S-58LM20A Series

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CMOS TEMPERATURE SENSOR IC

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Rev.3.1_02

The S-58LM20A Series is a high-accuracy temperature sensor IC on a single chip, provides output voltage which is linear against the temperature change.
Each chip consists of a temperature sensor, a constant current circuit, and an operational amplifier.
The operating ambient temperature is from –55°C to 130°C. This IC has much better linearity than other conventional temperature sensors such as thermistor, it is possible to achieve the extensive application for temperature control.

■ Features

- Accuracy against temperature: ±2.5°C (–55°C to +130°C)
- Linear output voltage: –11.77 mV/°C Typ.
  Ta = –30°C : 2.205 V Typ.
  Ta = +30°C : 1.515 V Typ.
  Ta = +130°C : 0.303 V Typ.
- Nonlinearity: ±0.4% Typ. (–20 to +80°C)
- Operation in wide range of power supply voltage: V_{DD} = 2.4 to 5.5 V (–30°C to +130°C)
  V_{DD} = 2.7 to 5.5 V (–55°C to +130°C)
- Low current consumption: 4.5 μA Typ. (+25°C) 6.0 μA Max. (–55°C to +130°C)
- Built-in operational amplifier
- Output voltage referred to V_{SS}
- Lead-free, Sn 100%, halogen-free*1

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

■ Applications

- Compensation of high-frequency circuits such as cellular phones and radio equipment
- Compensation of oscillation frequency in crystal oscillator
- LCD contrast compensation
- Compensation of amplifier gain
- Compensation of auto focus circuits
- Temperature detection in battery management
- Overheating prevention for charged batteries or halogen lights

■ Package

- SC-82AB
- SNT-4A
- WLP-4B

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■ Block Diagram

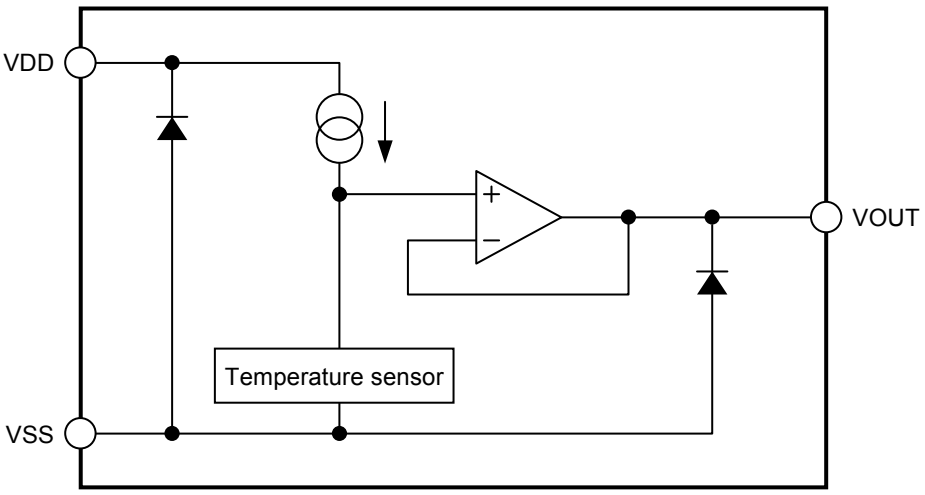


Figure 1

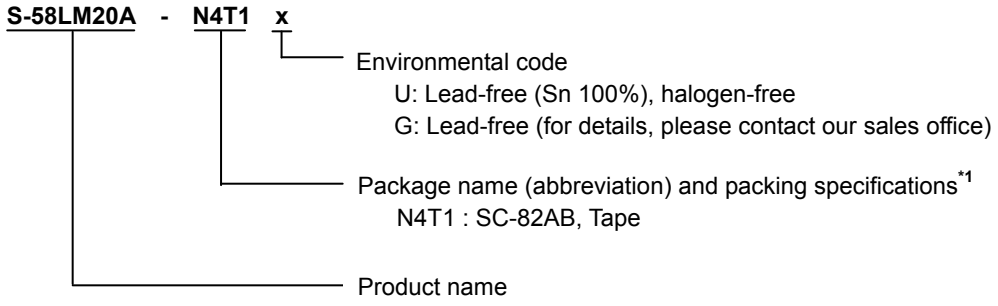
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■ Product Name Structure

Users can select the product type in the S-58LM20A Series. Refer to "**1. Product name**" regarding the contents of product name, "**2. Package**" regarding the package drawings and "**3. Product name list**" regarding the product type.

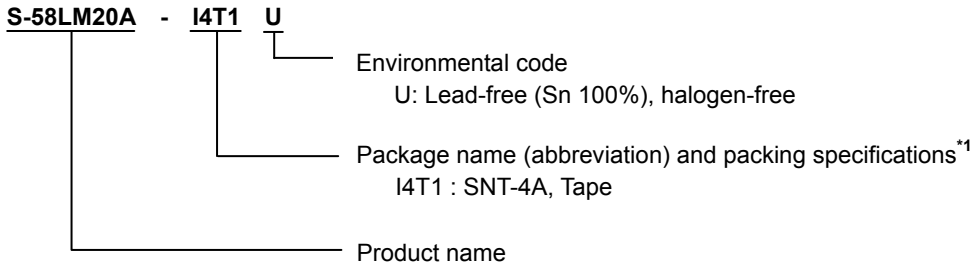
1. Product name

(1) SC-82AB package



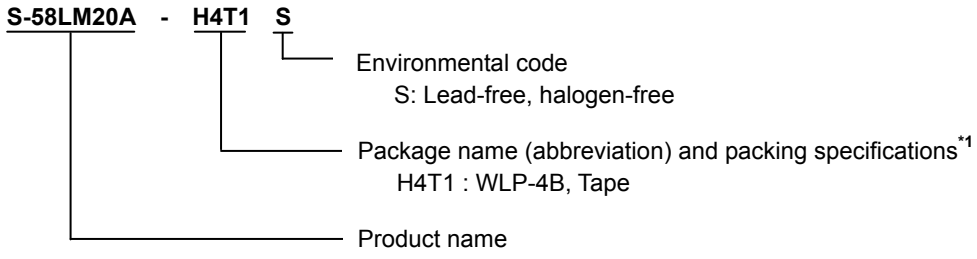
***1.** Refer to the tape drawing.

(2) SNT-4A package



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

(3) WLP-4B package



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

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2. Package

Package Name	Drawing Code			
	Package	Tape	Reel	Land
SC-82AB	NP004-A-P-SD	NP004-A-C-SD	NP004-A-R-SD	—
SNT-4A	PF004-A-P-SD	PF004-A-C-SD	PF004-A-R-SD	PF004-A-L-SD
WLP-4B	HB004-C-P-SD	HB004-C-C-SD	HB004-C-R-SD	—

3. Product name list

Table 1

Product Name	Temperature Accuracy	Package
S-58LM20A-N4T1x	±2.5°C	SC-82AB
S-58LM20A-I4T1U	±2.5°C	SNT-4A
S-58LM20A-H4T1S	±2.5°C	WLP-4B

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

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■ Pin Configuration

SC-82AB
Top view

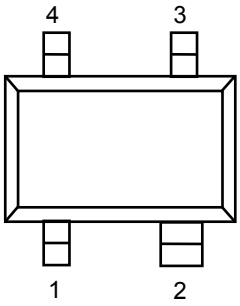


Figure 2

Table 2

Pin No.	Pin Name	Description
1	VDD	Power supply pin
2	VSS	GND pin
3	NC*1	No connection
4	VOUT	Output voltage pin

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

SNT-4A
Top view

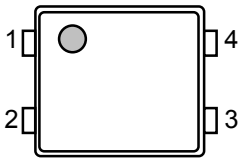


Figure 3

Table 3

Pin No.	Pin Name	Description
1	VSS	GND pin
2	VDD	Power supply pin
3	VOUT	Output voltage pin
4	NC*1	No connection

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

WLP-4B
Top view

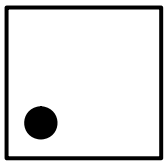


Figure 4

Table 4

Pin No.	Pin Name	Description
1	VDD	Power supply pin
2	VSS*1	GND pin
3	VSS*1	GND pin
4	VOUT	Output voltage pin

***1.** Connect both VSS pins to GND.

WLP-4B
Bottom view

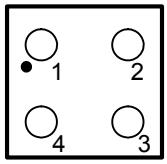


Figure 5

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■ Absolute Maximum Ratings

Table 5

(Ta = 25°C unless otherwise specified)

Item		Symbol	Absolute Maximum Rating	Unit
Power supply pin voltage		V_{DD}	V_{SS} – 0.3 to V_{SS} + 6.5	V
Output voltage		V_{OUT}	V_{SS} – 0.3 to V_{DD} + 0.3	V
Power dissipation	SC-82AB	P_D	350[*1]	mW
	SNT-4A		300[*1]	mW
	WLP-4B		290[*1]	mW
Operating ambient temperature		T_{opr}	–55 to +130	°C
Storage temperature		T_{stg}	–65 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.

