S-57A1 A Series

FOR AUTOMOTIVE 125°C OPERATION HIGH-WITHSTAND VOLTAGE HIGH-SPEED UNIPOLAR DETECTION TYPE HALL IC

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Rev.1.3_00

The S-57A1 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-57A1 A Series detects the intensity level of magnetic flux density. Using the S-57A1 A Series with a magnet makes it possible to detect the open / close and rotation status in various devices.
The S-57A1 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-57A1 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[*1]: Detection of S pole, detection of N pole
- Detection logic for magnetism[*1]: Active "L", active "H"[*2]
- Output form[*1]: Nch open-drain output, Nch driver + built-in pull-up resistor
- Magnetic sensitivity[*1]: B_{OP} = 3.0 mT typ., B_{OP} = 6.0 mT typ.
- Operating cycle: t_{CYCLE} = 16.0 µs typ.
- Power supply voltage range: V_{DD} = 3.5 V to 26.0 V
- Built-in regulator
- Built-in reverse voltage protection circuit
- Built-in output current limit circuit
- Operation temperature range: Ta = −40°C to +125°C
- Lead-free (Sn 100%), halogen-free
- AEC-Q100 in process[*3]

***1.** The option can be selected.
***2.** Under development
***3.** Contact our sales office for details.

■ Applications

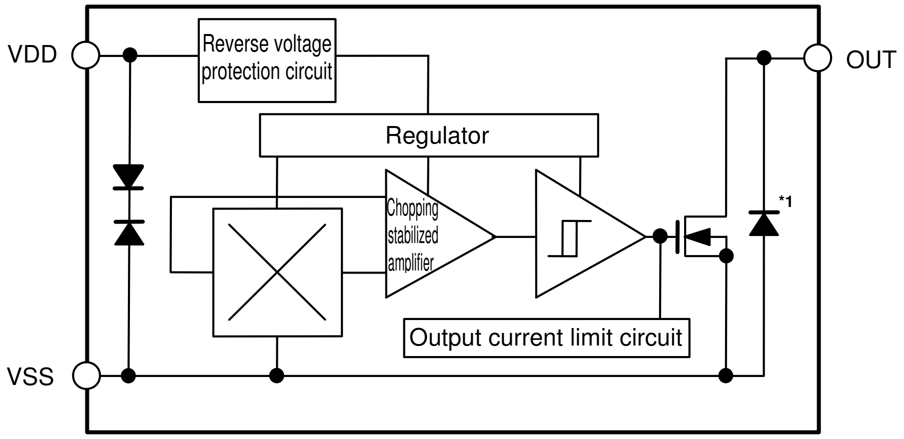
- Automobile equipment
- Home appliance
- DC brushless motor
- Housing equipment
- Industrial equipment

