS</sub> = 0 V unless otherwise specified)

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

■ **Magnetic Characteristics**

**1. Product with  $B_{OP} = 1.8 \text{ mT typ.}$**

**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* <sup>1</sup>	S pole	$B_{OP}$	–	0.3	1.8	3.3	mT	4
Release point* <sup>2</sup>	N pole	$B_{RP}$	–	–3.3	–1.8	–0.3	mT	4
Hysteresis width* <sup>3</sup>		$B_{HYS}$	$B_{HYS} = B_{OP} - B_{RP}$	–	3.6	–	mT	4

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

**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* <sup>1</sup>	S pole	$B_{OP}$	–	1.5	3.0	4.5	mT	4
Release point* <sup>2</sup>	N pole	$B_{RP}$	–	–4.5	–3.0	–1.5	mT	4
Hysteresis width* <sup>3</sup>		$B_{HYS}$	$B_{HYS} = B_{OP} - B_{RP}$	–	6.0	–	mT	4

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

**Table 8**

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

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Test Circuit
Operation point* <sup>1</sup>	S pole	$B_{OP}$	–	3.0	6.0	9.0	mT	4
Release point* <sup>2</sup>	N pole	$B_{RP}$	–	–9.0	–6.0	–3.0	mT	4
Hysteresis width* <sup>3</sup>		$B_{HYS}$	$B_{HYS} = B_{OP} - B_{RP}$	–	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-5741 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-5741 Series by the magnet (N pole) is increased (by moving the magnet closer).

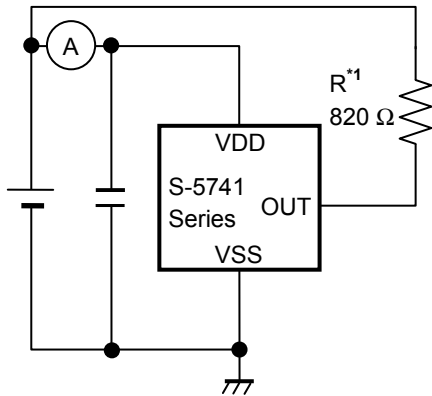
$V_{OUT}$  retains the status until a magnetic flux density of the S pole higher than  $B_{OP}$  is applied.

**\*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

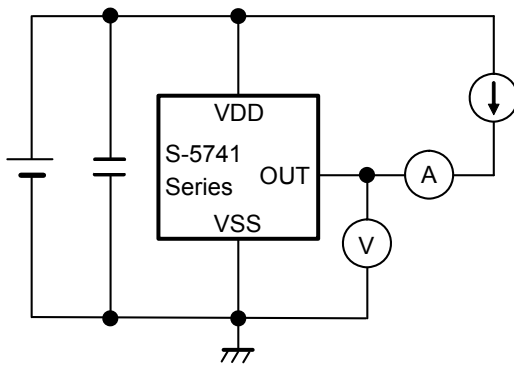


Figure 6 Test Circuit 2

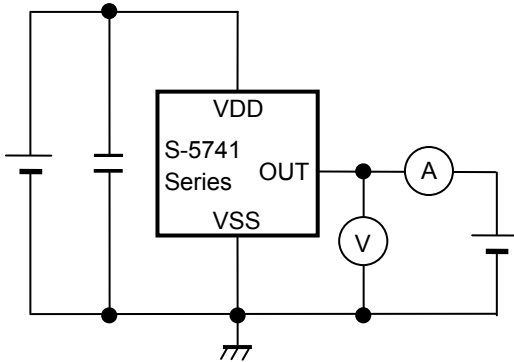
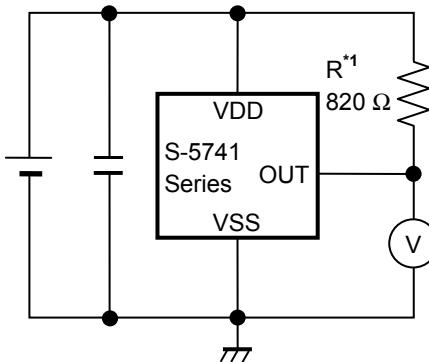


