

**HIGH-ACCURACY DIGITAL TEMPERATURE SENSOR
WITH THERMOSTAT FUNCTION**www.ablicinc.com

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Rev.1.2_01

The S-5852A Series is a high-accuracy digital temperature sensor with thermostat function, which operates in 1.7 V to 3.6 V voltage ranges. The S-5852A Series interfaces with exteriors via I²C-bus and operates at 1.0 MHz maximum. The temperature detection signal is output by using the thermostat function which can be set by the I²C-bus. Moreover, a substantial reduction in current consumption may be achieved by using the shutdown mode which can be set by the I²C-bus.

The operation of the S-5852A Series is explained in the user's manual. Contact our sales office for more information.

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 ABLIC Inc. is indispensable.

■ Features

- Temperature accuracy, high-accuracy temperature range^{*1}: ±0.5°C typ. / ±1.0°C max. (Ta = 0°C to +65°C)
±0.5°C typ. / ±1.0°C max. (Ta = +75°C to +95°C)
- Temperature resolution: 0.5°C, 0.25°C, 0.125°C, 0.0625°C
(Selectable by the resolution register)
- Temperature sample rate: 7 samples / s min.
- Hysteresis width: No hysteresis, 1.5°C, 3.0°C, 6.0°C
(Selectable by the configuration register)
- Current consumption:
 - Shutdown mode at serial bus non-active: I_{DD3} = 0.3 μA typ., I_{DD3} = 3.0 μA max.
 - Active mode at serial bus non-active: I_{DD1} = 40.0 μA typ., I_{DD1} = 100.0 μA max.
- Operation voltage range: 1.7 V to 3.6 V
- Operation frequency: 1.0 MHz max. (V_{DD} = 2.2 V to 3.6 V)
400 kHz max. (V_{DD} = 1.7 V to 2.2 V)
- Thermostat function: Dual trip mode, single trip mode
(Selectable by the configuration register)
- Noise suppression: Schmitt trigger and noise filter on input pins (SCL, SDA)
- Operation temperature range: Ta = -40°C to +125°C
- Lead-free (Sn 100%), halogen-free

*1. The option of the high-accuracy temperature range can be selected.

■ Applications

- Solid state drive
- Hard disk drive
- Notebook PC, tablet PC
- Refrigerator
- Air conditioning system

■ Package

- HSNT-8(2030)