■ Package

- SOT-23-3

■ Block Diagrams

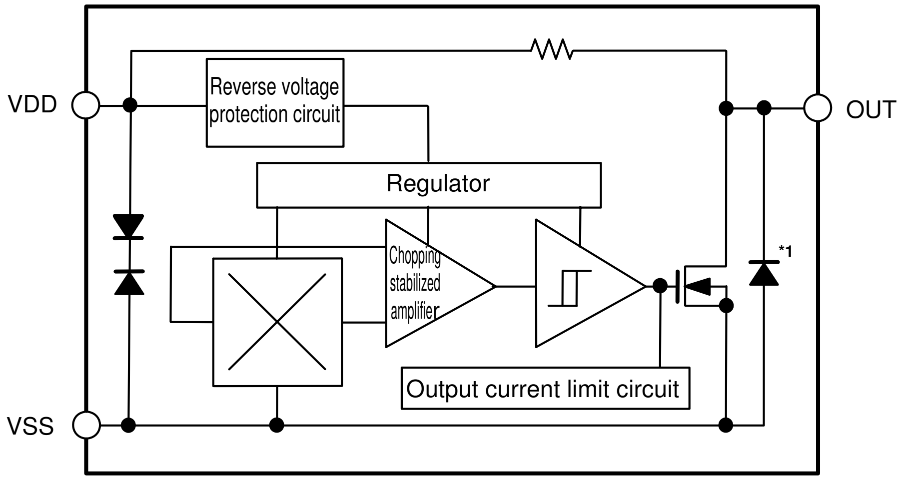
1. Nch open-drain output product



***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

S-57A1 x x x x A - M3T2 U

Environmental code
U: Lead-free (Sn 100%), halogen-free

Package name (abbreviation) and packing specifications*1
M3T2: SOT-23-3, Tape

Operation temperature
A: Ta = −40°C to +125°C

Magnetic sensitivity
1: B_{OP} = 3.0 mT typ.
2: B_{OP} = 6.0 mT typ.

Detection logic for magnetism
L: Active "L"
H: Active "H"*2

Pole detection
S: Detection of S pole
N: Detection of N pole

Output form
N: Nch open-drain output
R: Nch driver + built-in pull-up resistor

***1.** Refer to the tape drawing.
***2.** Under development

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-57A1NSL1A-M3T2U	Nch open-drain output	S pole	Active "L"	3.0 mT typ.
S-57A1NSL2A-M3T2U	Nch open-drain output	S pole	Active "L"	6.0 mT typ.
S-57A1NNL2A-M3T2U	Nch open-drain output	N pole	Active "L"	6.0 mT typ.
S-57A1RSL1A-M3T2U	Nch driver + built-in pull-up resistor	S pole	Active "L"	3.0 mT typ.

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

■ Pin Configuration

1. SOT-23-3

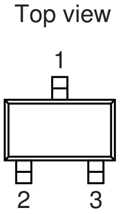


Figure 3

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.

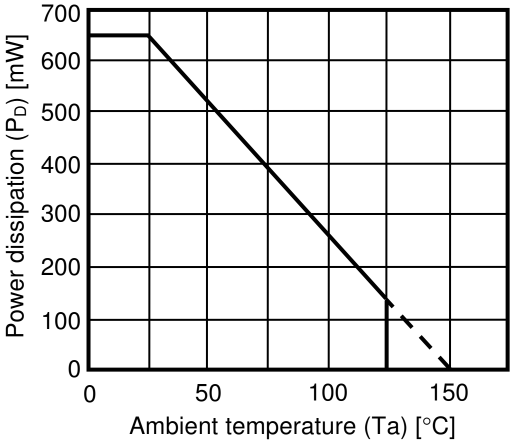


Figure 4 Power Dissipation of Package (When Mounted on Board)

■ 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}	–	–	16.0	–	μs	–
Operating frequency	f_{CYCLE}	–	–	62.5	–	kHz	–
Output limit current	I_{OM}	V_{OUT} = 12.0 V	22	–	70	mA	3
Start up time	t_{PON}	–	–	30	–	μs	4
Pull-up resistor	R_L	Nch driver + built-in pull-up resistor product	7	10	13	kΩ	–

■ Magnetic Characteristics

1. Product with S pole detection

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

Table 6

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

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Test Circuit
Operation point[*1]	S pole	B_{OPS}	–	1.5	3.0	4.5	mT	4
Release point[*2]	S pole	B_{RPS}	–	1.0	2.0	3.3	mT	4
Hysteresis width[*3]	S pole	B_{HYSS}	$B_{HYSS} = B_{OPS} - B_{RPS}$	–	1.0	–	mT	4

1. 2 Product with B_{OP} = 6.0 mT typ.

Table 7

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

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Test Circuit
Operation point[*1]	S pole	B_{OPS}	–	3.0	6.0	9.0	mT	4
Release point[*2]	S pole	B_{RPS}	–	2.5	4.5	7.5	mT	4
Hysteresis width[*3]	S pole	B_{HYSS}	$B_{HYSS} = B_{OPS} - B_{RPS}$	–	1.5	–	mT	4

2. Product with N pole detection

2. 1 Product with B_{OP} = 6.0 mT typ.