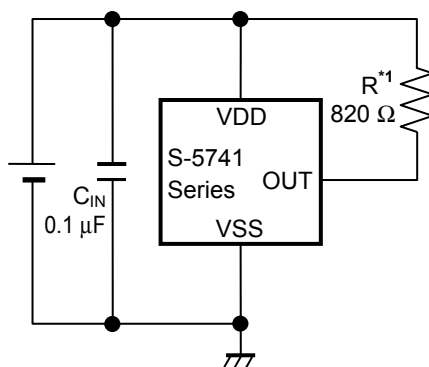
Figure 7 Test Circuit 3



\*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-5741 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.

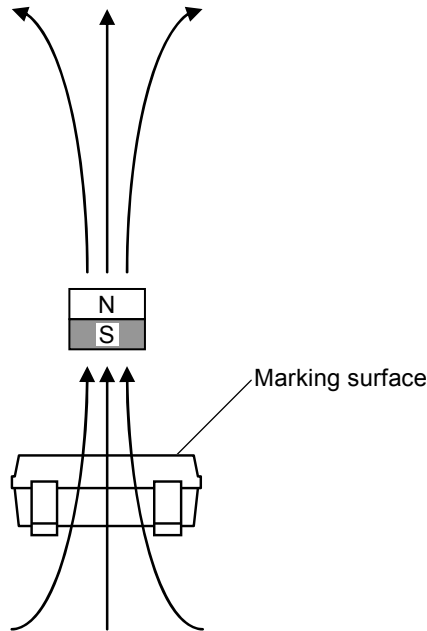


Figure 10

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.

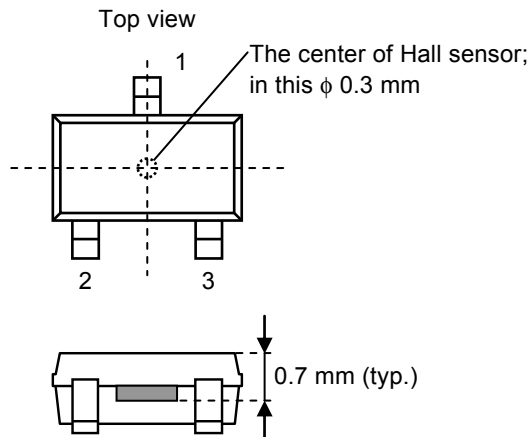


Figure 11

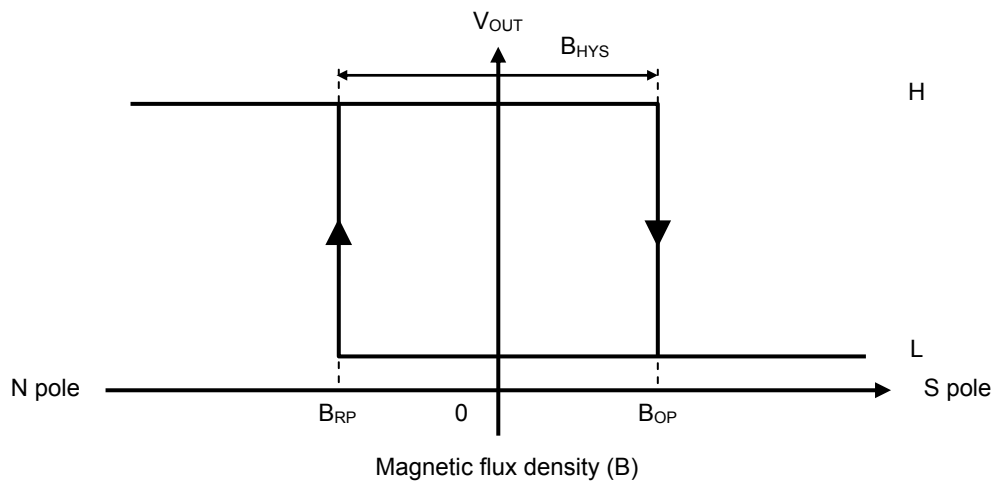
**3. Basic operation**

The S-5741 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-5741 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-5741 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  $V_{OUT}$ .