■ **Block Diagram**

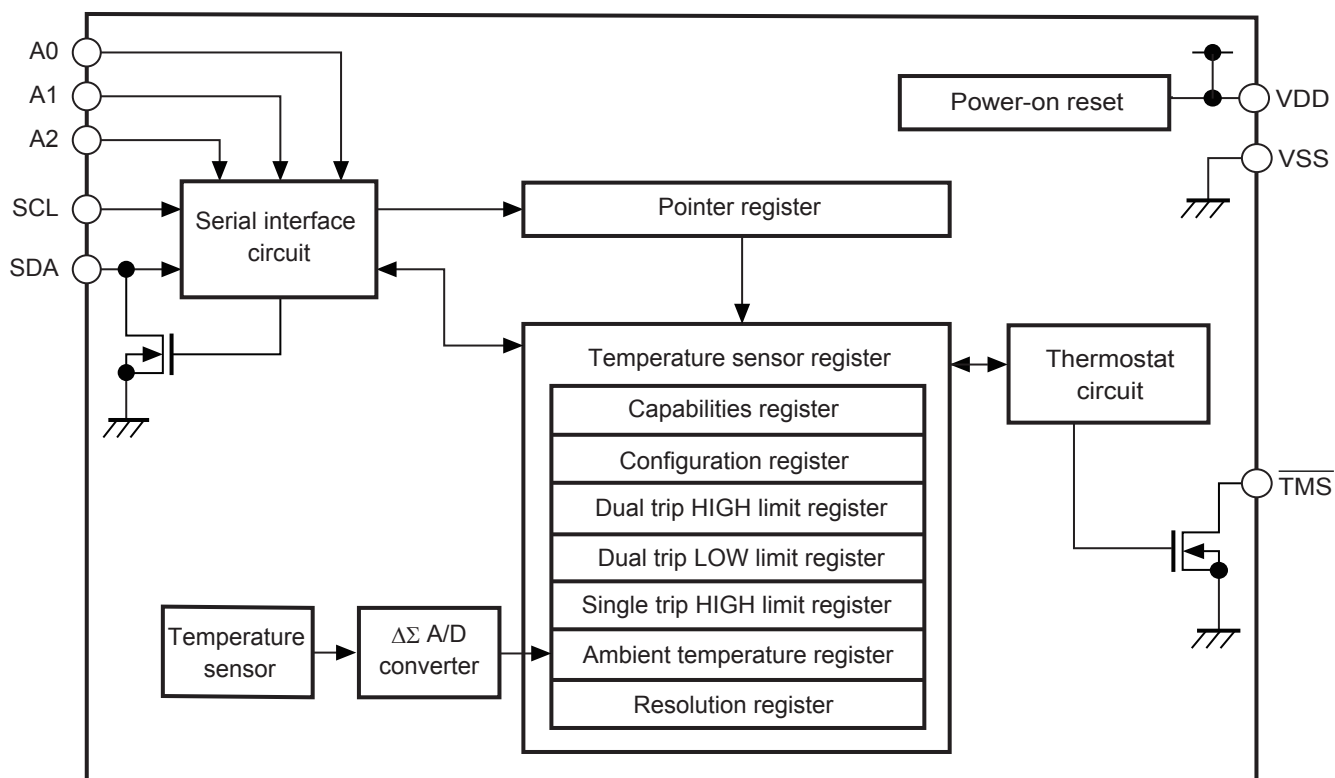
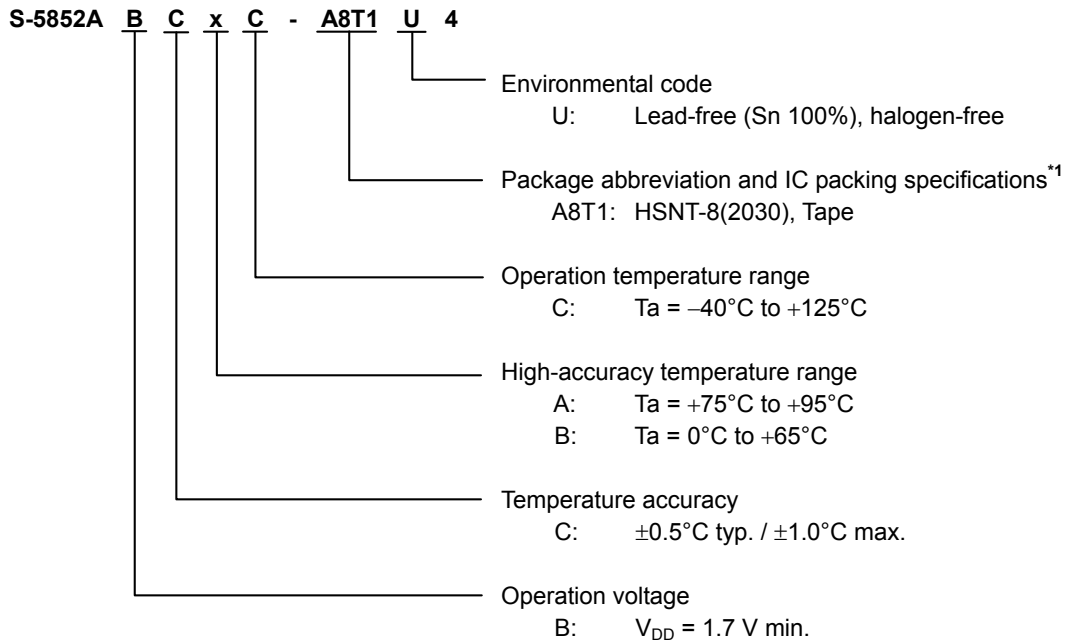


Figure 1

■ Product Name Structure

1. Product name



*1. Refer to the tape drawing.

