CMOS TEMPERATURE SENSOR IC S-8110C/8120C Series

The S-8110C/8120C Series is a family of high-precision temperature sensor ICs on a single chip with a linear output voltage for temperature changes.
Each chip is composed of a temperature sensor, a constant current circuit, and an operational amplifier. It can be used at temperatures ranging from –40 °C to 100 °C. These devices have much better linearity than other temperature sensors such as thermistors, and can be used for a wide range of temperature control applications.

■ Features

- Temperature accuracy — S-8110C Series: ±5.0 °C (–30 to +100 °C); S-8120C Series: ±2.5 °C (–30 to +100 °C)
- Linear output voltage — –8.20 mV/ °C Typ.; Ta=–30 °C: 1.951 V Typ.; Ta=+30 °C: 1.474 V Typ.; Ta=+100 °C: 0.882 V Typ.
- Nonlinearity — ±0.5 % typ. (–20 to +80 °C)
- Wide power supply voltage operation — V_{DD}=2.4 to 10.0 V
- Low current consumption — 4.5 μA typ. (+25 °C)
- Built-in operational amplifier
- V_{SS} standard output
- Ultra-small plastic package — SC-82AB, 4-Pin SNB(B)

■ Applications

- 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
- Heat prevention for charged batteries or halogen lights

■ Packages

- SC-82AB (Package drawing code: NP004-A)
- 4-Pin SNB(B) (Package drawing code: BB004-A)

■ Block Diagram

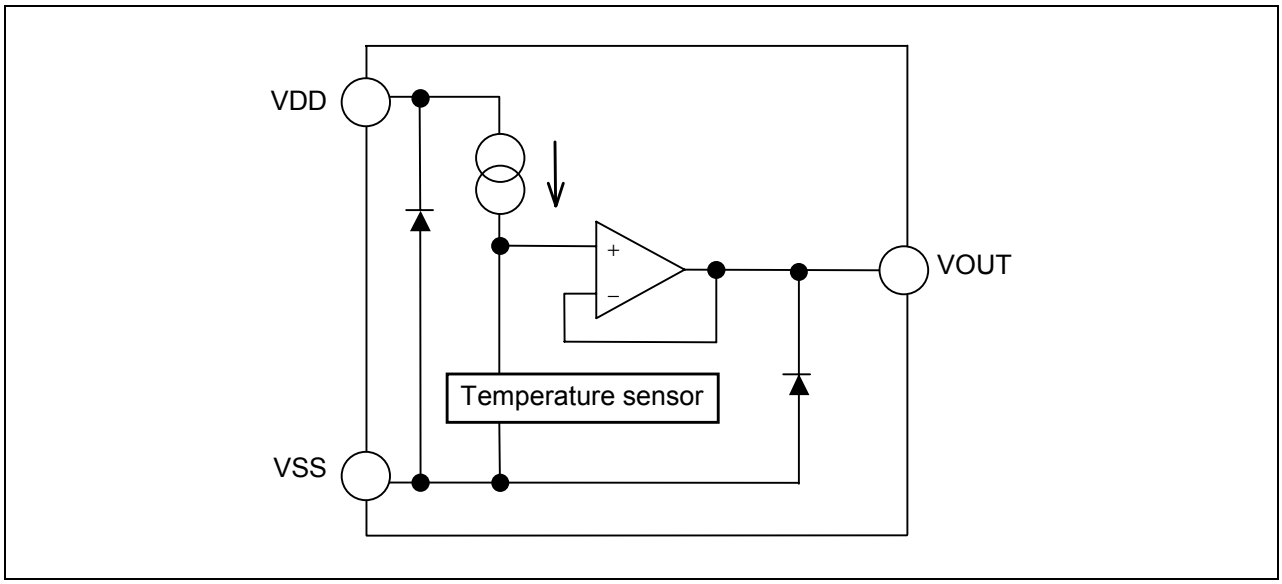
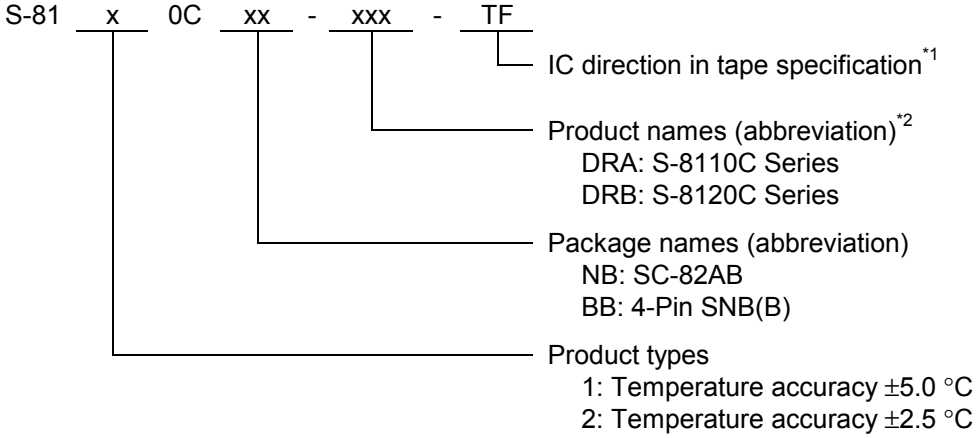


Figure 1

■ Selection Guide

- The product types and package types for S-8110C/8120C Series can be selected at the user's request. Please refer to the "Product name selection guide" for the construction of the product name and "Product name list" for the full product names.