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■ Electrical Characteristics

Table 6

(Ta = 25°C, V_{DD} = 2.7 V, I_{OUT} = 0 A unless otherwise specified)

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit	Test Circuit
Range of power supply voltage	V_{DD}	−30°C ≤ Ta ≤ +130°C	2.4	—	5.5	V	1
		−55°C ≤ Ta ≤ +130°C	2.7	—	5.5	V	1
Output voltage $V_{OUT} = (-3.88 \times 10^{-6} \times T^2) + (-1.15 \times 10^{-2} \times T) + 1.8639$ V	V_{OUT}	Ta = −30°C	2.177	2.205	2.234	V	1
		Ta = +30°C	1.486	1.515	1.545	V	1
		Ta = +130°C	0.272	0.303	0.335	V	1
Temperature sensitivity	V_{SE}	−30°C ≤ Ta ≤ +130°C	−12.20	−11.77	−11.40	mV/°C	—
Nonlinearity	ΔN_L	−20°C ≤ Ta ≤ +80°C	—	±0.4	—	%	—
Operating temperature range	Topr	—	−55	—	130	°C	—
Current consumption	I_{DD}	−55°C ≤ Ta ≤ +130°C	—	4.5	6.0	μA	1
Current consumption − Power supply voltage	ΔI_{DD1}	V_{DD} = 2.4 V to 5.5 V	—	0.1	—	μA	1
Current consumption − Temperature	ΔI_{DD2}	—	—	−11	—	nA/°C	1
Line regulation	ΔV_{OUT1}	V_{DD} = 2.4 V to 5.5 V	—	—	3.3	mV/V	2
Load regulation*1	ΔV_{OUT2}	I_{OUT} = 0 μA to 16 μA	—	—	0.156	mV/μA	2

***1.** Do not flow current into the output voltage pin.

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■ Test Circuit

1.

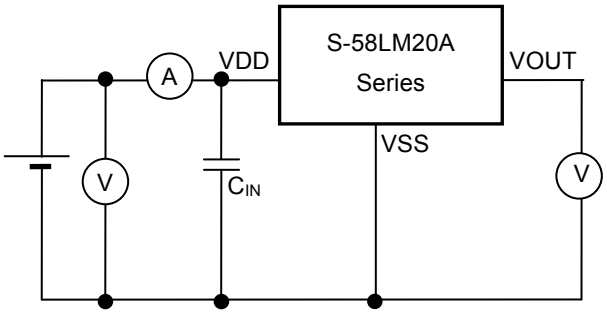


Figure 6

2.

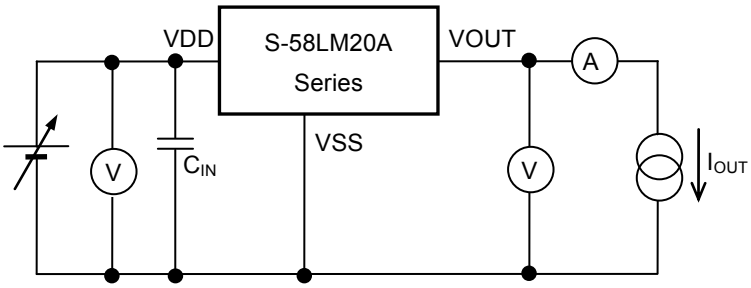


Figure 7

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■ Explanation of Terms

1. Output voltage (V_{OUT})

V_{OUT} indicates the output voltage at Ta = −30°C, Ta = +30°C, and Ta = +130°C.

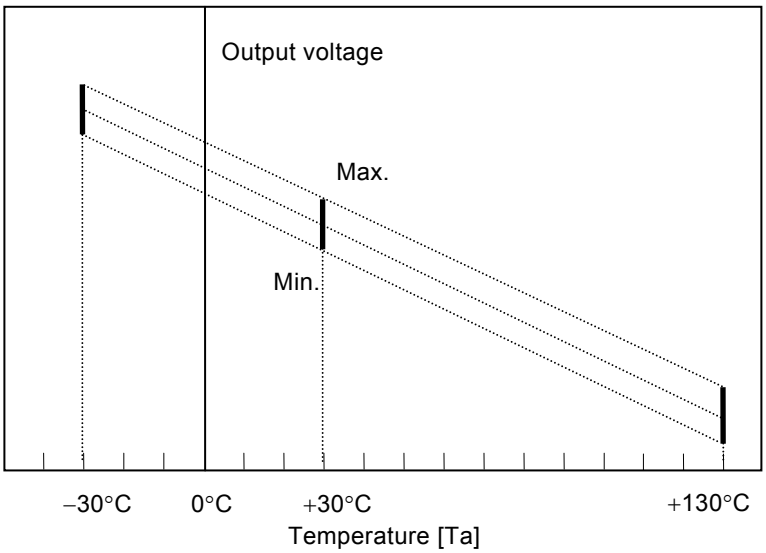


Figure 8

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2. Temperature Sensitivity (V_{SE})

V_{SE} is the temperature coefficient of output voltage which is calculated from an output voltage when Ta = −30°C and Ta = +130°C.
V_{SE} is calculated from the following formula.

$$V_{SE} = \frac{\left[V_{OUT}{}^{*1} - V_{OUT}{}^{*2}\right]}{160^{*3}}$$

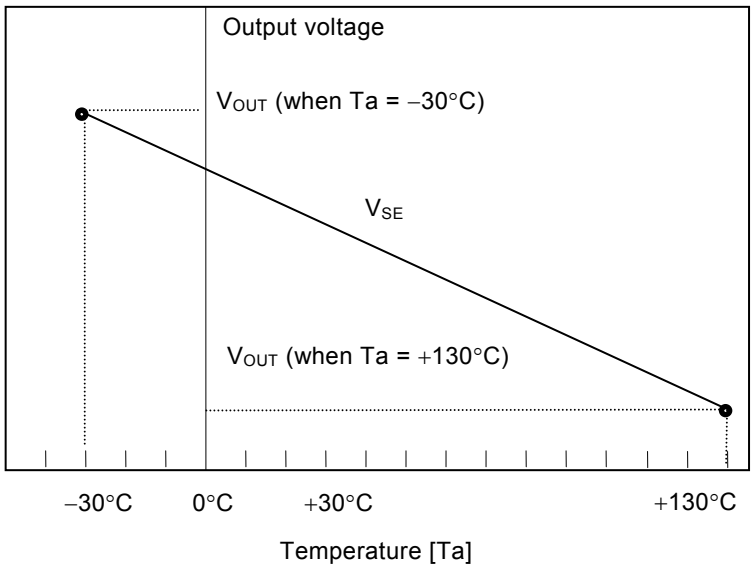


Figure 9

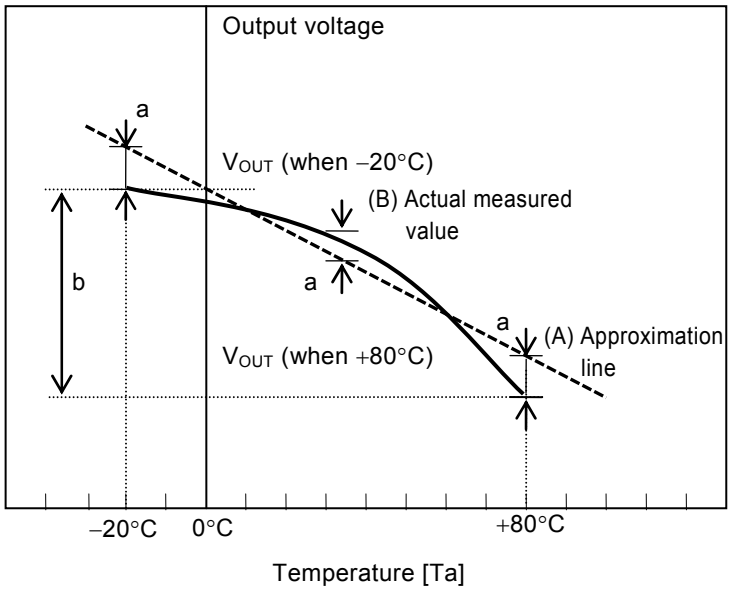
***1.** V_{OUT} value at Ta = +130°C [V]
***2.** V_{OUT} value at Ta = −30°C [V]
***3.** The difference of the temperature between Ta = +130°C and Ta = −30°C [°C]

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3. Nonlinearity (ΔN_L)

ΔN_L is the nonlinearity of output voltage. Its deviation with the approximation line is shown below.
ΔN_L is calculated from the following formula.

$$\Delta N_L = \frac{a^{*1}}{b^{*2}} \times 100$$



***1.** The maximum deviation of the actual measurement of output voltage (B) and an approximation line (A) in temperature −20°C to +80°C. The approximation line is the one to be drawn so that "a" should be the minimum value.
***2.** The difference of the actual measured value of output voltage when −20°C and +80°C.

