TEMPERATURE SWITCH IC (THERMOSTAT IC) WITH LATCH

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The S-5840B Series is a temperature switch IC (thermostat IC) with a latch function which detects the temperature with a temperature accuracy of ±2.5°C. When the temperature reaches the detection temperature, the output signal is inverted and being latched until the S-5840B Series detects decrease in a power supply voltage.
The S-5840B Series operates at the lower power supply voltage of 1.0 V and its current consumption is 12 μA typ. due to CMOS configuration.
The S-5840B Series has a temperature sensor using negative temperature coefficient, a reference voltage generation circuit, comparator, voltage detection circuit and noise suppression circuit on a chip, and they are enclosed in package SOT-23-5.

■ Features

- Detection temperature: T_{DET} = +55 to +95°C, +1°C step, detection accuracy: ±2.5°C
- Wide voltage operation: V_{DD} = 1.0 V to 10.0 V
- Release voltage: V_{RET} = 2.2 V to 3.4 V, 0.1 V step
- Low current consumption: I_{DD} = 12 μA typ. (Ta = +25°C).
- Built-in noise suppression circuit for preventing temperature detection malfunction
- Output logic level is fixed by the latch after temperature detection.
- Selectable output logic in active "H" or "L"
- Selectable output form in CMOS or Nch open drain
- Operation temperature range: Ta = −40°C to +100°C
- Lead-free, Sn 100%, halogen-free*1