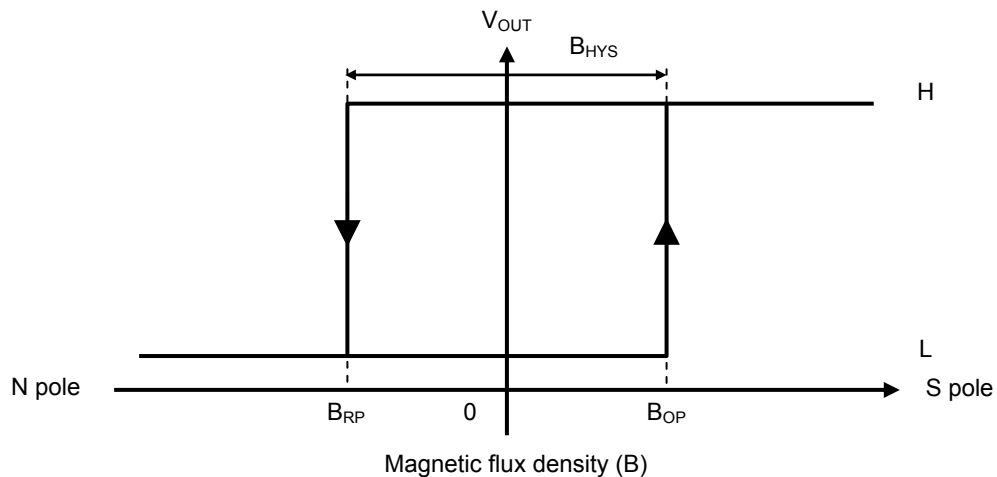


**Figure 12**

**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-5741 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-5741 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.

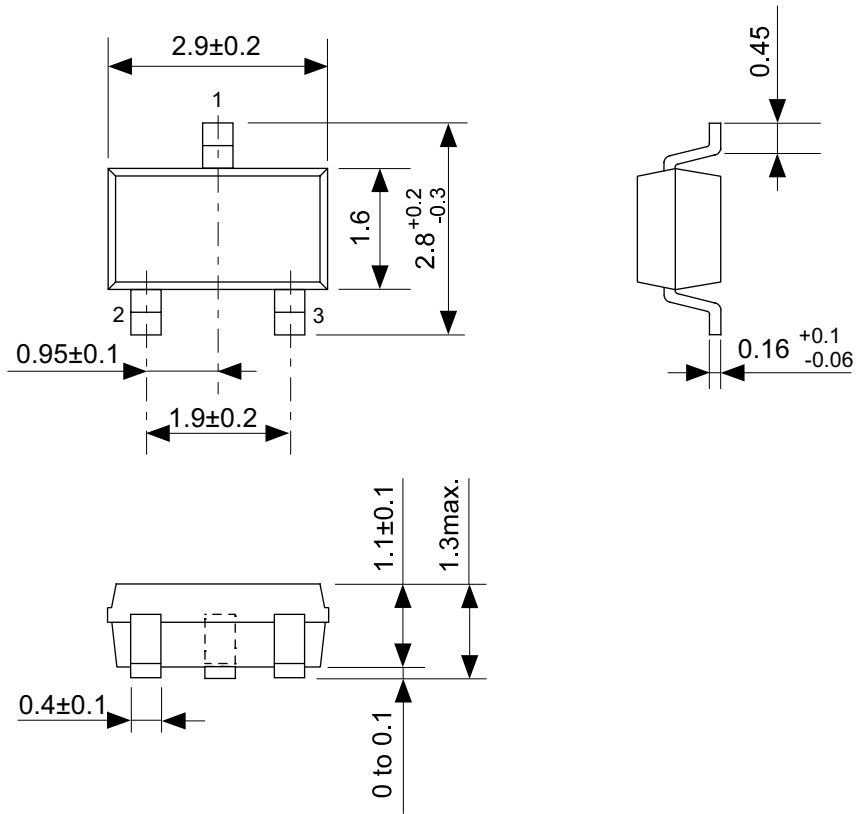
**Figure 13** shows the relationship between the magnetic flux density and  $V_{OUT}$ .