1. Product name selection guide



*1. Please refer to the taping drawings.
*2. Please refer to the product name list.

2. Product name list

Table 1

	SC-82AB	4-Pin SNB(B)
S-8110C Series	S-8110CNB-DRA-TF	S-8110CBB-DRA-TF
S-8120C Series	S-8120CNB-DRB-TF	S-8120CBB-DRB-TF

■ Pin Configurations

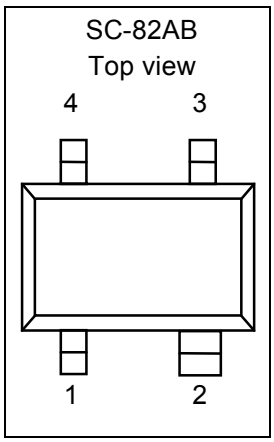


Figure 2

Table 2

Pin No.	Pin Symbol	Pin 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.

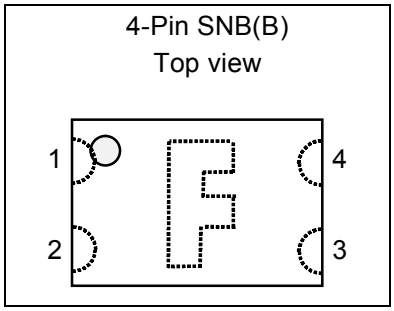


Figure 3

Table 3

Pin No.	Symbol	Pin 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.

■ Absolute Maximum Ratings

Table 4

(Ta=25 °C unless otherwise specified)

Items	Symbols	Absolute Maximum Ratings		Units
Power supply pin voltage	V_{DD}	V_{SS}–0.3 to V_{SS}+12.0		V
Output pin voltage	V_{OUT}	V_{SS}–0.3 to V_{DD}+0.3		
Power dissipation	P_D	SC-82AB	150	mW
		4-Pin SNB(B)	60	
Operating ambient temperature range	Topr	–40 to +100		°C
Storage ambient temperature range	Tstg	–40 to +125		

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

1. S-8110C Series

Table 5
(Ta=25 °C, V_{DD}=5.0 V, I_{OUT}=0 A unless otherwise specified)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Test circuit
Power supply voltage	V_{DD}	—	2.4	—	10.0	V	1
Output voltage	V_{OUT}	Ta= −30 °C	1.911	1.951	1.991		
		Ta= +30 °C	1.434	1.474	1.514		
		Ta= +100 °C	0.842	0.882	0.922		
Temperature sensitivity	V_{SE}	−30 °C ≤ Ta ≤ +100 °C	−8.40	−8.20	−8.00	mV/ °C	—
Nonlinearity	ΔN_L	−20 °C ≤ Ta ≤ +80 °C	—	±0.5	—	%	
Operating temperature range	Topr	—	−40	—	+100	°C	
Current consumption	I_{DD}	—	—	4.5	8.0	μA	1
Line regulation	ΔV_{OUT1}	V_{DD}=2.4 V to 10.0 V	—	—	0.05	%/ V	2
Load regulation*1	ΔV_{OUT2}	I_{OUT}=0 μA to 200 μA	—	—	1.0	mV	

***1.** Please do not flow sink current into the output voltage pin.

2. S-8120C Series

Table 6
(Ta=25 °C, V_{DD}=5.0 V, I_{OUT}=0 A unless otherwise specified)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Test Circuit
Power supply voltage	V_{DD}	—	2.4	—	10.0	V	1
Output voltage	V_{OUT}	Ta= −30 °C	1.931	1.951	1.971		
		Ta= +30 °C	1.454	1.474	1.494		
		Ta= +100 °C	0.862	0.882	0.902		
Temperature sensitivity	V_{SE}	−30 °C ≤ Ta ≤ +100 °C	−8.40	−8.20	−8.00	mV/ °C	—
Nonlinearity	ΔN_L	−20 °C ≤ Ta ≤ +80 °C	—	±0.5	—	%	
Operating temperature range	Topr	—	−40	—	+100	°C	
Current consumption	I_{DD}	—	—	4.5	8.0	μA	1
Line regulation	ΔV_{OUT1}	V_{DD}=2.4 V to 10.0 V	—	—	0.05	%/ V	2
Load regulation*1	ΔV_{OUT2}	I_{OUT}=0 μA to 200 μA	—	—	1.0	mV	

***1.** Please do not flow sink current into the output voltage pin.

■ Test Circuits

1.