Figure 10

4. Line regulation (ΔV_{OUT1})

ΔV_{OUT1} indicates the dependency of output voltage against input voltage. This indicates how much the output voltage varies when changing the input voltage after fixing the output current constant.

5. Load regulation (ΔV_{OUT2})

ΔV_{OUT2} indicates the dependency of output voltage against output current. This indicates how much the output voltage varies when changing output current after fixing the input voltage constant.

6. Current consumption – Power supply voltage (ΔI_{DD1})

ΔI_{DD1} indicates the dependency of current consumption against power supply voltage. This indicates how much current consumption varies when changing the temperature after fixing an output current constant.

7. Current consumption — Temperature (ΔI_{DD2})

ΔI_{DD2} indicates the dependency of current consumption against temperature. This indicates how much current consumption varies when changing the temperature after fixing an output current constant.

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■ Precautions

- Wire each pin of VDD, VSS and VOUT carefully in order to set them in low impedance when wiring an IC on a patterned board.
- In this IC, if load capacitance of the VOUT pin is large, VOUT pin voltage may oscillate. It is recommended not to use an external capacitor between the VOUT and VSS pin. When using an external capacitor, set near the VOUT pin.
  When connecting an A/D converter etc. to the VOUT pin, the input pin capacitance of the A/D converter and the parasitic capacitance component between wires are included as load capacitance.
  To prevent oscillation, it is recommended to use the following output load condition.

  Load capacitance of VOUT pin (C_{L1}) : 300 pF or less

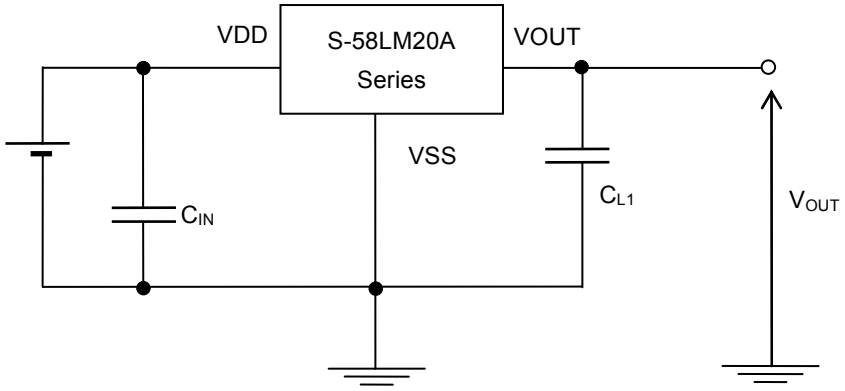


Figure 11

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

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In this IC, it is necessary to add a capacitor from an output pin to GND with a series resistor in the ambience having excessive noise, as seen in **Figure 12** and **Figure 13**. In the combination shown in **Table 7**, a time constant against heat of this IC is much later than the time constant composed of RC, therefore it does not affect on the response time of this IC.

Table 7

R_{L2} (Ω)	C_{L2} (μF)
200	1
470	0.1
680	0.01
1 k	0.001

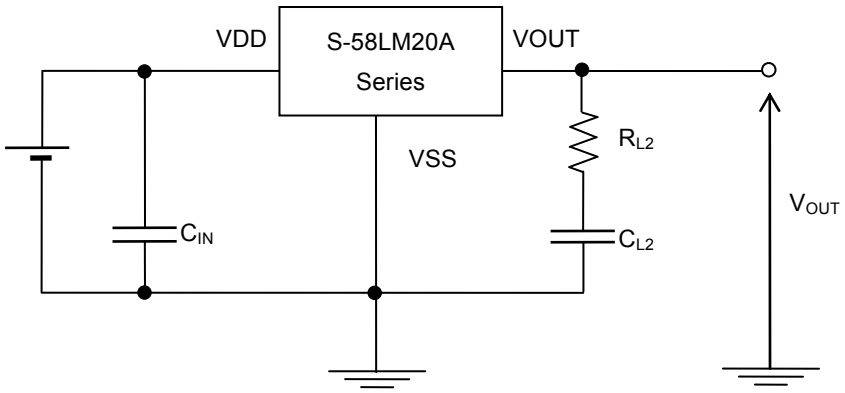


Figure 12

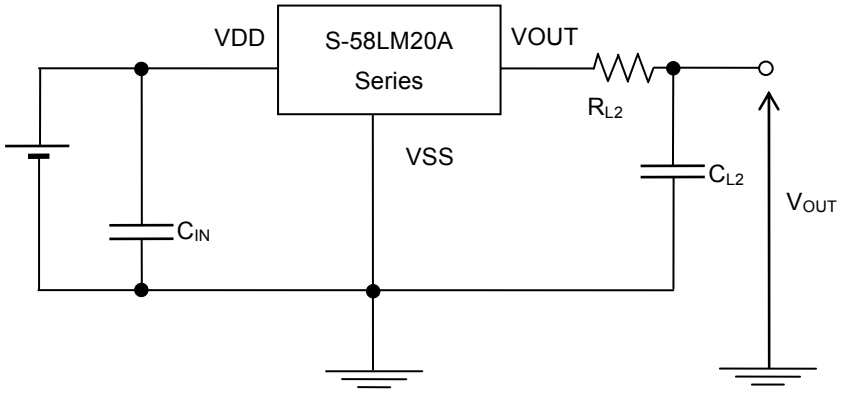


Figure 13

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

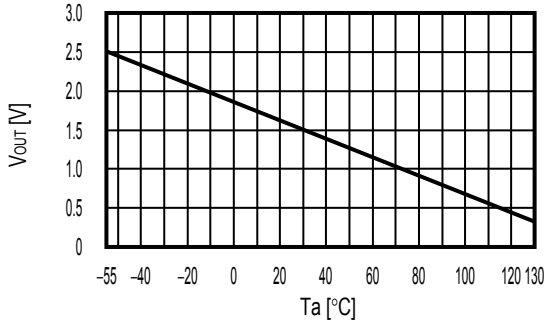
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- For stabilization, set a capacitor (C_{IN}) of approx. 0.1 μF between VDD and VSS pin.
- Do not connect a pull-up resistor to the output pin.
- The application condition for input voltage, output voltage and load voltage must not exceed the package power dissipation.
- Do not apply an electrostatic discharge to this IC that exceeds the performance ratings of the built-in electrostatic protection circuit.
- Regarding the current at the output pin, refer to load regulation and footnote ***1** in **Table 6** "■ **Electrical Characteristics**".
- 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.

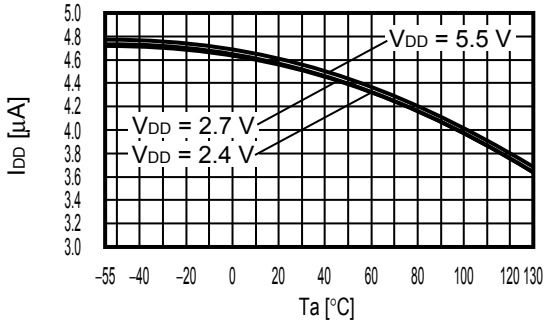
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■ Characteristics (Typical Data)

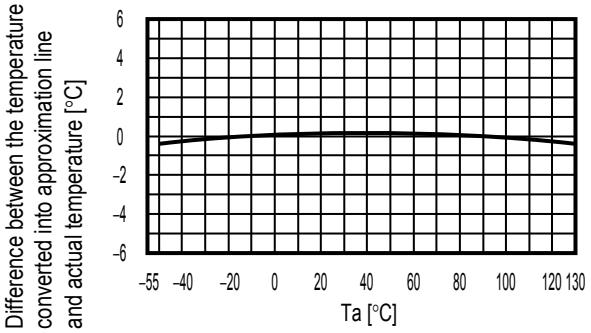
1. Output voltage (V_{OUT}) vs. Temperature (Ta)



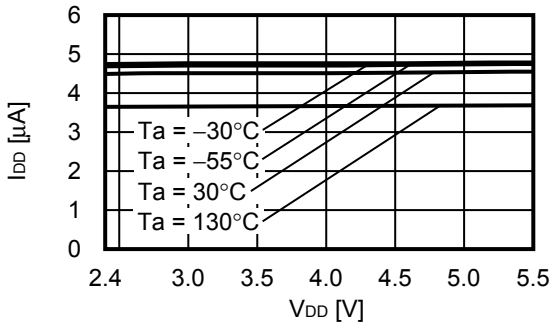
2. Current consumption (I_{DD}) vs. Temperature (Ta)