**Figure 13**

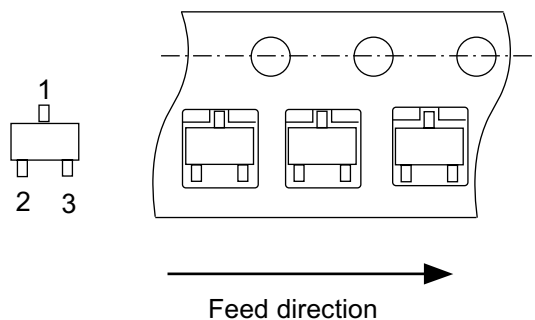
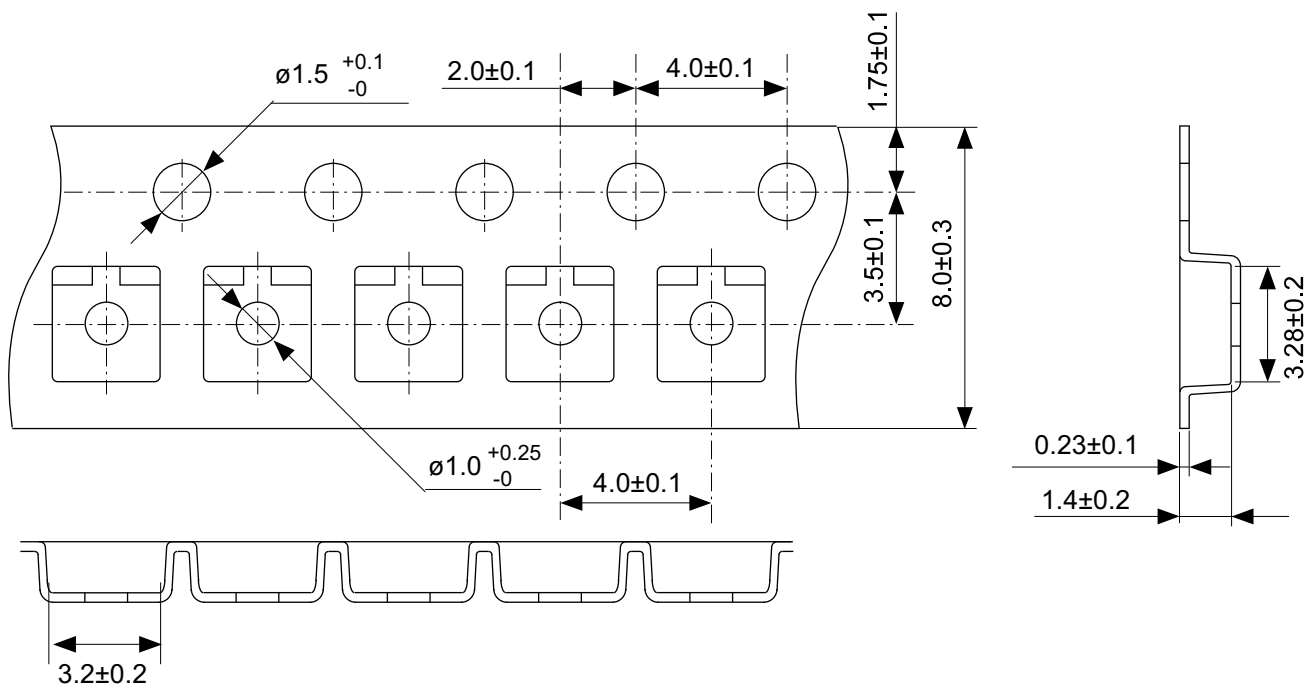
**■ Precautions**