***1.** Refer to "■ **Product Name Structure**" for details.

■ Applications

- Game console
- Electronic device

■ Package

- SOT-23-5

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■ Block Diagrams

1. CMOS output product

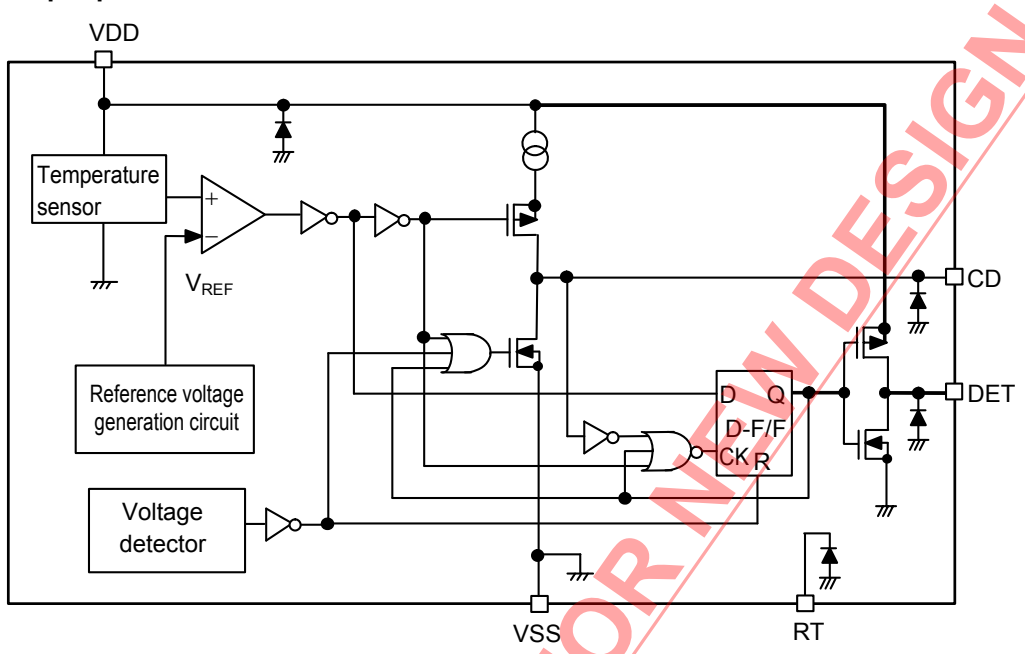


Figure 1

2. Nch open drain output product

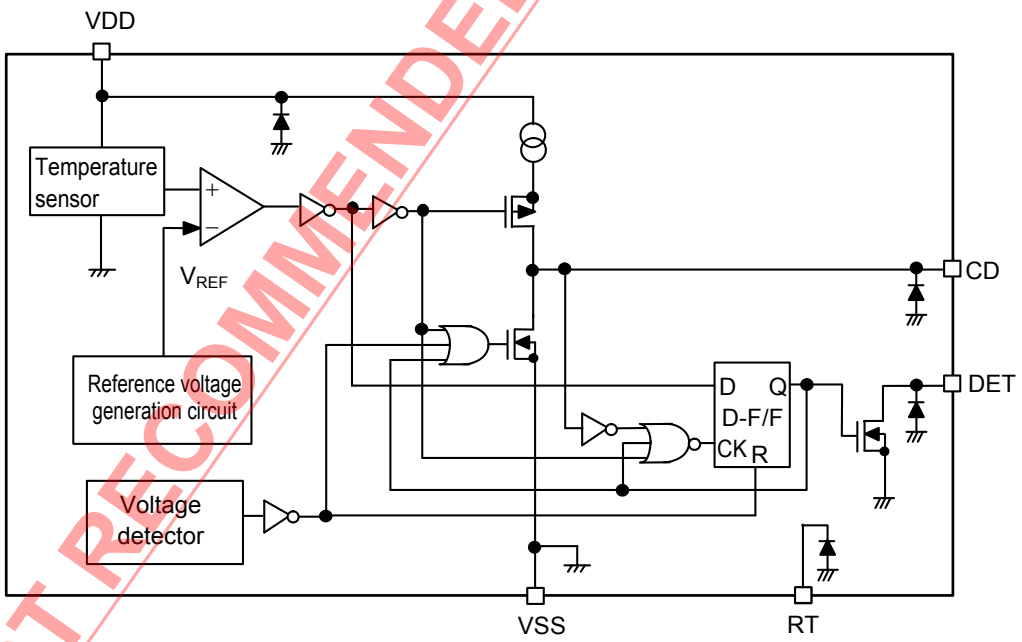


Figure 2

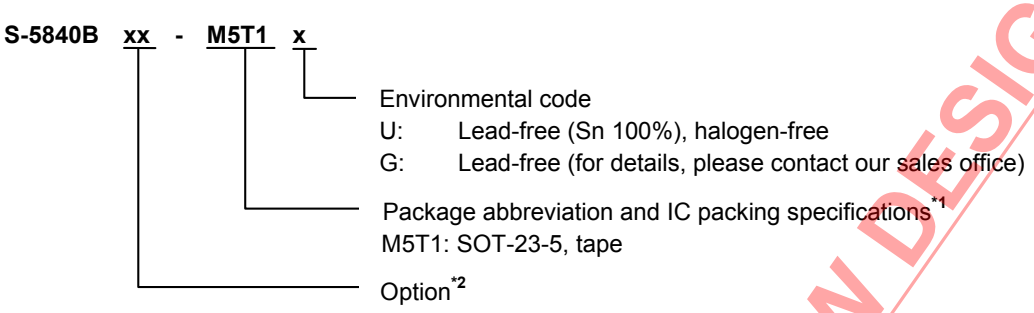
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■ Product Name Structure

Users are able to select the option for detection temperature, output form and logic, release voltage for the S-5840B Series.

1. Product name



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

***2.** Option list

- The detection temperature (T_{DET}) can be set in the range of +55°C to +95° at 1°C step.
- The DET pin output can be selected the output logic in active "H" or "L".
- The DET pin output can be selected the output form in CMOS or Nch open drain.
- The release voltage (V_{RET}) can be set in the range of 2.2 V to 3.4 V at 0.1 V step.

2. Package

Table 1 Package Drawing Codes

Package Name	Dimension	Tape	Reel
SOT-23-5	MP005-A-P-SD	MP005-A-C-SD	MP005-A-R-SD

3. Product name list

Table 2

Product Name	Detection Temperature (T_{DET})	DET Pin Output Form	DET Pin Output Logic	Release Voltage (V_{RET})
S-5840BAG-M5T1x	+60°C	CMOS	Active "L"	2.9 V
S-5840BAH-M5T1x	+90°C	CMOS	Active "H"	2.9 V
S-5840BAJ-M5T1x	+80°C	Nch open drain	Active "L"	2.2 V

Remark 1. Please contact our sales office for options other than that specified above.