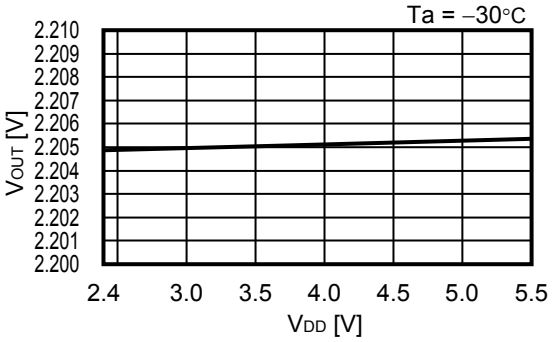
3. Error range of each temperature

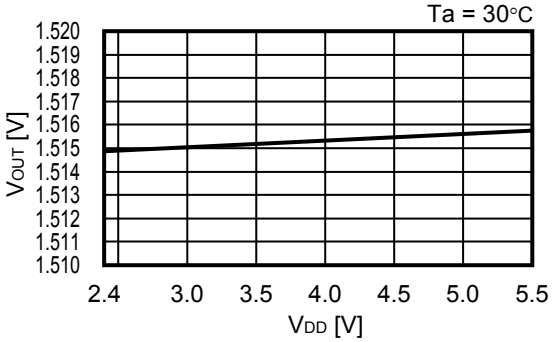


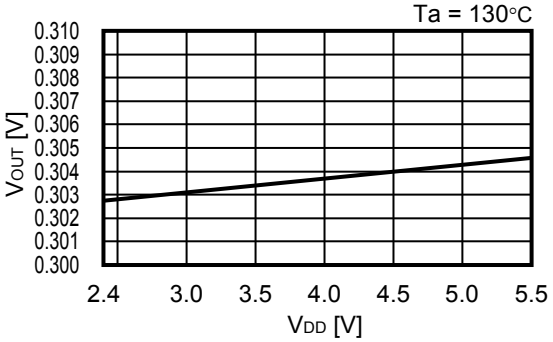
4. Current consumption (I_{DD}) vs. Power supply voltage (V_{DD})



5. Output voltage (V_{OUT}) vs. Power supply voltage (V_{DD})

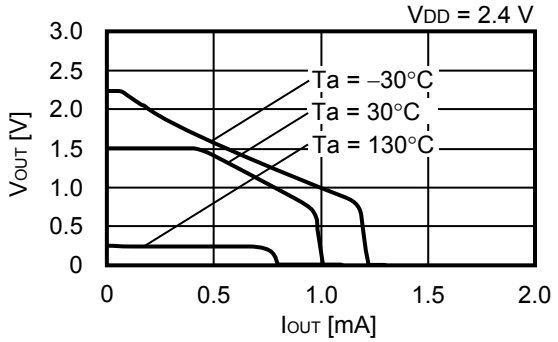


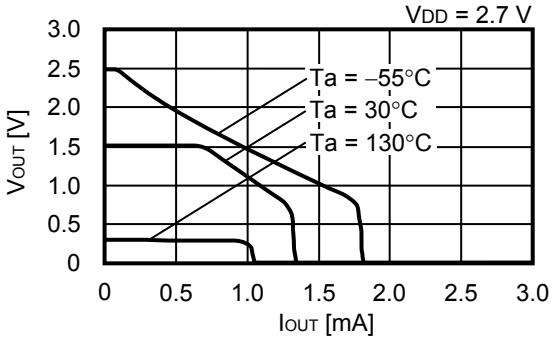


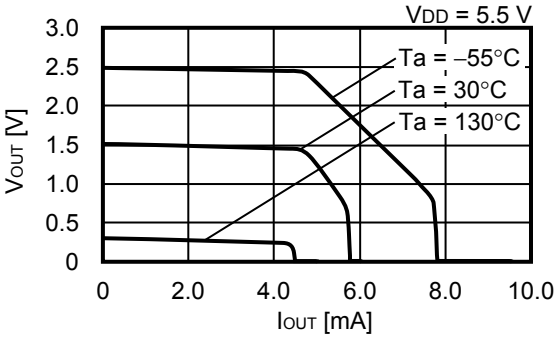


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6. Output voltage (V_{OUT}) vs. Load current (I_{OUT})

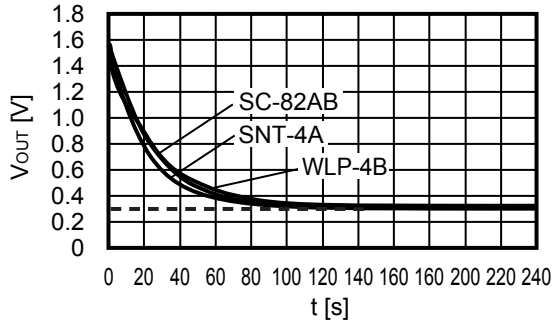




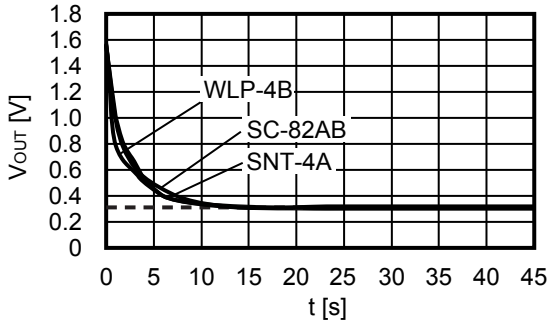


7. Heat response Output voltage (V_{OUT}) vs. Time (t)

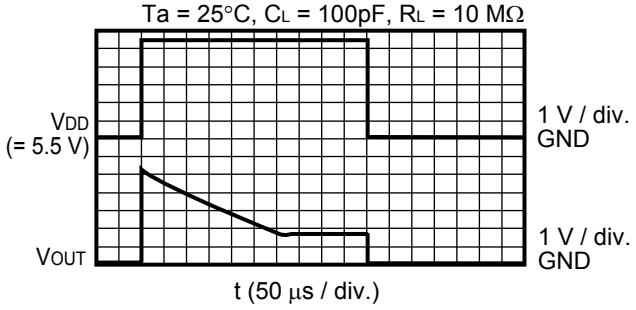
When packages are put into the air of 130°C from the air of 25°C

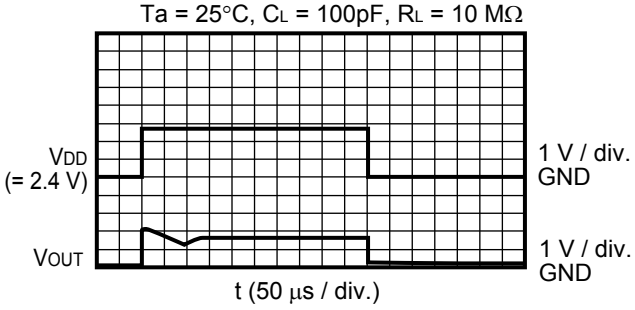


When packages are put into the liquid of 130°C from the air of 25°C



8. Start up response



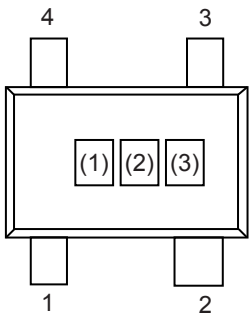


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■ Marking Specifications

1. SC-82AB

Top view



(1) to (3) : Product code (refer to **Product name vs. Product code**)

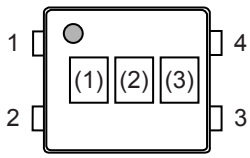
Product name vs. Product code

Product name	Product code		
	(1)	(2)	(3)
S-58LM20A-N4T1x	D	R	E

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

2. SNT-4A

Top view



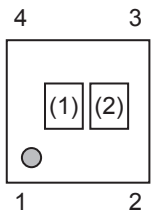
(1) to (3) : Product code (refer to **Product name vs. Product code**)