2. Package

Table 1 Package Drawing Codes

| Package Name | Dimension | Tape | Reel | Land |
|--------------|--------------|--------------|--------------|--------------|
| HSNT-8(2030) | PP008-A-P-SD | PP008-A-C-SD | PP008-A-R-SD | PP008-A-L-SD |

3. Product name list

Table 2

| Product Name | Operation Voltage | Temperature Accuracy | High-accuracy Temperature Range | Operation Temperature Range |
|--------------------|-------------------|---------------------------|---------------------------------|-----------------------------|
| S-5852ABCAC-A8T1U4 | 1.7 V min. | ±0.5°C typ. / ±1.0°C max. | Ta = +75°C to +95°C | Ta = -40°C to +125°C |
| S-5852ABCBC-A8T1U4 | 1.7 V min. | ±0.5°C typ. / ±1.0°C max. | Ta = 0°C to +65°C | Ta = -40°C to +125°C |

■ **Pin Configuration**

1. HSNT-8(2030)

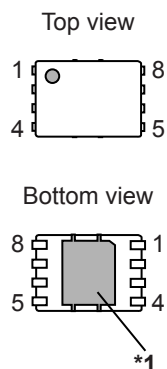


Table 3

| Pin No. | Symbol | Description |
|---------|-------------------|---|
| 1 | A0 | Slave address input pin |
| 2 | A1 | Slave address input pin |
| 3 | A2 | Slave address input pin |
| 4 | VSS | GND pin |
| 5 | SDA ^{*2} | Serial data I/O pin |
| 6 | SCL ^{*2} | Serial clock input pin |
| 7 | TMS | Temperature switch output (Thermostat output) pin |
| 8 | VDD | Power supply pin |

Figure 2

- *1. Connect the heat sink of backside at shadowed area to the board, and set electric potential open or GND. However, do not use it as the function of electrode.
- *2. Do not use it in "High-Z".

■ Absolute Maximum Ratings

Table 4

| Item | Symbol | Absolute Maximum Rating | Unit |
|---------------------------------|-----------|-------------------------|------|
| Power supply voltage | V_{DD} | -0.3 to +4.3 | V |
| Input voltage (SCL, A0, A1, A2) | V_{IN} | -0.3 to +4.3 | V |
| I/O voltage (SDA) | V_{IO} | -0.3 to +4.3 | V |
| Output voltage (TMS) | V_{OUT} | -0.3 to +4.3 | V |
| Operation ambient temperature | T_{opr} | -40 to +125 | °C |
| Storage temperature | T_{stg} | -65 to +150 | °C |

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 Operation Conditions

Table 5

| Item | Symbol | Min. | Max. | Unit |
|-------------------------------|-----------|---------------------|---------------------|------|
| Power supply voltage | V_{DD} | 1.7 | 3.6 | V |
| Operation ambient temperature | T_{opr} | -40 | +125 | °C |
| High level input voltage | V_{IH} | $0.7 \times V_{DD}$ | 3.6 | V |
| Low level input voltage | V_{IL} | -0.3 | $0.3 \times V_{DD}$ | V |

■ Pin Capacitance

Table 6

($T_a = +25^\circ\text{C}$, $f_{SCL} = 1.0 \text{ MHz}$, $V_{DD} = 2.5 \text{ V}$)

| Item | Symbol | Condition | Min. | Max. | Unit |
|--------------------|-----------|--|------|------|------|
| Input capacitance | C_{IN} | $V_{IN} = 0 \text{ V}$ (SCL, A0, A1, A2) | - | 6 | pF |
| I/O capacitance | $C_{I/O}$ | $V_{I/O} = 0 \text{ V}$ (SDA) | - | 8 | pF |
| Output capacitance | C_{OUT} | $V_{OUT} = 0 \text{ V}$ (TMS) | - | 8 | pF |