2. x: G or U

3. Please select products of environmental code = U for Sn 100%, halogen-free products.

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■ Pin Configuration

1. SOT-23-5

Top view

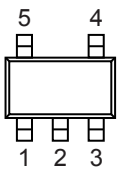


Figure 3

Table 3

Pin No.	Symbol	Description
1	RT*1	Test pin
2	VSS	GND pin
3	CD	Capacitor connection pin for setting malfunction prevention time
4	DET	Output pin
5	VDD	Power supply pin

***1.** Set the RT pin open in use.

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■ Absolute Maximum Ratings

Table 4

(Ta = +25°C unless otherwise specified)

Item		Symbol	Absolute Maximum Rating	Unit
Power supply voltage (V_{SS} = 0 V)		V_{DD}	V_{SS} + 12	V
Pin voltage		V_{RT}, V_{CD}	V_{SS} − 0.3 to V_{DD} + 0.3	V
Output voltage	CMOS output	V_{DET}	V_{SS} − 0.3 to V_{DD} + 0.3	V
	Nch open drain output		V_{SS} − 0.3 to V_{SS} + 12.0	V
Power dissipation		P_D	300 (when not mounted on board)	mW
			600 *1	mW
Operating temperature		T_{opr}	−40 to +100	°C
Storage temperature		T_{stg}	−55 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.

■ Recommended Values for External Parts

Table 5

Item	Symbol	Value	Unit
CD capacitance	C_D	4.7	nF

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■ DC Electrical Characteristics

1. CMOS output product

Table 6

(Ta = +25°C, unless otherwise specified)

Item	Symbol	Condition		Min.	Typ.	Max.	Unit	Test Circuit
Power supply voltage	V_{DD}	–		1.0	–	10.0	V	1
Detection temperature	$+T_D$	–		$T_{DET} - 2.5$	T_{DET}	$T_{DET} + 2.5$	°C	1
Output current	I_{DETH}	V_{DD} = 3.5 V, Apply to DET pin	V_{DET} = 2.7 V	2	9.4	–	mA	2
	I_{DETL}		V_{DET} = 0.4 V	0.5	2.8	–	mA	2
Release voltage for built-in voltage detector	V_R	–		$V_{RET} \times 0.98$	V_{RET}	$V_{RET} \times 1.02$	V	–
Hysteresis width for built-in voltage detector	V_{HYS}	–		–	$V_{RET} \times 0.05$	–	V	–
Temperature coefficient for built-in voltage detector	$\frac{\Delta V_{RET}}{\Delta Ta \bullet V_{RET}}$	Ta = −40°C to +100°C		–	±100	–	ppm/°C	–
Current consumption during operation	I_{DD}	V_{DD} = 3.5 V		–	12	24	μA	1

2. Nch open drain output product

Table 7

(Ta = +25°C, unless otherwise specified)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Test Circuit
Power supply voltage	V_{DD}	–	1.0	–	10.0	V	1
Detection temperature	$+T_D$	–	$T_{DET} - 2.5$	T_{DET}	$T_{DET} + 2.5$	°C	1
Output current	I_{DETL}	V_{DET} = 0.4 V, V_{DD} = 3.5 V	0.5	2.8	–	mA	2
	I_{LEAK}	V_{DET} = 10.0 V, V_{DD} = 3.5 V	–	–	100	nA	2
Release voltage for built-in voltage detector	V_R	–	$V_{RET} \times 0.98$	V_{RET}	$V_{RET} \times 1.02$	V	–
Hysteresis width for built-in voltage detector	V_{HYS}	–	–	$V_{RET} \times 0.05$	–	V	–
Temperature coefficient for built-in voltage detector	$\frac{\Delta V_{RET}}{\Delta Ta \bullet V_{RET}}$	Ta = −40°C to +100°C	–	±100	–	ppm/°C	–
Current consumption during operation	I_{DD}	V_{DD} = 3.5 V	–	12	24	μA	1