Table 8

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

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Test Circuit
Operation point[*1]	N pole	B_{OPN}	–	−9.0	−6.0	−3.0	mT	4
Release point[*2]	N pole	B_{RPN}	–	−7.5	−4.5	−2.5	mT	4
Hysteresis width[*3]	N pole	B_{HYSN}	$B_{HYSN} = \lvert B_{OPN} - B_{RPN} \rvert$	–	1.5	–	mT	4

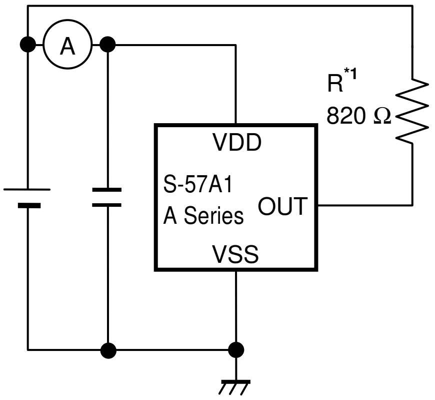
***1.** B_{OPN}, B_{OPS}: Operation points
B_{OPN} and B_{OPS} are the values of magnetic flux density when the output voltage (V_{OUT}) changes after the magnetic flux density applied to the S-57A1 A Series by the magnet (N pole or S pole) is increased (by moving the magnet closer).
Even when the magnetic flux density exceeds B_{OPN} or B_{OPS}, V_{OUT} retains the status.

***2.** B_{RPN}, B_{RPS}: Release points
B_{RPN} and B_{RPS} are the values of magnetic flux density when the output voltage (V_{OUT}) changes after the magnetic flux density applied to the S-57A1 A Series by the magnet (N pole or S pole) is decreased (the magnet is moved further away).
Even when the magnetic flux density falls below B_{RPN} or B_{RPS}, V_{OUT} retains the status.

***3.** B_{HYSN}, B_{HYSS}: Hysteresis widths
B_{HYSN} and B_{HYSS} are the difference between B_{OPN} and B_{RPN}, and B_{OPS} and B_{RPS}, respectively.

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 pull-up resistor built-in product.

Figure 5 Test Circuit 1

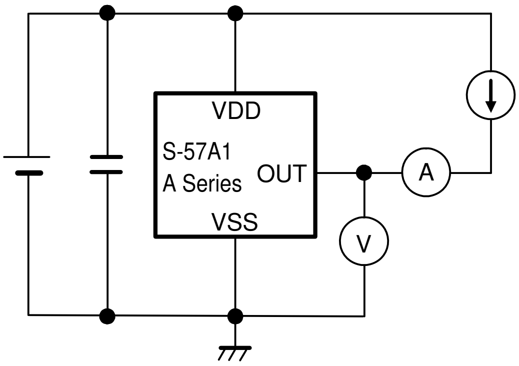


Figure 6 Test Circuit 2

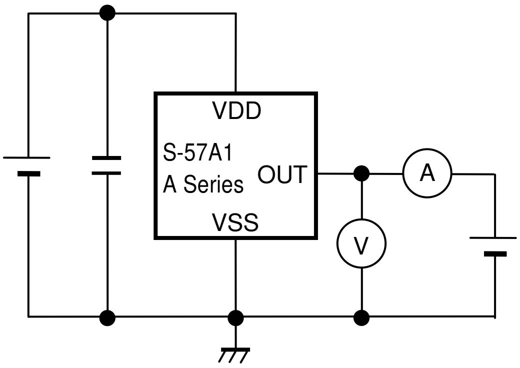
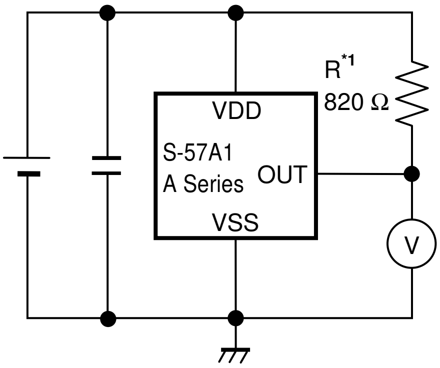


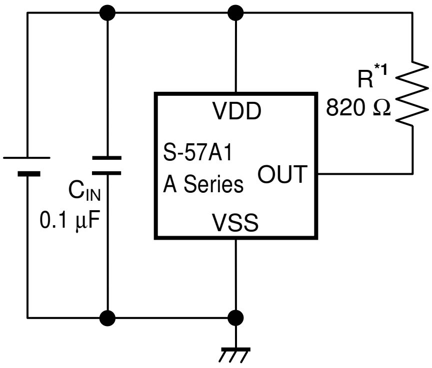
Figure 7 Test Circuit 3



*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-57A1 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.