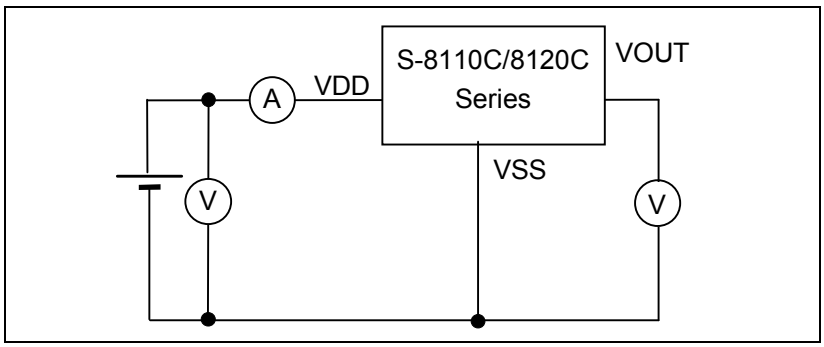


Figure 4

2.

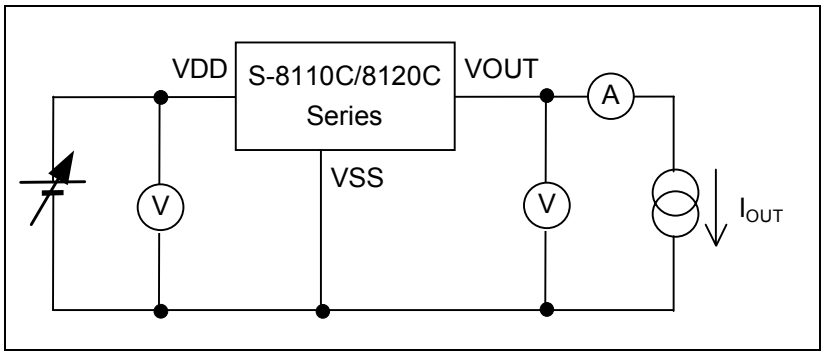


Figure 5

■ Definition of Terms

1. Output voltage (V_{OUT})

V_{OUT} indicates the output voltage at Ta=–30 °C, Ta=+30 °C and Ta=+100 °C.

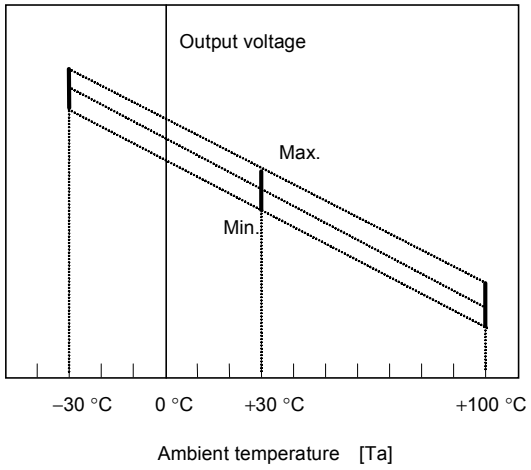


Figure 6

2. Temperature sensitivity (V_{SE})

V_{SE} indicates the temperature coefficient of the output voltage calculated using the output voltage at Ta=–30 °C and Ta=+100 °C.
V_{SE} is calculated using the following formula.

$$V_{SE} = \frac{\left[V_{OUT}{}^{*1} - V_{OUT}{}^{*2}\right]}{130^{*3}}$$

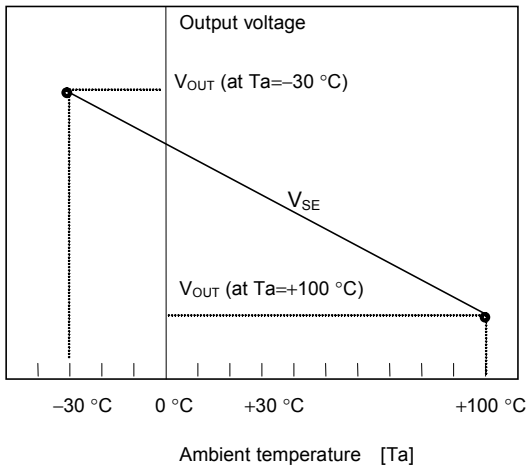


Figure 7

***1.** V_{OUT} value at Ta=+100 °C. [V]
***2.** V_{OUT} value at Ta=–30 °C. [V]
***3.** The difference of the temperature from Ta=+100 °C to Ta=–30 °C. [°C]

3. Nonlinearity (ΔN_L)

ΔN_L indicates the nonlinearity of the output voltage and is defined as the difference of the characteristic curve of the output voltage and the approximated straight line shown below.
ΔN_L is calculated using the following formula.