■ AC Electrical Characteristics

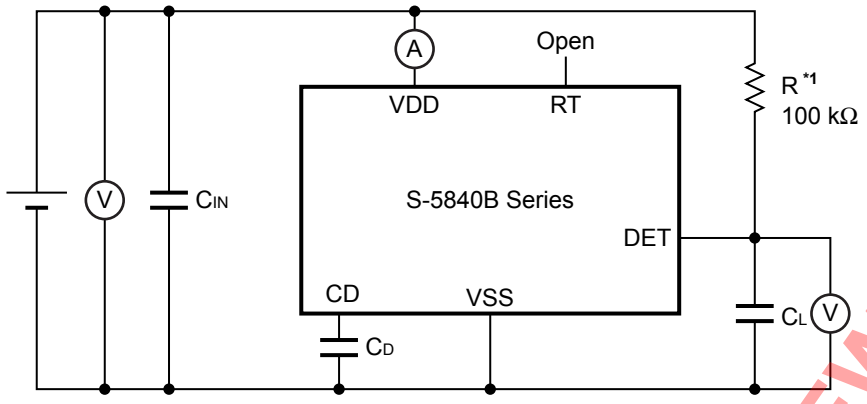
Table 8

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Test Circuit
Noise suppression time	t_{noise}	C_D = 4.7 nF, V_{DD} = 3.5 V, Ta = detection temperature	10	30	50	ms	–

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■ Test Circuits



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

Figure 4 Test Circuit 1

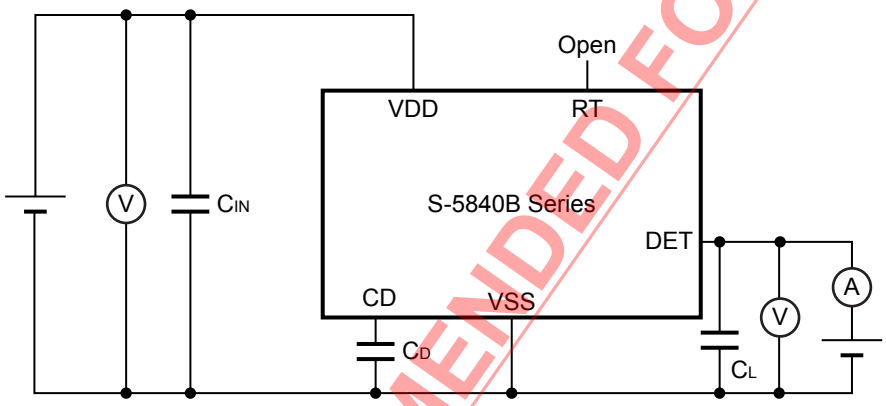


Figure 5 Test Circuit 2

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■ Operation

1. Basic operation

The S-5840B Series is a temperature switch IC (thermostat IC) which detects the temperature and sends a signal to an external device. The users can select a combination of the parameters such as detection temperature and release voltage.

Following is about the operation when the DET pin output logic is active "H".
When the power supply voltage is turned on, the DET pin voltage goes to "L" since the flip-flop circuit in the detection circuit is cleared by the voltage detection circuit. Temperature detection then starts and the DET pin is held "L" as long as the temperature is lower than the detection temperature. When the temperature rises and when the temperature exceeds the detection temperature; longer than the time defined by the capacitor connected to the CD pin, the DET pin goes to "H". Once the over-temperature is detected and the DET pin goes to "H", the state is held by the flip-flop circuit. In order to release the state, the power supply voltage should be set under the detection voltage ($V_R - V_{HYS}$) of the built-in voltage detector circuit to reset the internal circuit.
Using the internal reference voltage and built-in temperature sensor, a detection temperature accuracy of ±2.5°C is achieved in the S-5840B Series.

2. Noise suppression circuit

The noise suppression circuit prevents malfunction of the temperature switch caused by noise.
The noise suppression circuit starts charging the capacitor connected to the CD pin when the output of the internal comparator enters the active state due to an external noise or a rapid change in the power supply voltage. In the normal operation, the flip-flop circuit is set when the capacitor is charged to a certain voltage. But in the noise triggered operation, the comparator output goes back to the inactive state and the CD pin voltage is held "L" since the charging of the external capacitor (C_D) is insufficient. As a result, the DET pin is held "L" and malfunction does not occur.

Noise suppression time (t_{noise}) is determined by the time constant consisting of internal constant current and the capacitance of the C_D, and calculated by the following equation.