- 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.
- 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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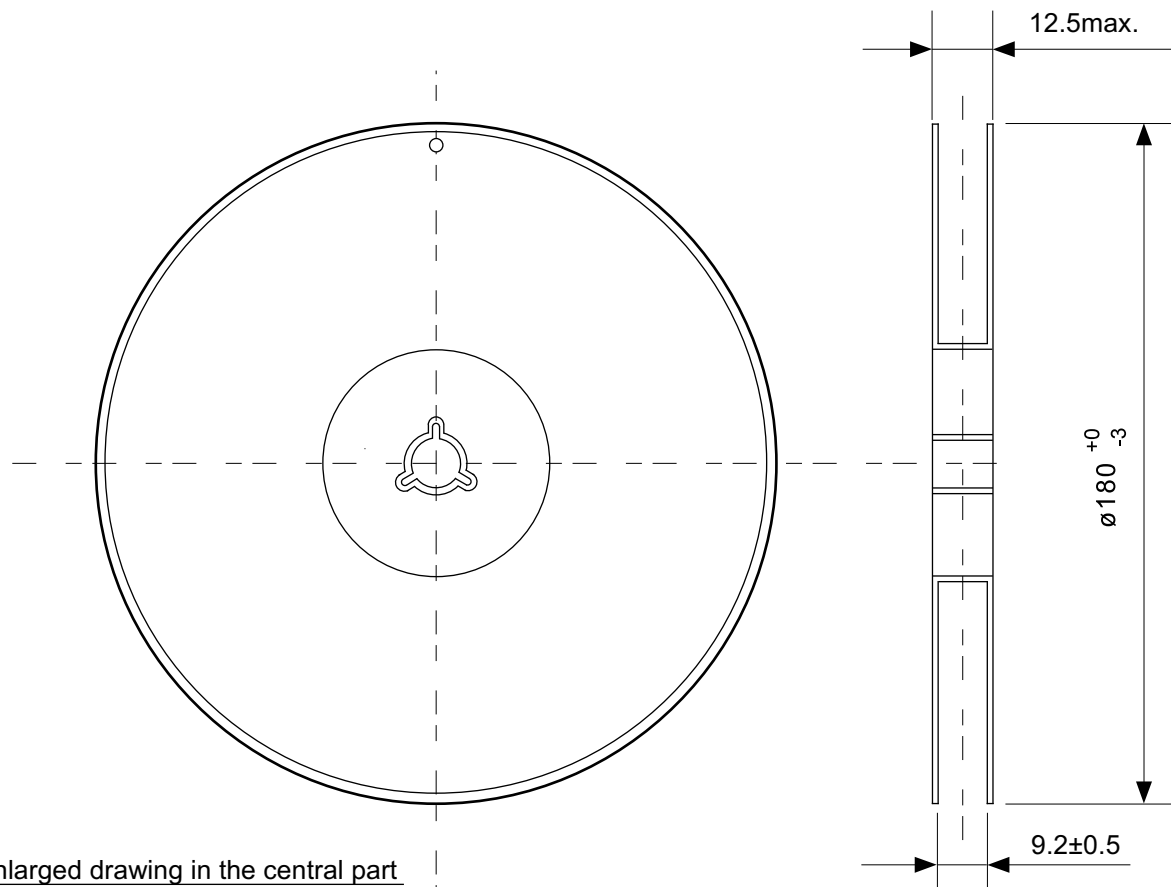
No. MP003-C-P-SD-1.1

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

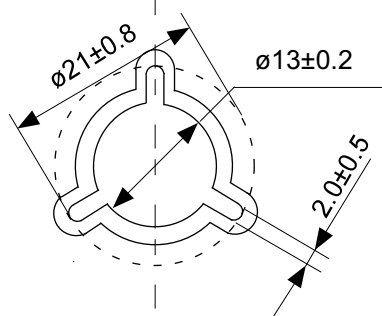


No. MP003-C-C-SD-2.0

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



Enlarged 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		
SII Semiconductor Corporation			

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