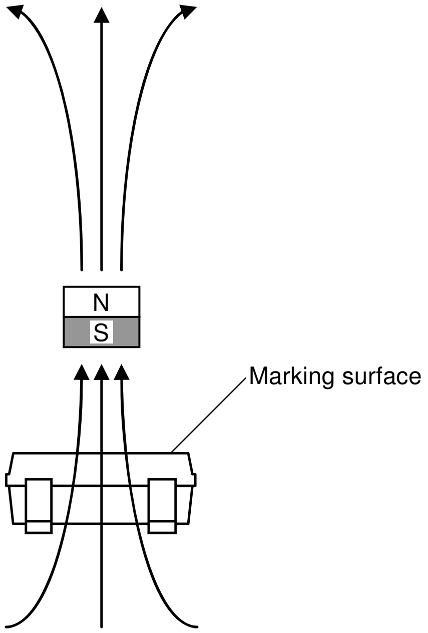


Figure 10

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.

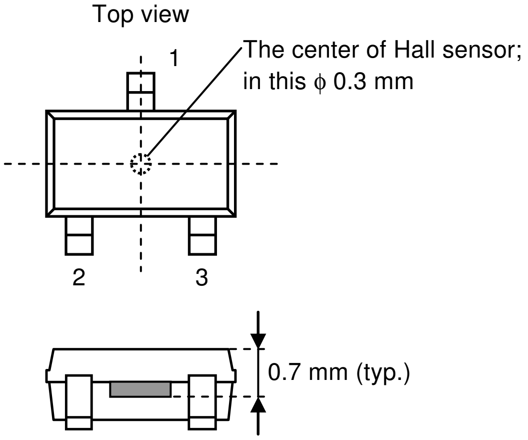


Figure 11

3. Basic operation

The S-57A1 A Series changes the output voltage (V_{OUT}) according to the level of the magnetic flux density (N pole or S pole) applied by a magnet.
Definition of the magnetic field is performed every operating cycle indicated in "■ **Electrical Characteristics**".
The following explains the operation when the magnetism detection logic is active "L".

3. 1 Product with S pole detection

When the magnetic flux density of the S pole perpendicular to the marking surface exceeds the operation point (B_{OPS}) after the S pole of a magnet is moved closer to the marking surface of the S-57A1 A Series, V_{OUT} changes from "H" to "L". When the S pole of a magnet is moved further away from the marking surface of the S-57A1 A Series 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}.

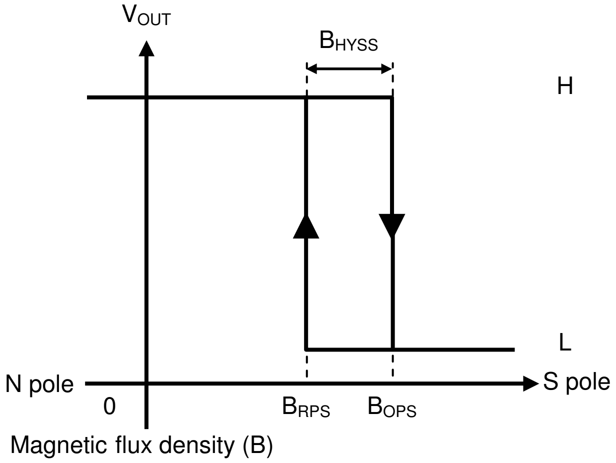


Figure 12

3. 2 Product with N pole detection

When the magnetic flux density of the N pole perpendicular to the marking surface exceeds the operation point (B_{OPN}) after the N pole of a magnet is moved closer to the marking surface of the S-57A1 A Series, V_{OUT} changes from "H" to "L". When the N pole of a magnet is moved further away from the marking surface of the S-57A1 A Series and the magnetic flux density of the N pole is lower than the release point (B_{RPN}), V_{OUT} changes from "L" to "H".
Figure 13 shows the relationship between the magnetic flux density and V_{OUT}.