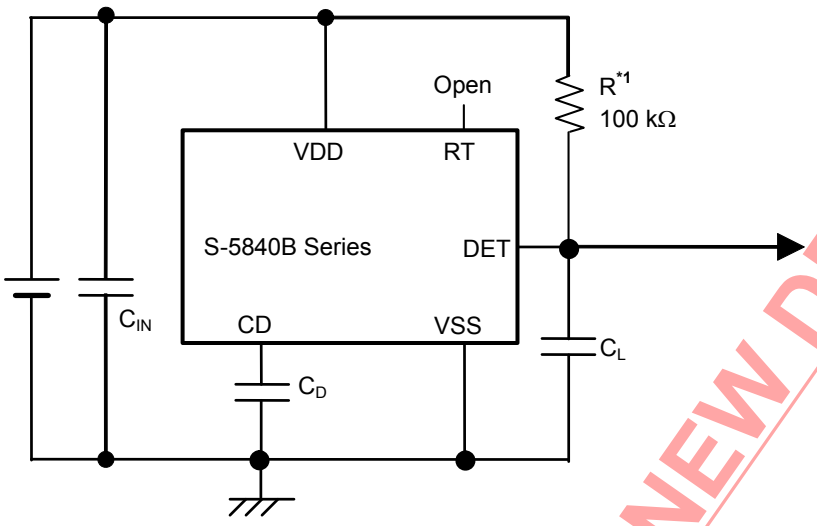
t_{noise} (ms) = Noise suppression time coefficient × C_D (nF)
Noise suppression time coefficient (Ta = +25°C): 6.4 typ.

The C_D has no limitation as long as its leak current is negligible compared to the internal constant current. The difference occurs in delay time if the capacitor has a leak current.

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■ Standard Circuit



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

Figure 6

Caution The above connection diagram will not guarantee successful operation. Perform thorough evaluation using actual application to set the constant.

■ Precautions

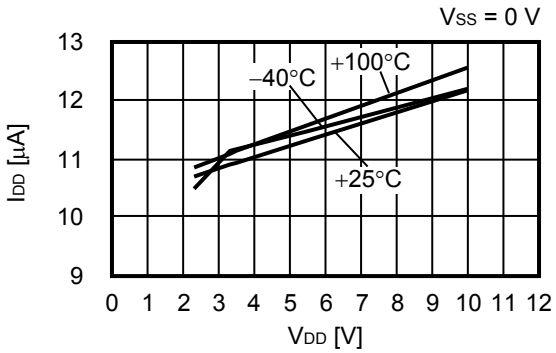
- Set a capacitor (C_{IN}) of 0.1 μF or more between VDD and VSS pin for stabilization.
- A capacitor (C_L) of about 1 μF should be connected to the DET pin to prevent malfunction caused by noise due to the power being on.
- Do not connect a capacitor to the RT pin (leave the RT pin open). Otherwise, this IC may oscillate.
- Do not apply an electrostatic discharge to this IC that exceeds the performance ratings of the built-in electrostatic protection circuit.
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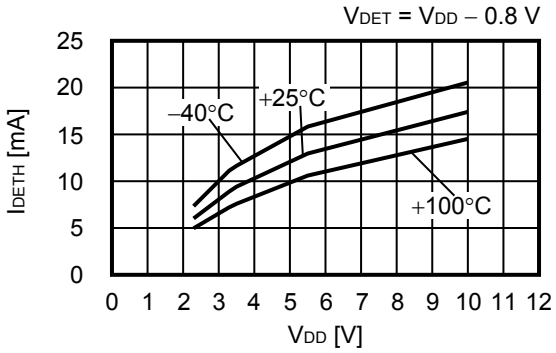
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■ Characteristics (Typical Data)

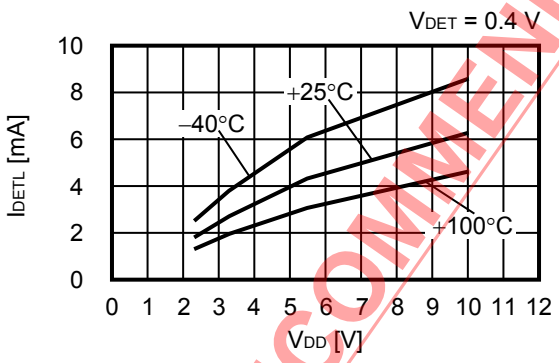
1. Current consumption vs. Power supply voltage characteristics