■ DC Electrical Characteristics

Table 7

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|--------------------------------------|------------------|--|------|------|-------|------|
| Current consumption at active mode | I _{DD1} | Active mode at serial bus non-active | – | 40.0 | 100.0 | μA |
| | I _{DD2} | Active mode at serial bus active | – | – | 400.0 | μA |
| Current consumption at shutdown mode | I _{DD3} | Shutdown mode at serial bus non-active | – | 0.3 | 3.0 | μA |
| | I _{DD4} | Shutdown mode at serial bus active | – | – | 400.0 | μA |

Table 8

| Item | Symbol | Condition | Min. | Max. | Unit |
|----------------------------|------------------|--|------|------|------|
| Input leakage current | I _{LI} | SCL, SDA V _{IN} = V _{SS} to V _{DD} | – | 1.0 | μA |
| Output leakage current | I _{LO} | SDA, $\overline{\text{TMS}}$ V _{OUT} = V _{SS} to V _{DD} | – | 1.0 | μA |
| Input current 1 | I _{IL} | A0, A1, A2 V _{IN} < 0.3 × V _{DD} | – | 50.0 | μA |
| Input current 2 | I _{IH} | A0, A1, A2 V _{IN} > 0.7 × V _{DD} | – | 2.0 | μA |
| Input impedance 1 | Z _{IL} | A0, A1, A2 V _{IN} = 0.3 × V _{DD} | 30 | – | kΩ |
| Input impedance 2 | Z _{IH} | A0, A1, A2 V _{IN} = 0.7 × V _{DD} | 800 | – | kΩ |
| Low level output voltage | V _{OL} | SDA, $\overline{\text{TMS}}$ I _{OL} = 3.0 mA | – | 0.4 | V |
| Low level output current 1 | I _{OL1} | SDA, $\overline{\text{TMS}}$ V _{OL} = 0.4 V, 2.2 V ≤ V _{DD} ≤ 3.6 V | 20 | – | mA |
| Low level output current 2 | I _{OL2} | SDA, $\overline{\text{TMS}}$ V _{OL} = 0.6 V, 1.7 V ≤ V _{DD} ≤ 2.2 V | 6 | – | mA |

■ AC Electrical Characteristics

Table 9 Measurement Conditions

| | |
|-----------------------------------|--|
| Input pulse voltage | $0.2 \times V_{DD}$ to $0.8 \times V_{DD}$ |
| Input pulse rising / falling time | 20 ns or less |
| Output reference voltage | $0.3 \times V_{DD}$ to $0.7 \times V_{DD}$ |
| Output load | 100 pF + 1 kΩ pull-up resistance |

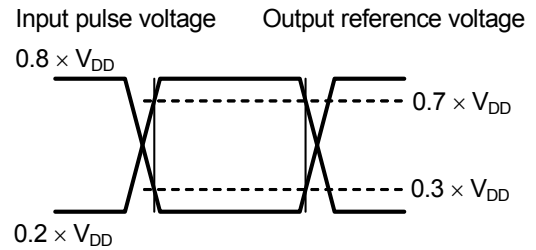


Figure 3 Input / Output Waveform during AC Measurement

Table 10

| Item | Symbol | $V_{DD} = 1.7 \text{ V to } 3.6 \text{ V}$ | | $V_{DD} = 2.2 \text{ V to } 3.6 \text{ V}$ | | Unit |
|----------------------------|--------------|--|------|--|------|------|
| | | Min. | Max. | Min. | Max. | |
| SCL clock frequency | f_{SCL} | 0 | 400 | 0 | 1000 | kHz |
| SCL clock time "L" | t_{LOW} | 1.3 | – | 0.5 | – | μs |
| SCL clock time "H" | t_{HIGH} | 0.6 | – | 0.26 | – | μs |
| SDA output delay time | t_{AA} | 0.1 | 0.9 | 0.1 | 0.45 | μs |
| SDA output hold time | t_{DH} | 50 | – | 50 | – | ns |
| SCL, SDA rising time | t_R | 0.02 | 0.3 | – | 0.12 | μs |
| SCL, SDA falling time | t_F | 0.02 | 0.3 | – | 0.12 | μs |
| Data input setup time | $t_{SU.DAT}$ | 100 | – | 50 | – | ns |
| Data input hold time | $t_{HD.DAT}$ | 0 | – | 0 | – | ns |
| Start condition setup time | $t_{SU.STA}$ | 0.6 | – | 0.26 | – | μs |
| Start condition hold time | $t_{HD.STA}$ | 0.6 | – | 0.26 | – | μs |
| Stop condition setup time | $t_{SU.STO}$ | 0.6 | – | 0.26 | – | μs |
| Bus release time | t_{BUF} | 1.3 | – | 0.5 | – | μs |
| Noise suppression time | t_i | – | 50 | – | 50 | ns |