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

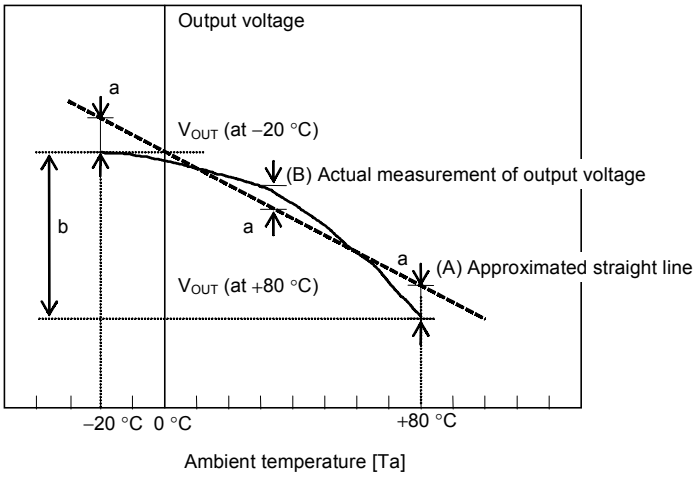


Figure 8

***1.** The maximum deviation of the actual measurement of output voltage (B) and an approximated straight line (A) in temperature within −20 °C to +80 °C. (An approximated straight line is taken as the straight line from which the "a" becomes the minimum.)
***2.** The difference of the output voltage within −20 °C to +80 °C.

4. Line regulation (ΔV_{OUT1})

ΔV_{OUT1} indicates the output voltage dependence on the input voltage. That is, the values express how the output voltage changes, when input voltage is changed under the condition that output current is fixed.

5. Load regulation (ΔV_{OUT2})

ΔV_{OUT2} indicates the output voltage dependence on the output current. That is, the values express how the output voltage changes, when output current is changed under the condition that input voltage is fixed.

■ Precautions

- Wiring patterns for VDD pin, VOUT pin and VSS pin should be designed to hold low impedance. When mounting an output capacitor, the distance from the capacitor to the VOUT pin and to the VSS pin should be as short as possible.
- To prevent oscillation, it is recommended to use the external components under the following conditions.

  Output capacitor (C_L): 100 pF or less
  Output resistance (R_L): 500k Ω or more

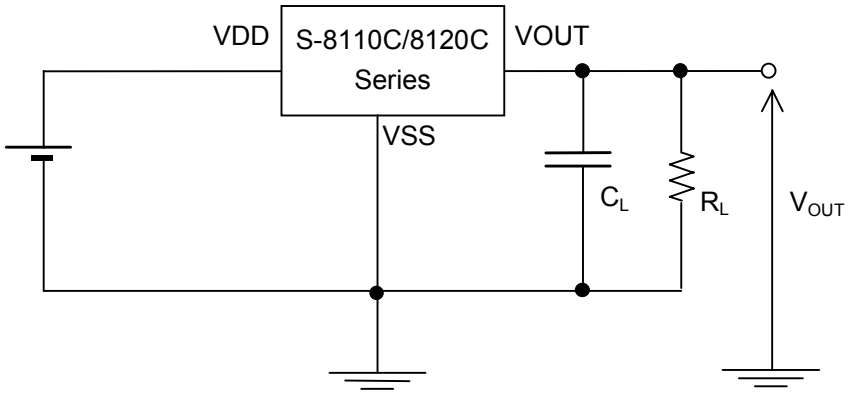


Figure 9

- Please do not connect a pull-up resistor to the output voltage pin.
- The application condition for input voltage, output voltage and load current should 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.
- In determining output current, attention should be paid to the output current value specified in the table 5 and table 6 for electrical characteristics and the footnote *1 of the table 5 and table 6.
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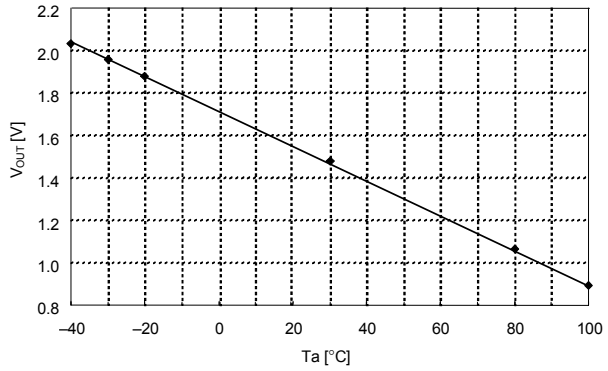
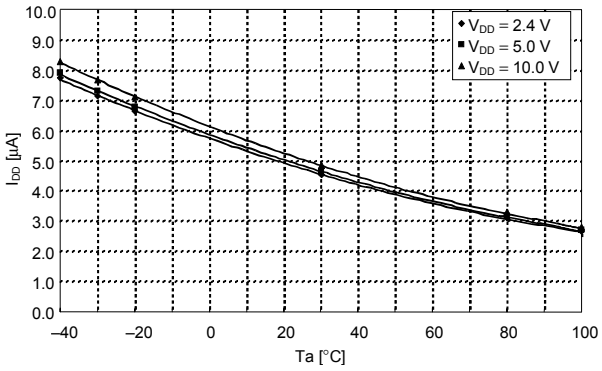
■ Typical Characteristics