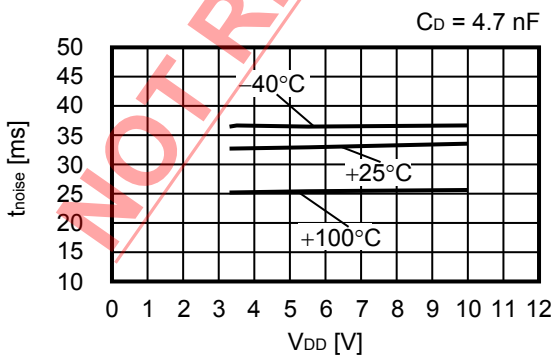
2. DET pin current "H" vs. Power supply voltage characteristics (CMOS output product only)



3. DET pin current "L" vs. Power supply voltage characteristics



4. Noise suppression time vs. Power supply voltage characteristics



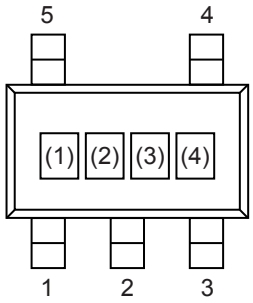
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■ Marking Specification

1. SOT-23-5

Top view



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

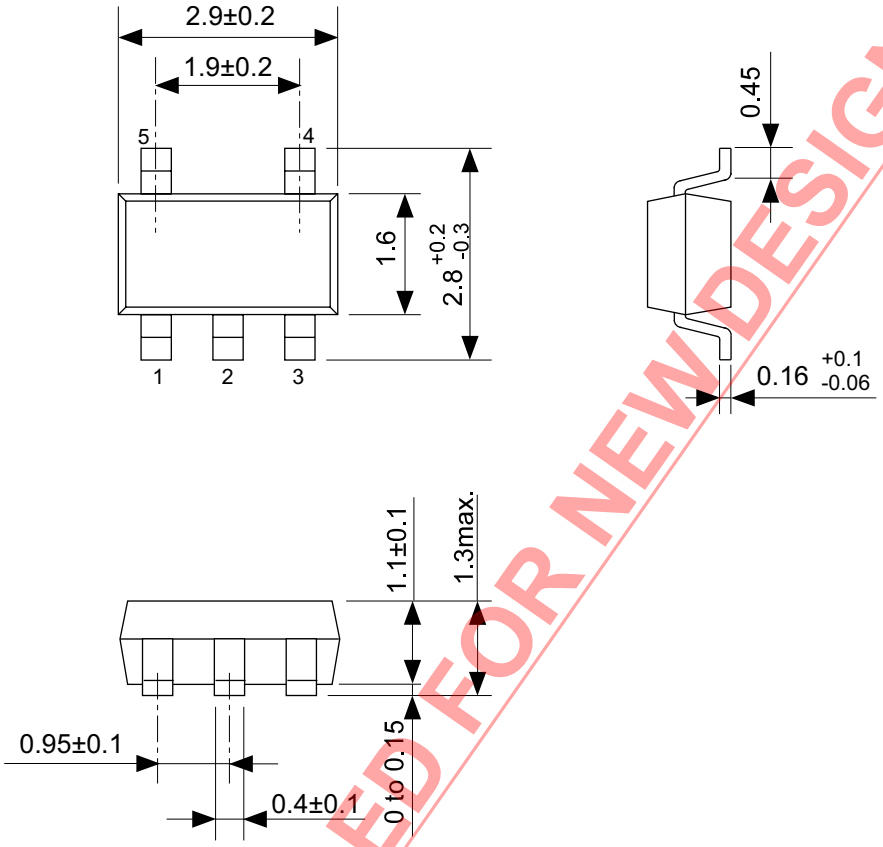
Product name vs. Product code

Product Name	Product Code		
	(1)	(2)	(3)
S-5840BAG-M5T1x	H	8	M
S-5840BAH-M5T1x	H	8	N
S-5840BAJ-M5T1x	H	8	O

Remark 1. x: G or U
2. Please select products of environmental code = U for Sn 100%, halogen-free products.