Product name vs. Product code

Product name	Product code		
	(1)	(2)	(3)
S-58LM20A-I4T1U	D	R	E

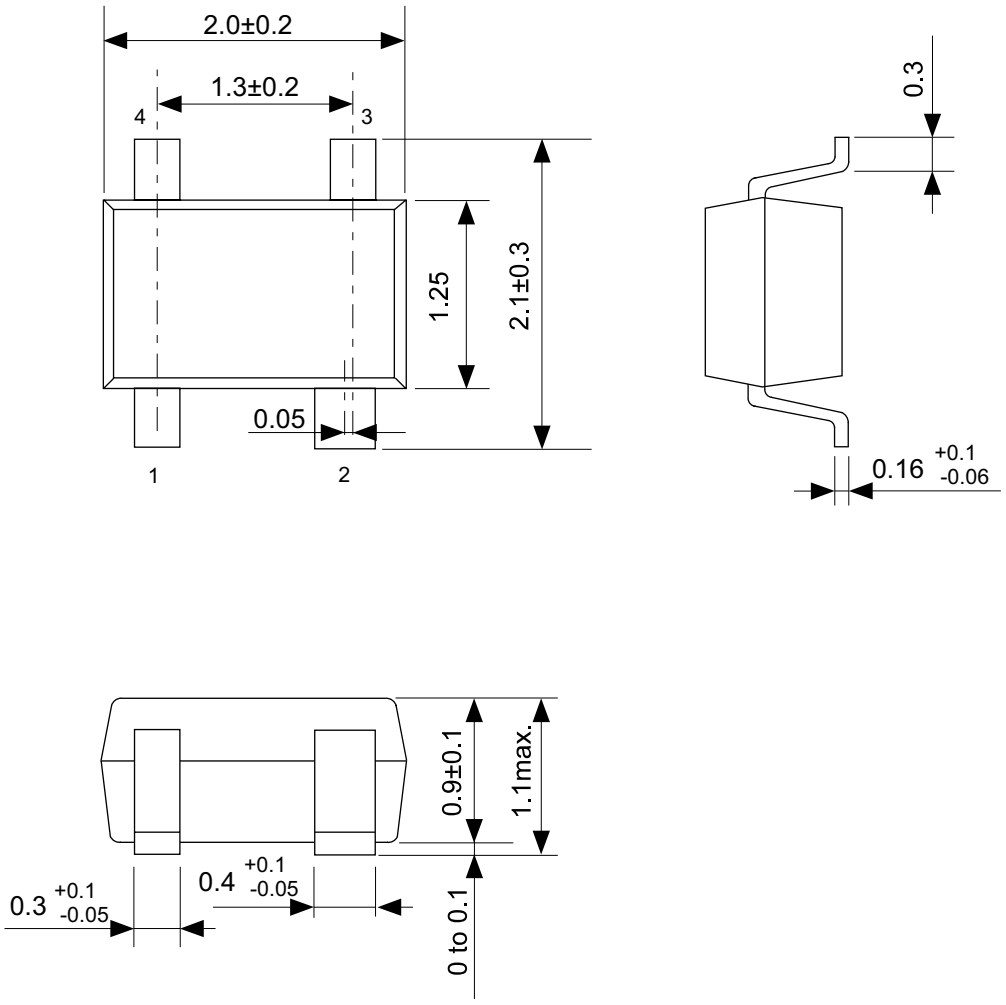
3. WLP-4B

Top view



(1) to (2) : Lot number

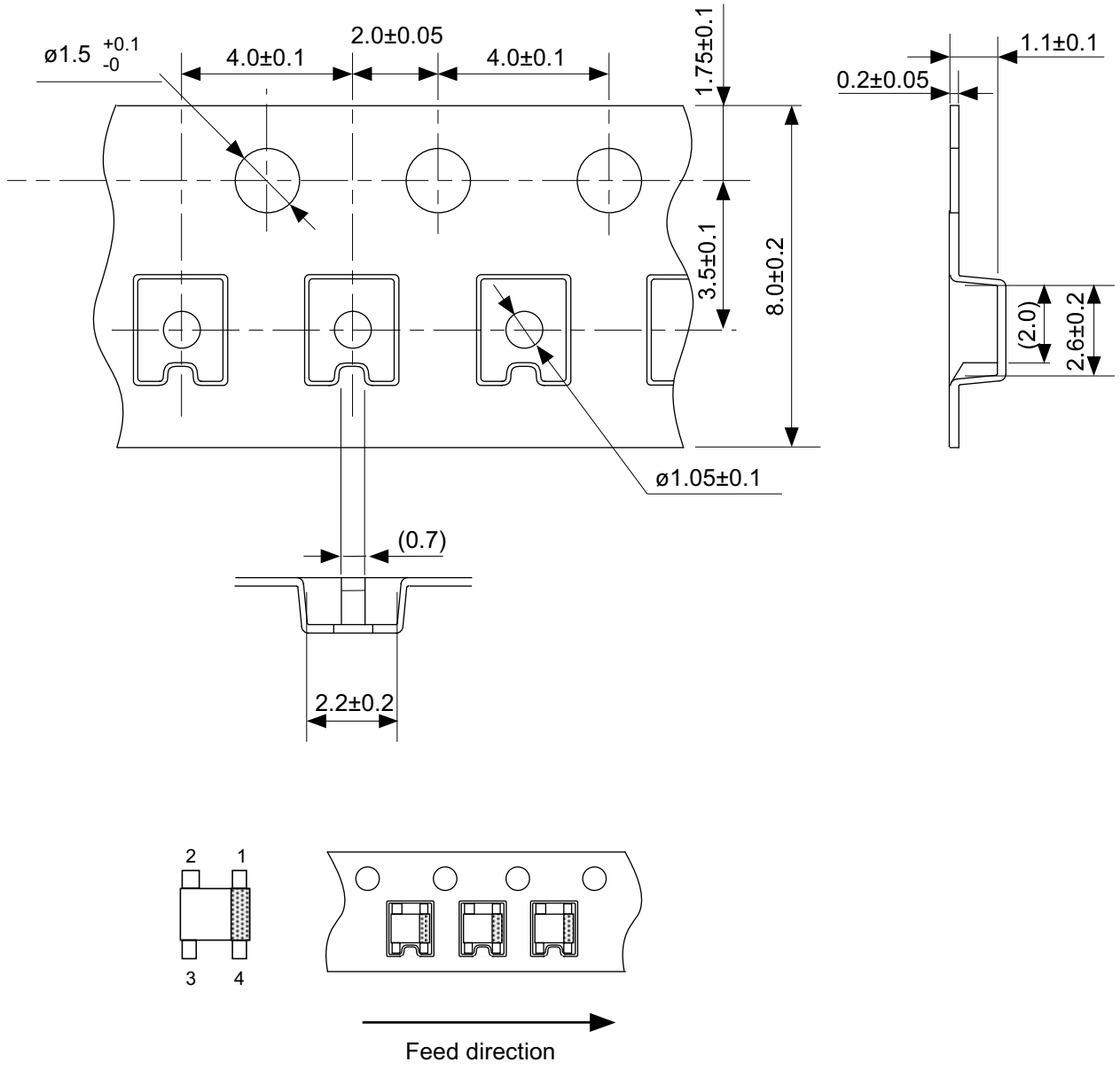
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No. NP004-A-P-SD-2.0

TITLE	SC82AB-A-PKG Dimensions
No.	NP004-A-P-SD-2.0
ANGLE	
UNIT	mm
	ABLIC Inc.

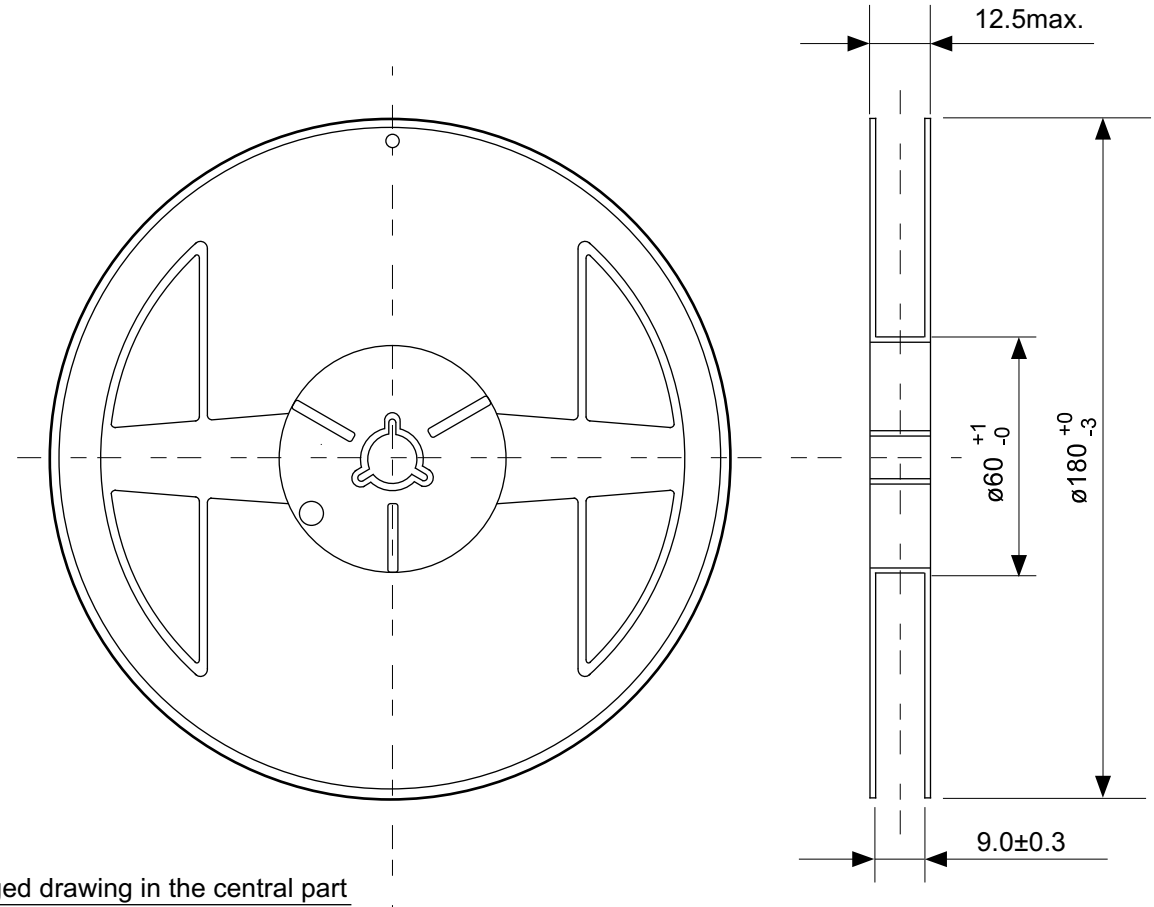
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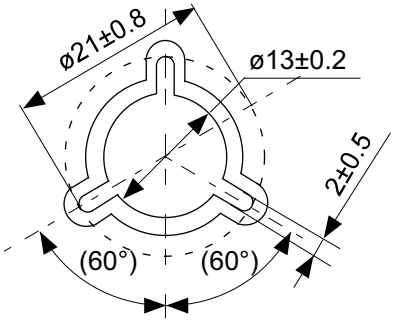
No. NP004-A-C-SD-3.0

TITLE	SC82AB-A-Carrier Tape
No.	NP004-A-C-SD-3.0
ANGLE	
UNIT	mm
	ABLIC Inc.