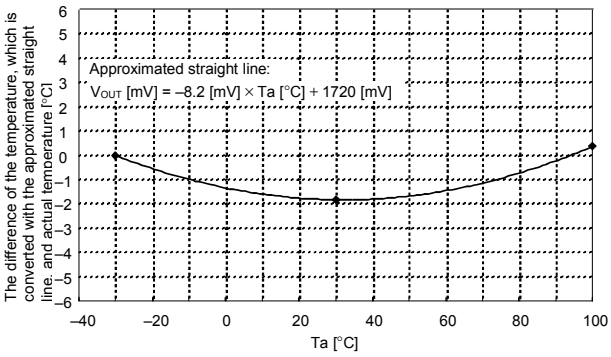
Temperature (Ta) vs. Output voltage (V_{OUT})



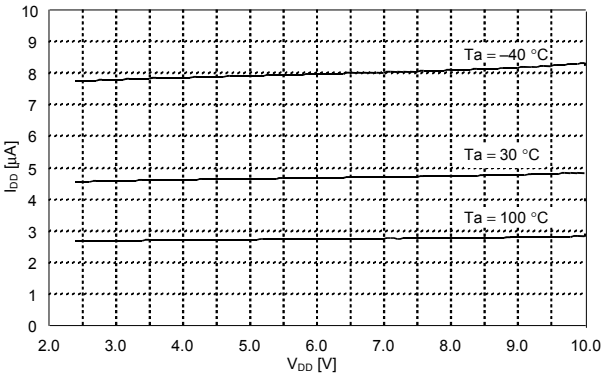
Temperature (Ta) vs. Current consumption (I_{DD})



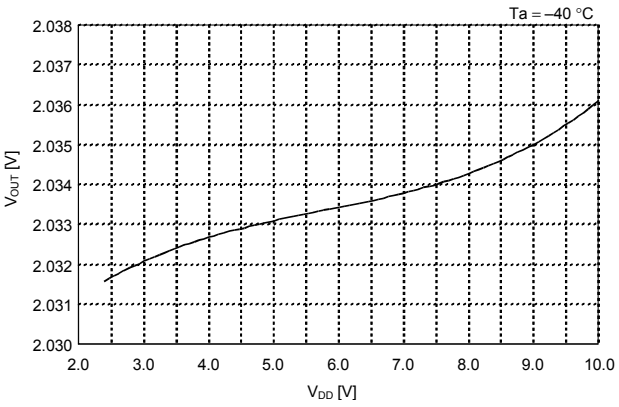
Error range of each temperature

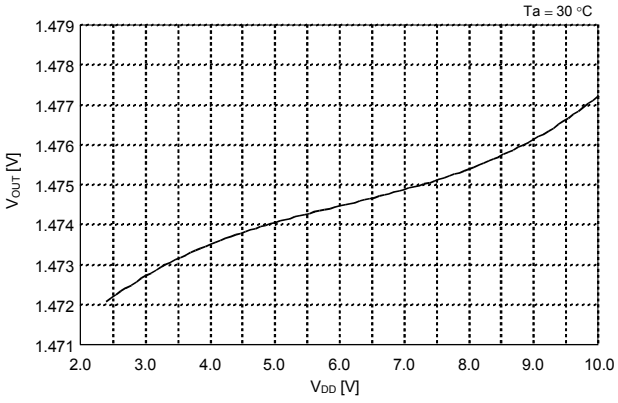


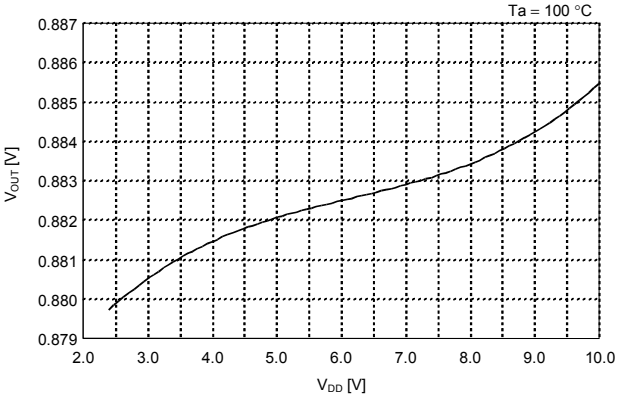
Power supply voltage (V_{DD}) vs. Current consumption (I_{DD})



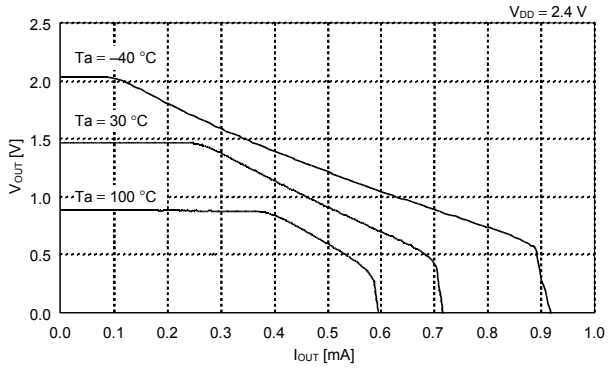
Power supply voltage (V_{DD}) vs. Output voltage (V_{OUT})