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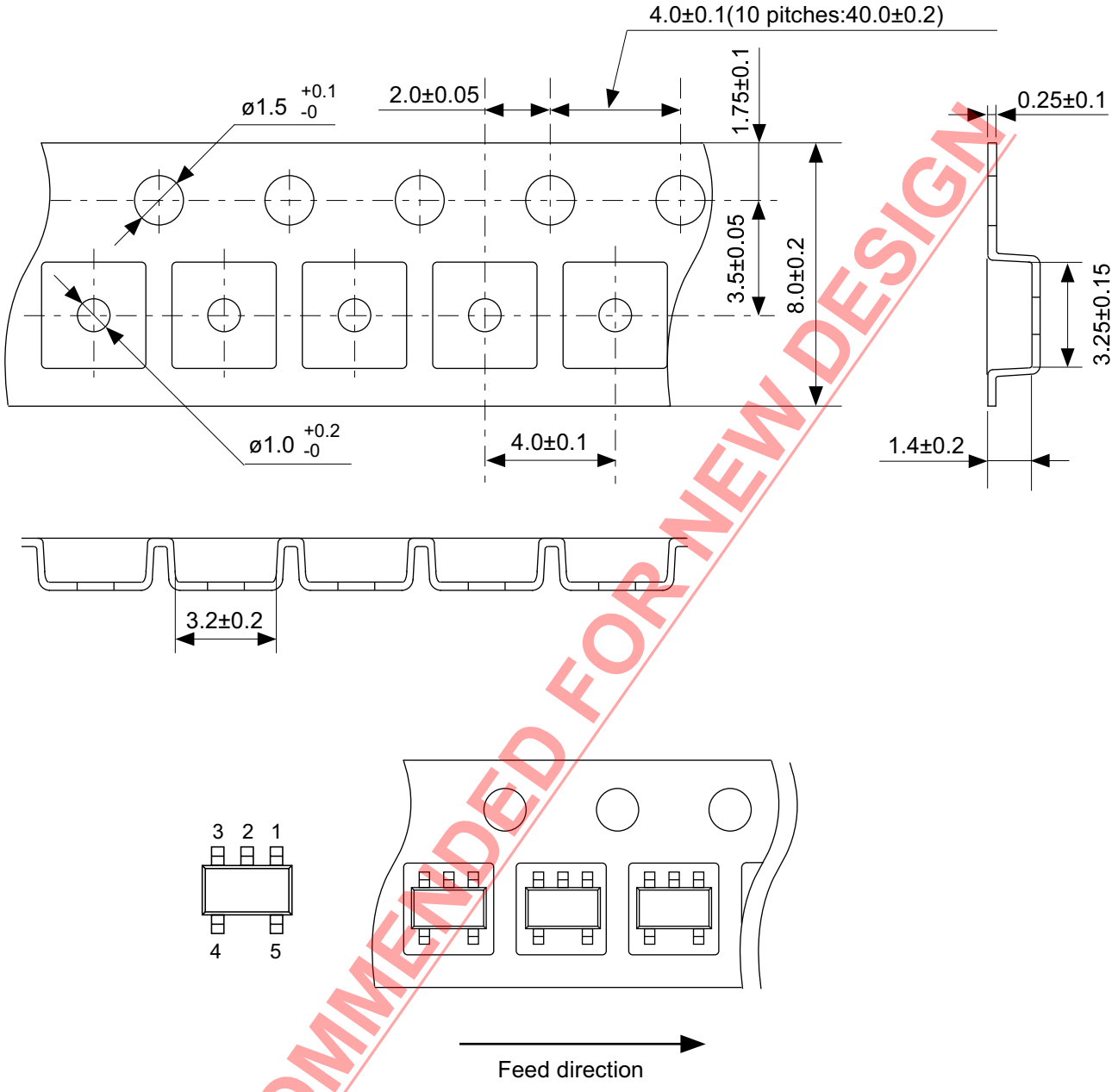
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No. MP005-A-P-SD-1.3