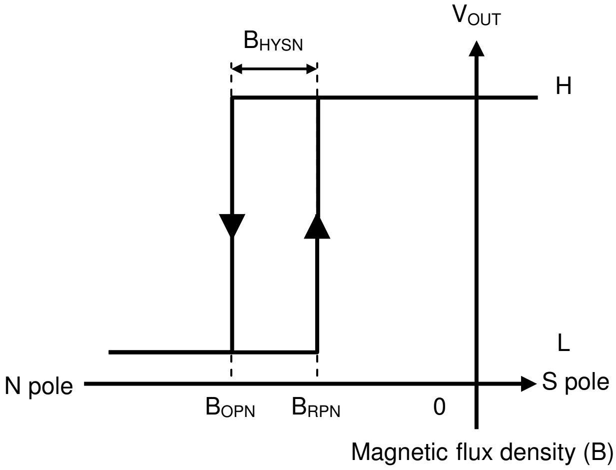


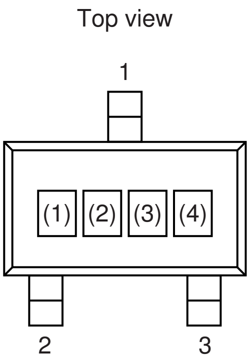
Figure 13

■ 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.
- Note that the output voltage may rarely change if the magnetic flux density between the operation point and the release point is applied to this IC continuously for a long time.
- 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 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 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.
- SII 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