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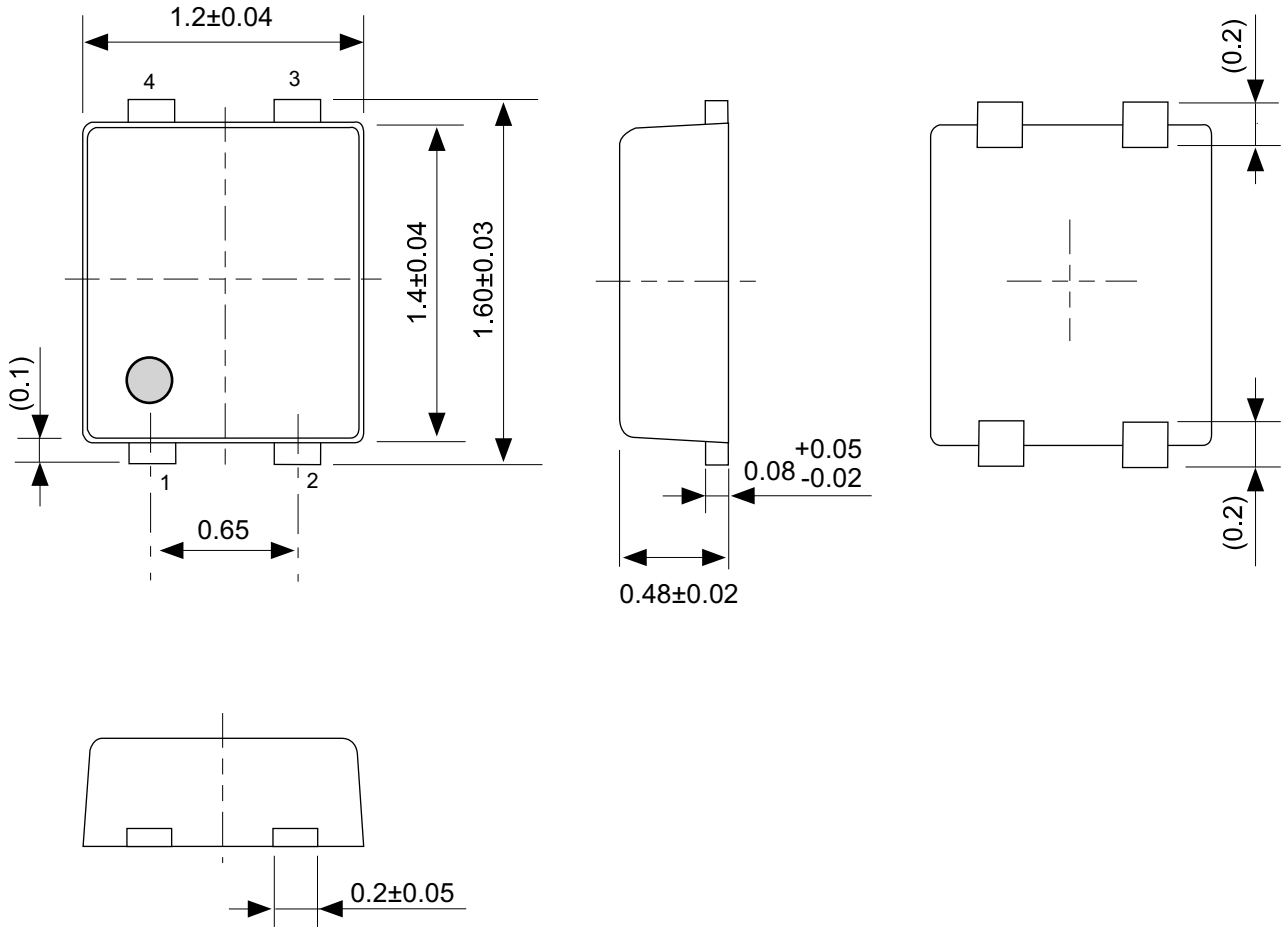
Enlarged drawing in the central part



No. NP004-A-R-SD-1.1

TITLE	SC82AB-A-Reel		
No.	NP004-A-R-SD-1.1		
ANGLE		QTY.	3,000
UNIT	mm		
	ABLIC Inc.		

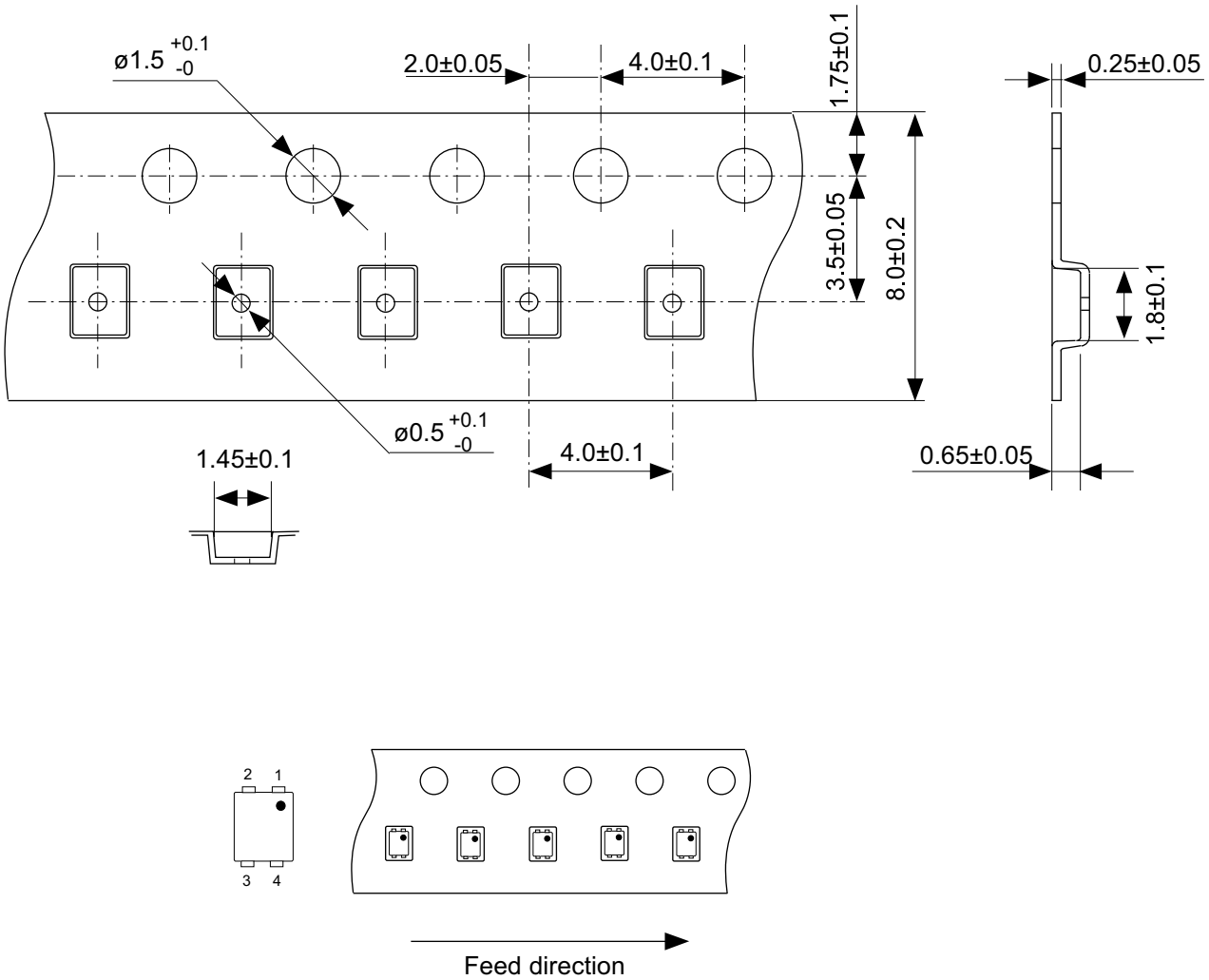
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No. PF004-A-P-SD-6.0