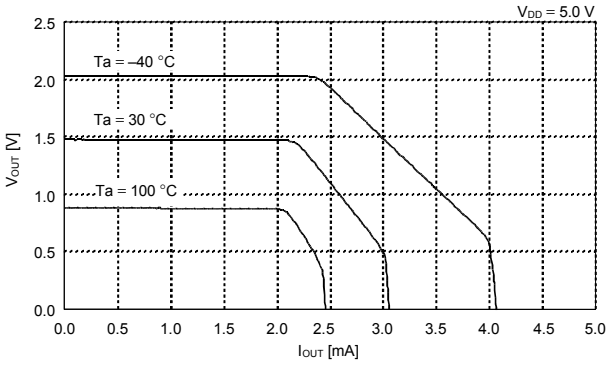


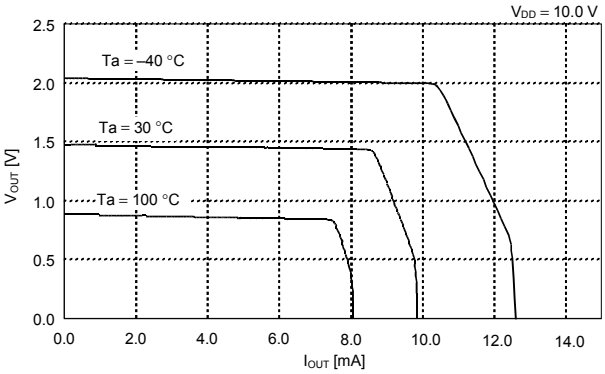




Load current (I_{OUT}) vs. Output voltage (V_{OUT})

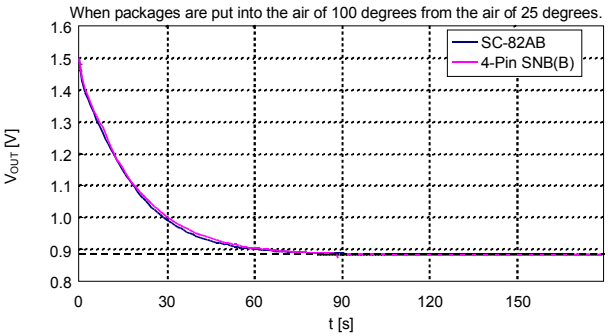


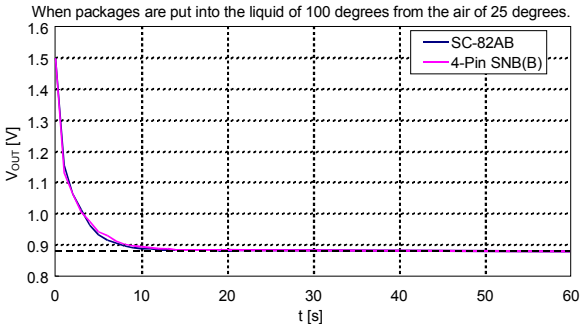




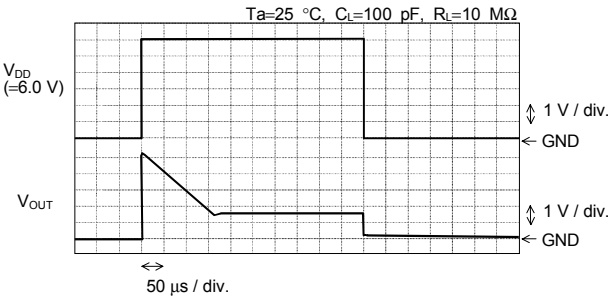
Heat response

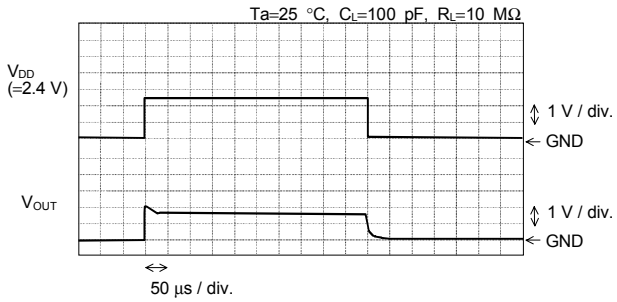
Time (t) vs. Output voltage (V_{OUT})