TITLE	SOT235-A-PKG Dimensions
No.	MP005-A-P-SD-1.3
ANGLE	
UNIT	mm

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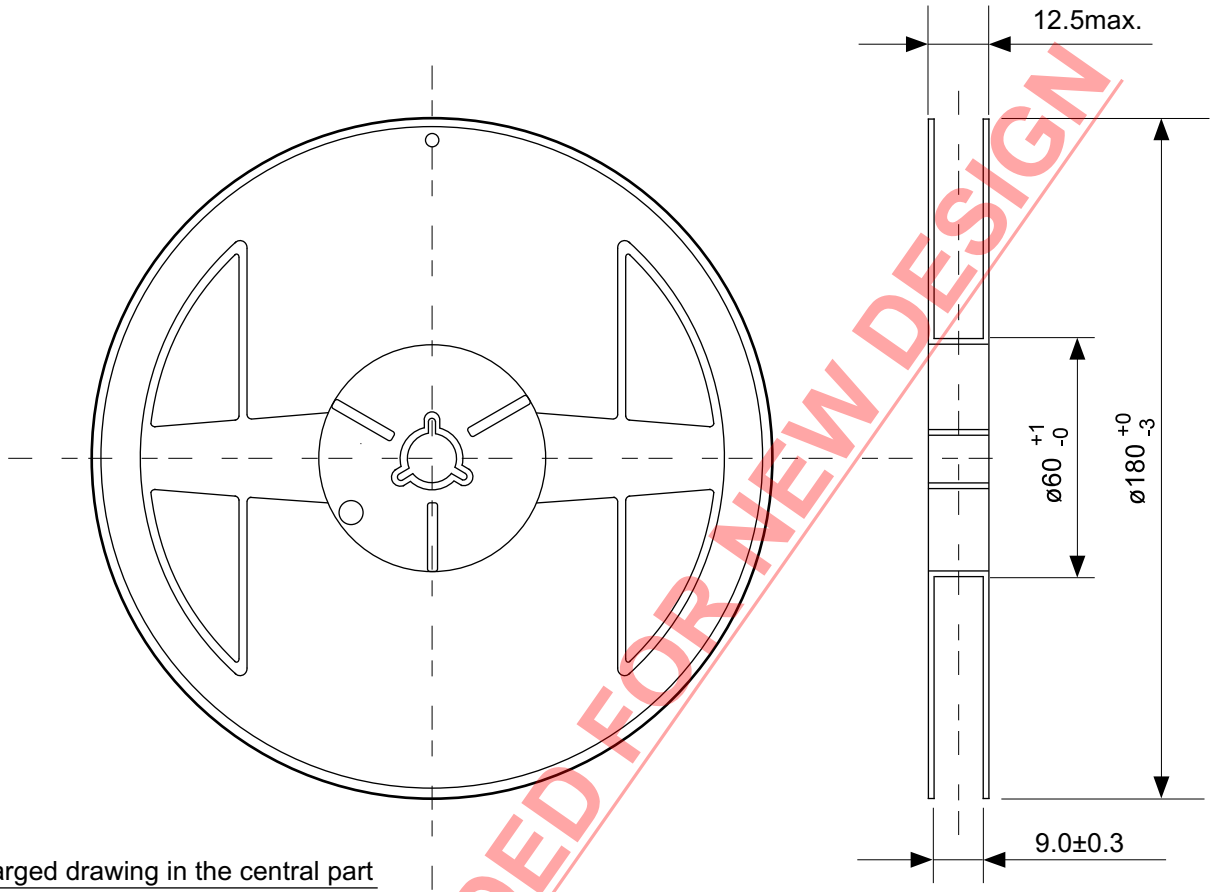


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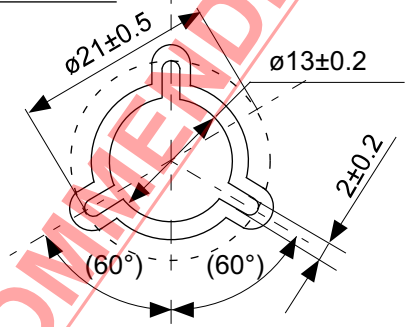
No. MP005-A-C-SD-2.1

TITLE	SOT235-A-Carrier Tape
No.	MP005-A-C-SD-2.1
ANGLE	
UNIT	mm
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Enlarged drawing in the central part



No. MP005-A-R-SD-1.1

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TITLE	SOT235-A-Reel		
No.	MP005-A-R-SD-1.1		
ANGLE		QTY.	3,000
UNIT	mm		
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