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

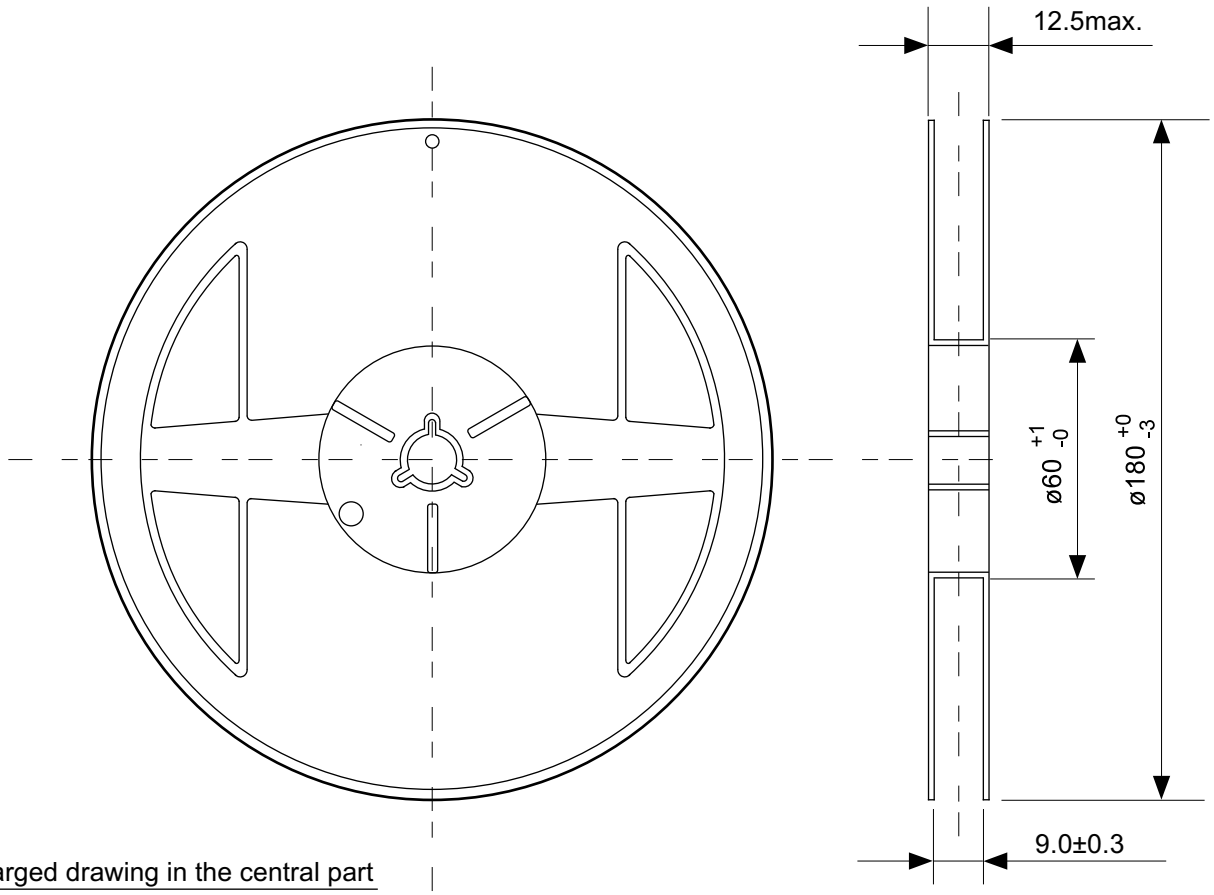
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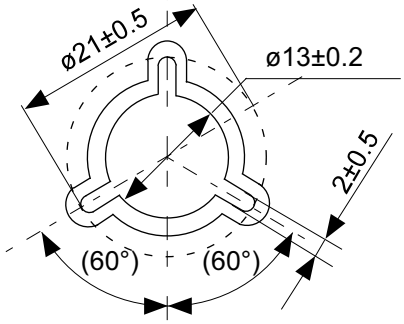
No. PF004-A-C-SD-2.0

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

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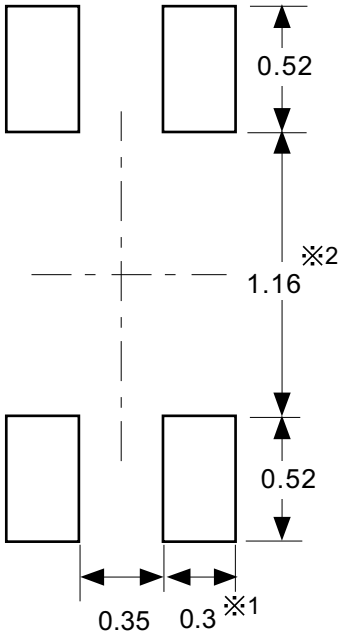
Enlarged drawing in the central part



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.			

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※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.

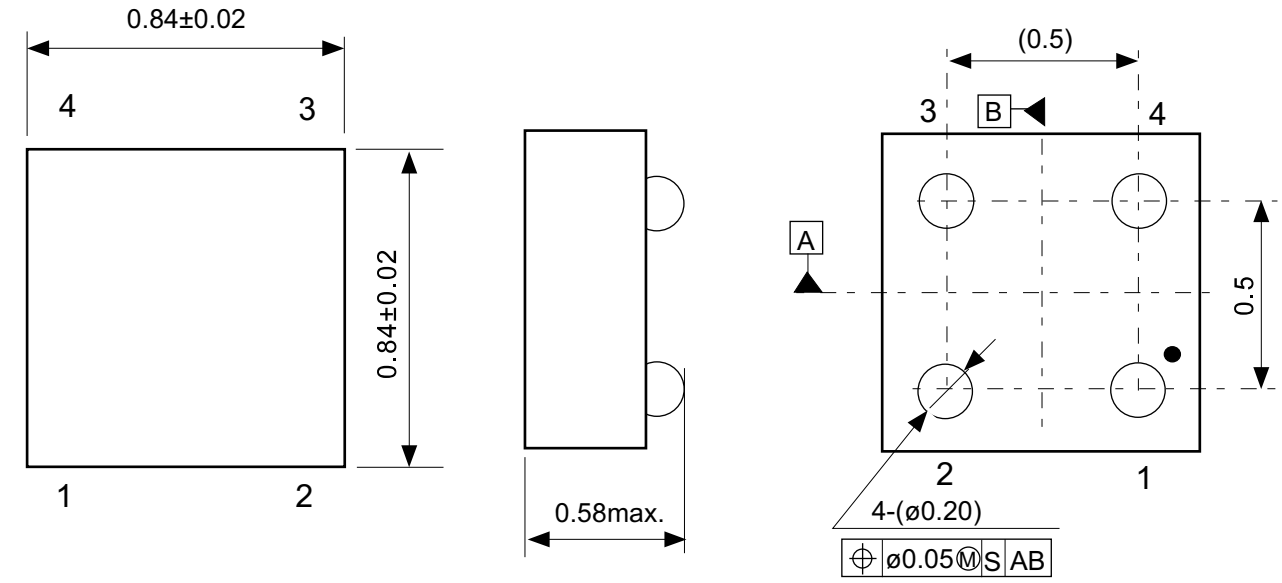
※1. 请注意焊盘模式的宽度 (0.25 mm min. / 0.30 mm typ.)。
※2. 请勿向封装中间扩展焊盘模式 (1.10 mm ~ 1.20 mm)。

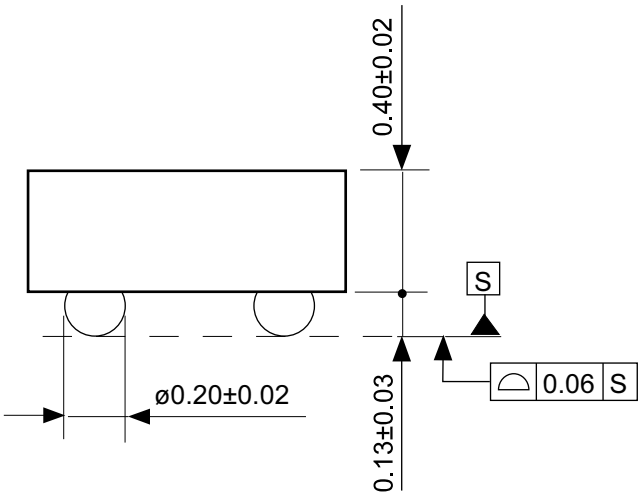
注意 1. 请勿在树脂型封装的下面印刷丝网、焊锡。
2. 在封装下、布线上的阻焊膜厚度 (从焊盘模式表面起) 请控制在 0.03 mm 以下。
3. 钢网的开口尺寸和开口位置请与焊盘模式对齐。
4. 详细内容请参阅 "SNT 封装的应用指南"。