Start up response



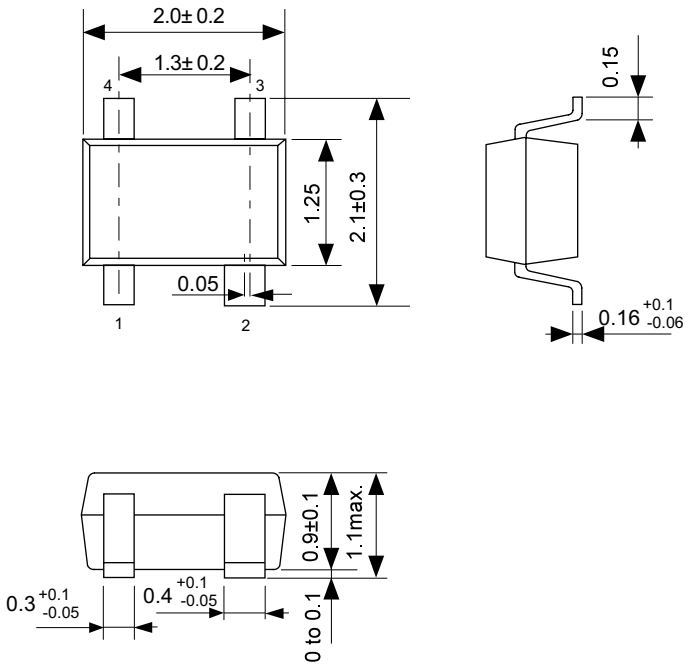


■ SC-82AB

NP004-A **Rev.2.0** 020921

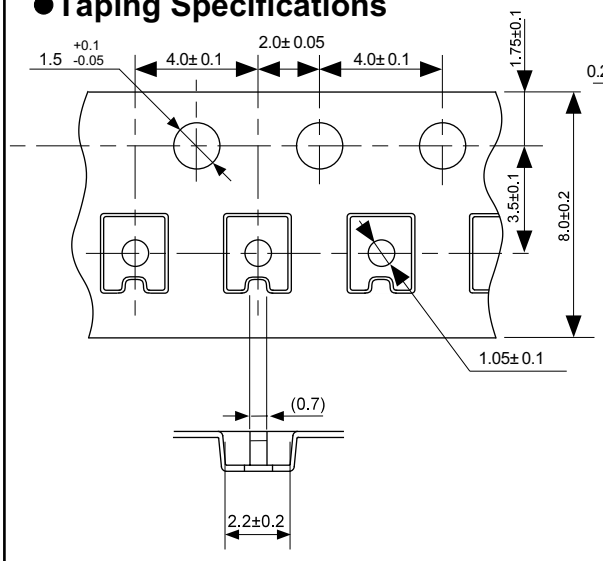
Unit:mm

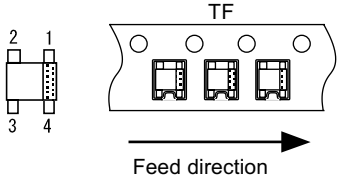
●Dimensions



No. NP004-A-P-SD-1.0

●Taping Specifications





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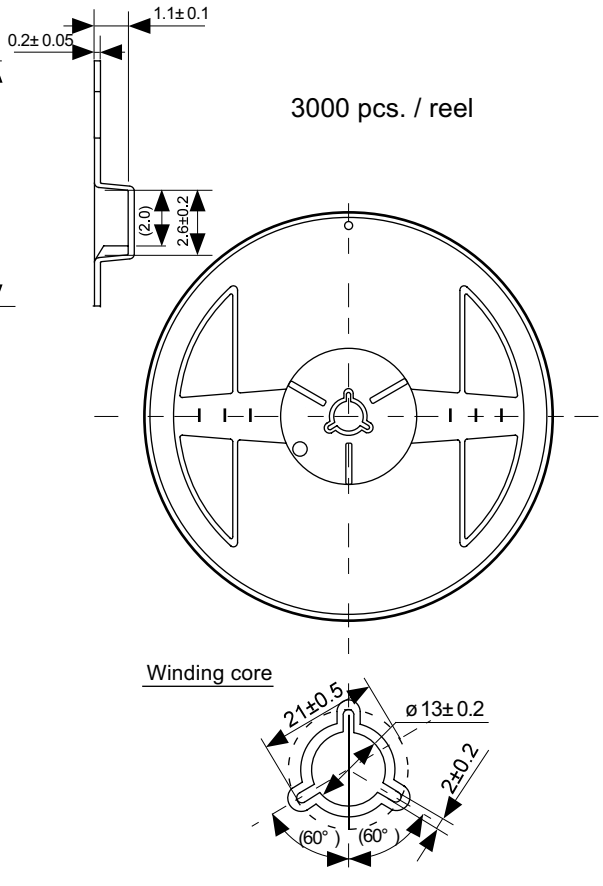
●Reel Specifications