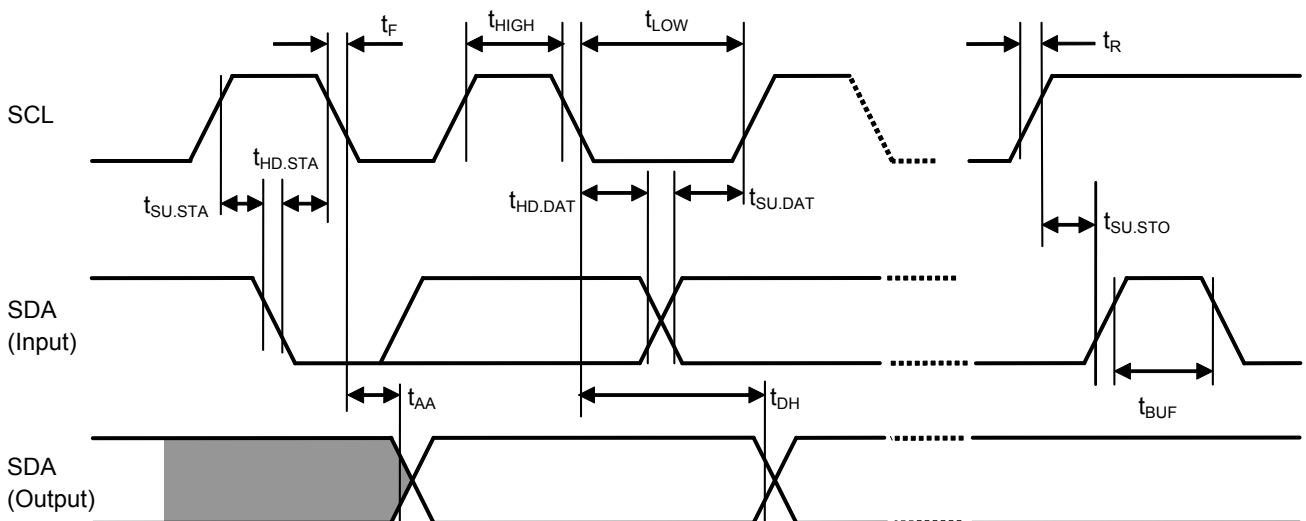


Figure 4 Bus Timing

■ **Temperature Characteristics**

Table 11

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|-----------------------------|--------------------|--|------|------|------|------|
| Temperature accuracy *1 | T _{ACC1} | Ta = 0°C to +65°C | – | ±0.5 | ±1.0 | °C |
| | T _{ACC2} | Ta = –40°C to +125°C | – | – | ±3.0 | °C |
| Temperature resolution | T _{RES} | Default value | – | 0.25 | – | °C |
| Temperature conversion time | t _{CONV1} | TRES[1:0] = "00" setting LSB = 0.5°C | – | – | 35 | ms |
| | t _{CONV2} | TRES[1:0] = "01" setting LSB = 0.25°C | – | – | 70 | ms |
| | t _{CONV3} | TRES[1:0] = "10" setting LSB = 0.125°C | – | – | 140 | ms |
| | t _{CONV4} | TRES[1:0] = "11" setting LSB = 0.0625°C | – | – | 140 | ms |