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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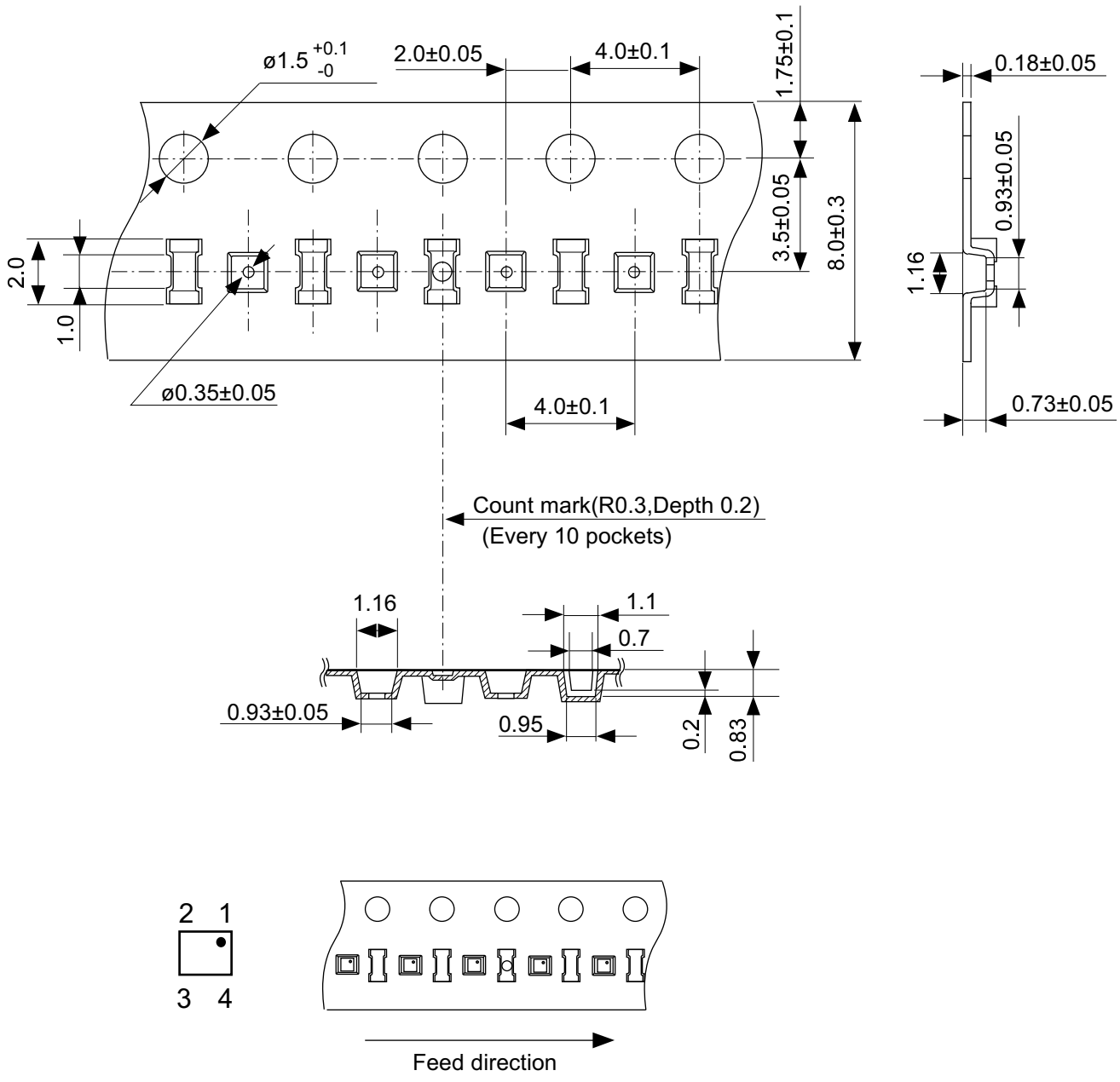


Pin No.	Symbol
1	VDD
2	VSS
3	VSS
4	VOUT

No. HB004-C-P-SD-2.0

TITLE	WLP-4B-C-PKG Dimensions (S-58LM20A)
No.	HB004-C-P-SD-2.0
ANGLE	
UNIT	mm
ABLIC Inc.	

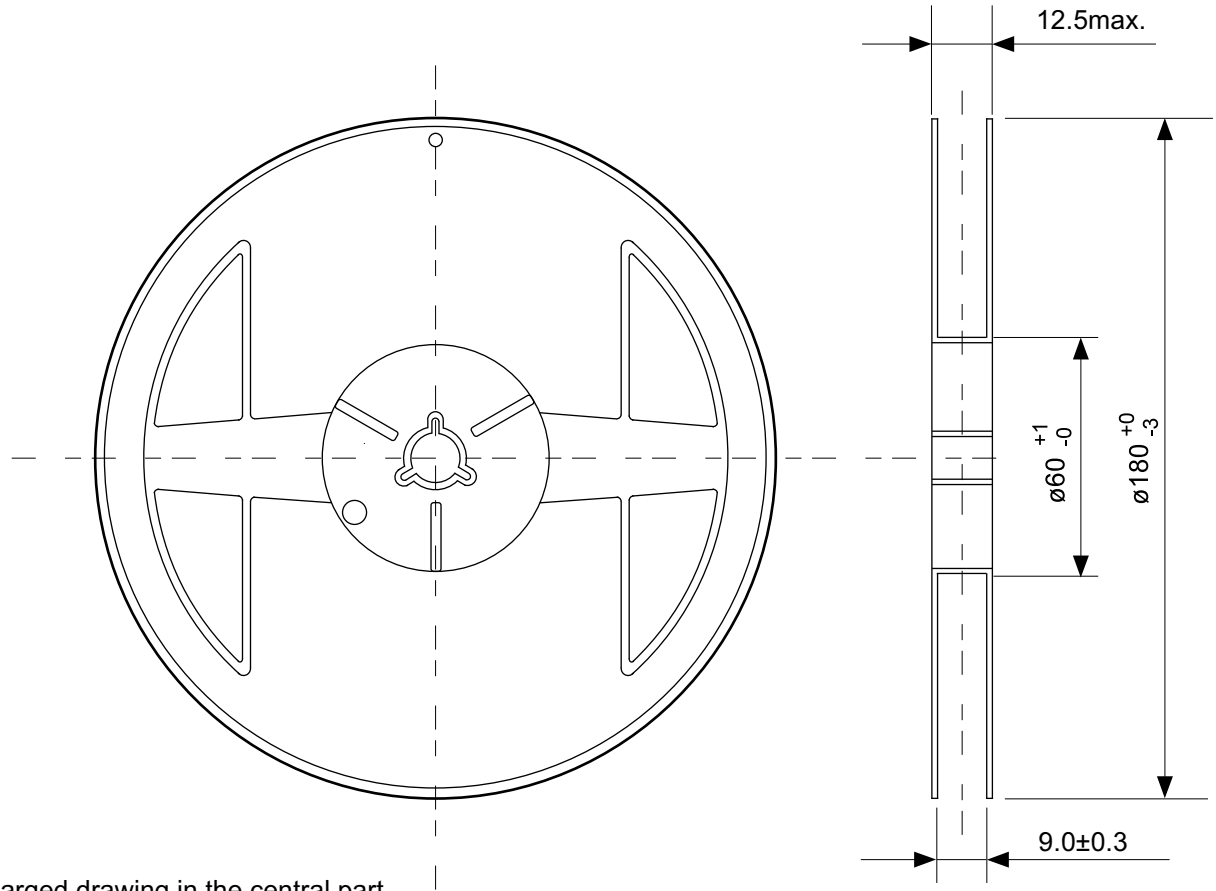
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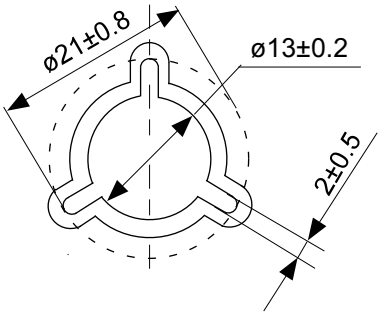
No. HB004-C-C-SD-1.1

TITLE	WLP-4B-C-Carrier Tape (S-58LM20A)
No.	HB004-C-C-SD-1.1
ANGLE	
UNIT	mm
ABLIC Inc.	

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Enlarged drawing in the central part



No. HB004-C-R-SD-1.0

TITLE	WLP-4B-C-Reel (S-58LM20A)		
No.	HB004-C-R-SD-1.0		
ANGLE		QTY.	3,000
UNIT	mm		
	ABLIC Inc.		

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