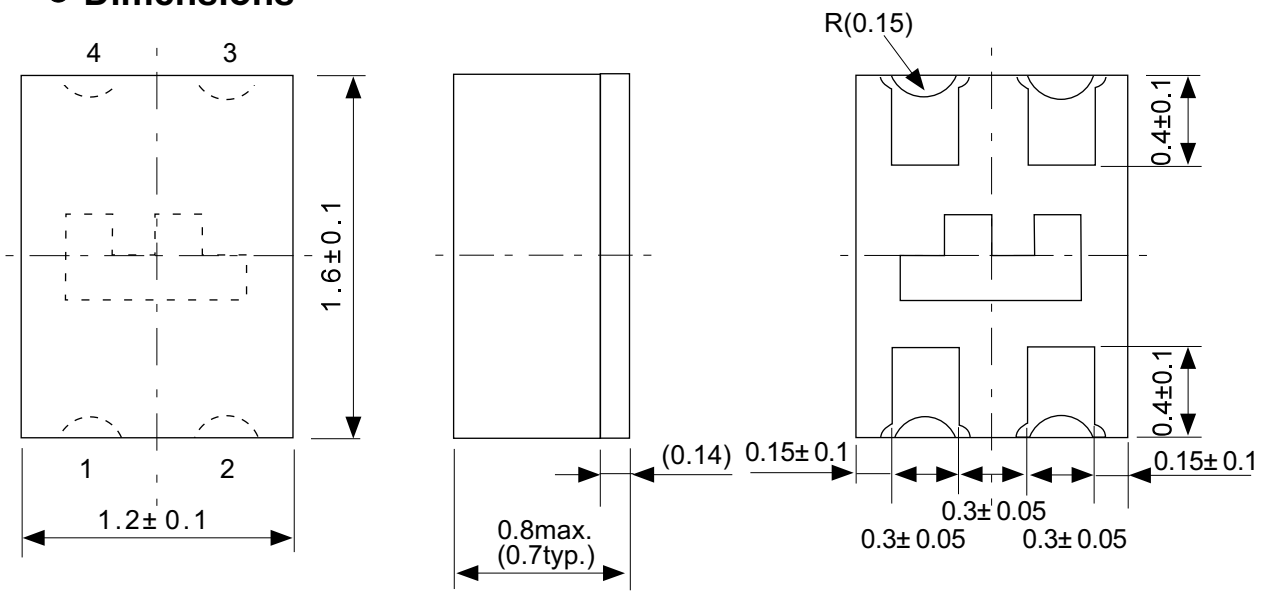
No. NP004-A-R-SD-1.0

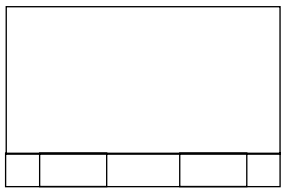
■ 4-Pin SNB(B) [SNB4B(1216)]

BB004-A 010801

Unit : mm

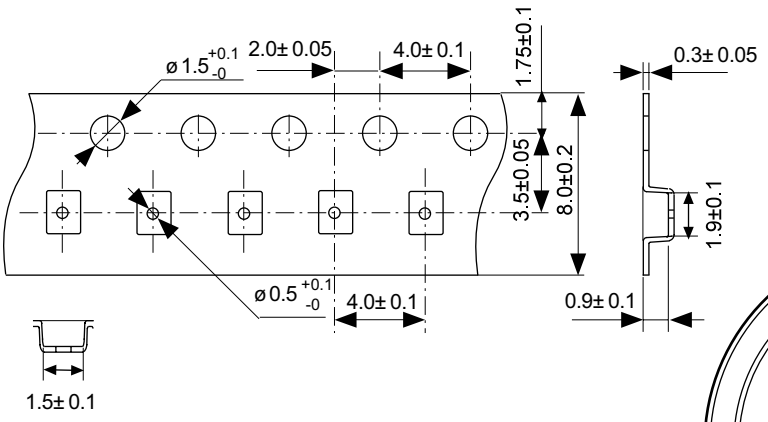
● Dimensions

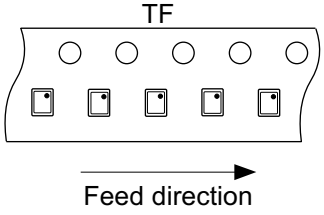




No. : BB004-A-P-SD-1.0

● Tape Specifications

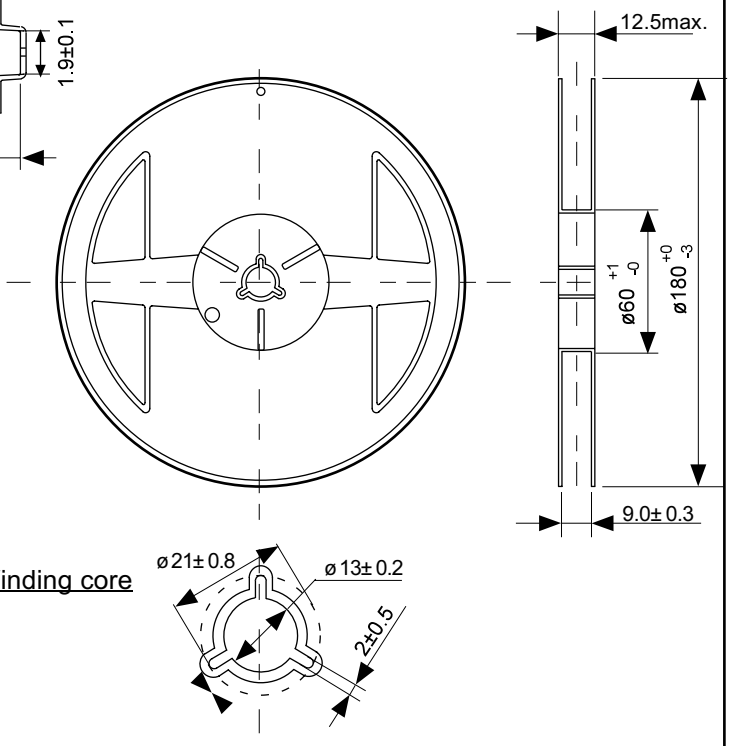




No. : BB004-A-C-SD-1.0

● Reel Specifications

5000 pcs./ reel



No. : BB004-A-R-SD-1.0

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