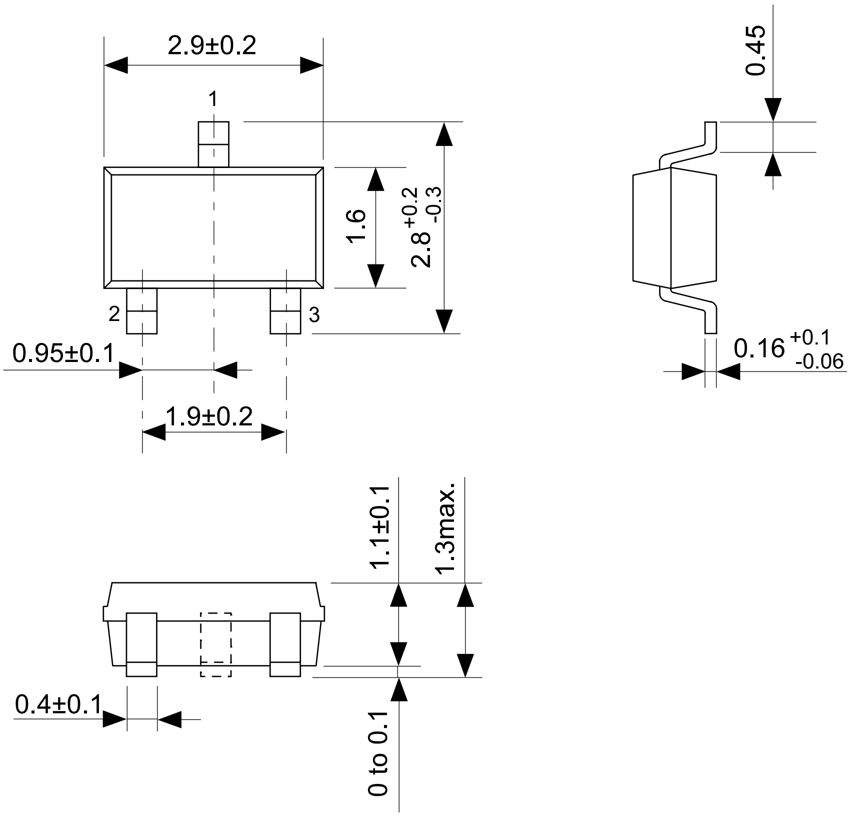
1. SOT-23-3



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

Product name vs. Product code

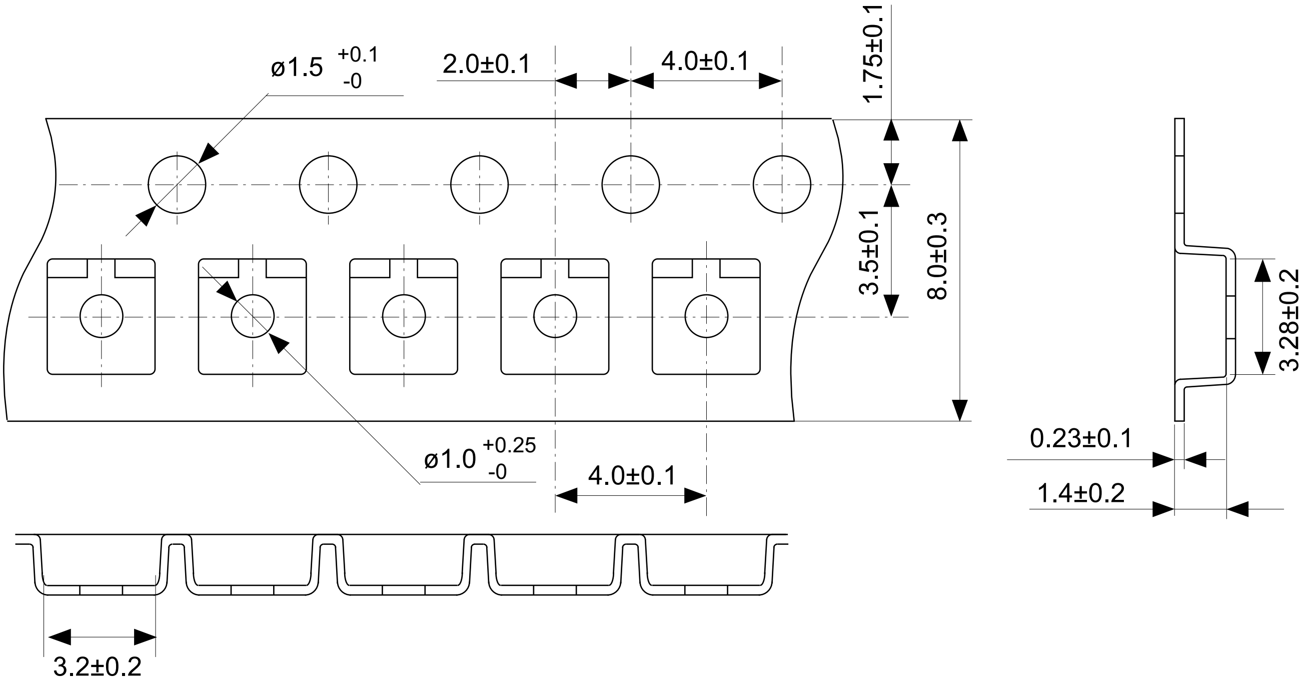
Product Name	Product Code		
	(1)	(2)	(3)
S-57A1NSL1A-M3T2U	Y	Y	E
S-57A1NSL2A-M3T2U	Y	Y	F
S-57A1NNL2A-M3T2U	Y	Y	H
S-57A1RSL1A-M3T2U	Y	Y	G

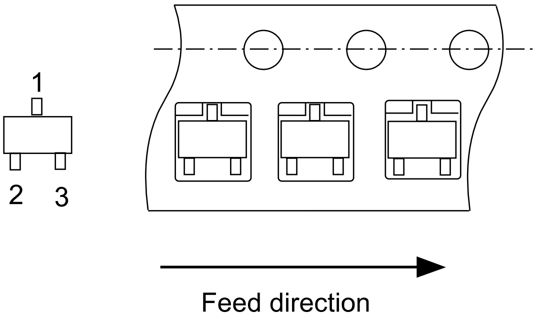


No. MP003-C-P-SD-1.0

TITLE	SOT233-C-PKG Dimensions
No.	MP003-C-P-SD-1.0
SCALE	
UNIT	mm

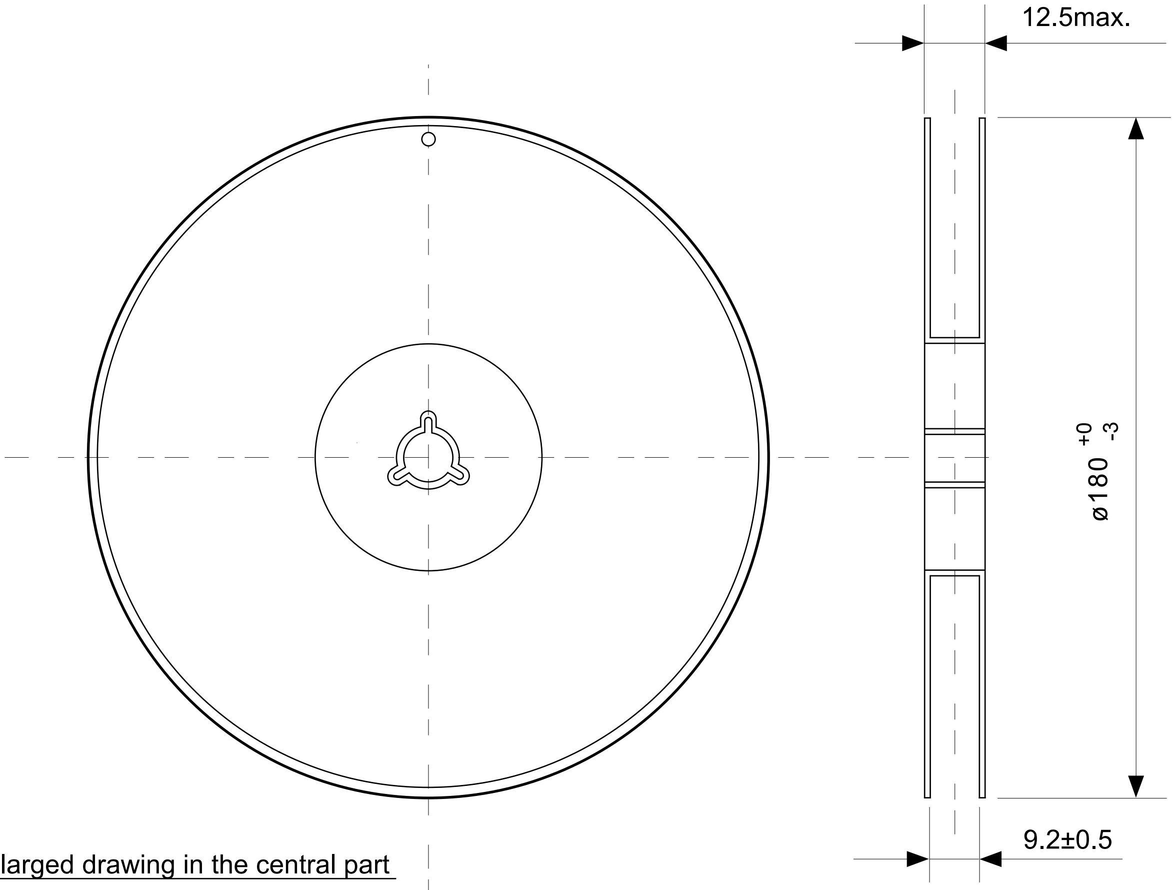
Seiko Instruments Inc.



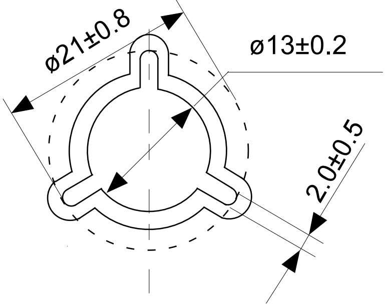


No. MP003-C-C-SD-2.0

TITLE	SOT233-C-Carrier Tape
No.	MP003-C-C-SD-2.0
SCALE	
UNIT	mm
Seiko Instruments Inc.	



Enlarged drawing in the central part



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.			

SII

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