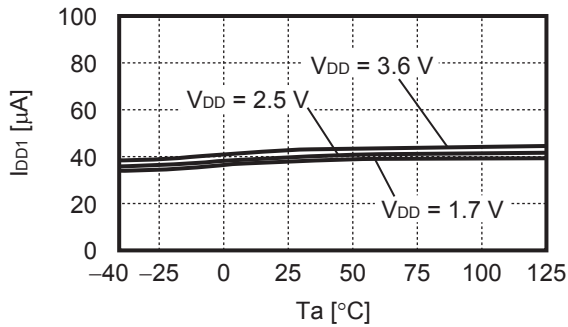
*1. TRES[1:0] = "11" setting

■ **Precautions**

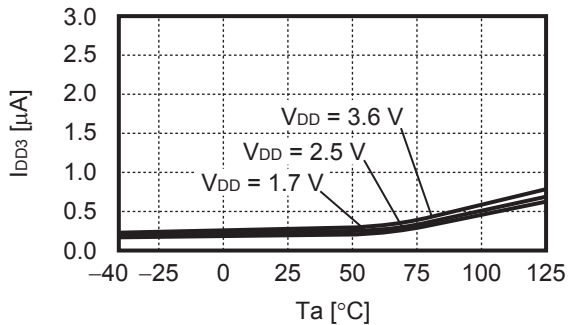
- Do not operate these ICs in excess of the absolute maximum ratings. Attention should be paid to the power supply voltage, especially. The surge voltage which exceeds the absolute maximum ratings can cause latch-up and malfunction. Perform operations after confirming the detailed operation condition in the datasheet.
- Operations with moisture on this IC's pins may occur malfunction by short-circuit between pins. Especially, in occasions like picking this IC up from low temperature tank during the evaluation. Be sure that there is no frost on this IC's pins to prevent malfunction by short-circuit.
Also attention should be paid in using on environment, which is easy to dew for the same reason.
- 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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■ Characteristics (Typical Data)

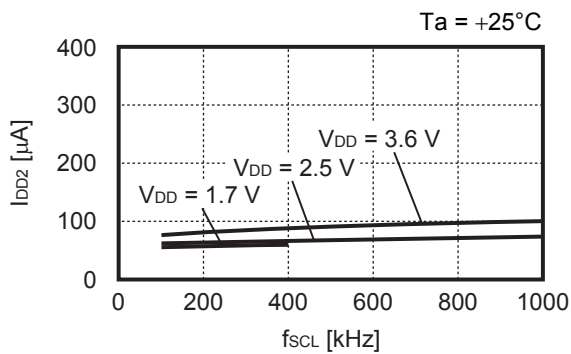
1. Current consumption at active mode (I_{DD1}) vs. Temperature (T_a)



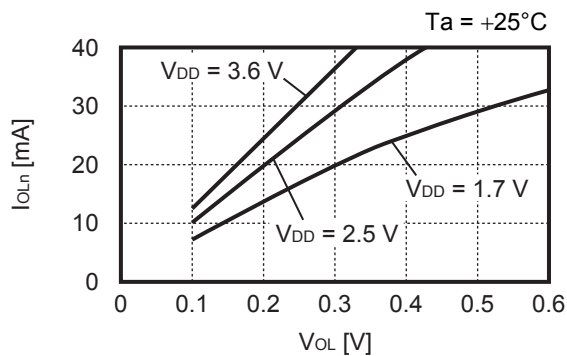
2. Current consumption at shutdown mode (I_{DD3}) vs. Temperature (T_a)



3. Current consumption at active mode (I_{DD2}) vs. SCL clock frequency (f_{SCL})

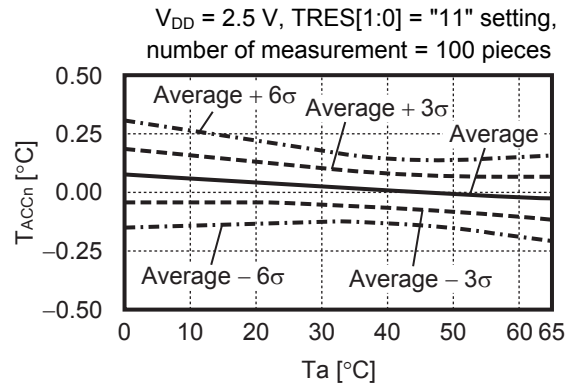
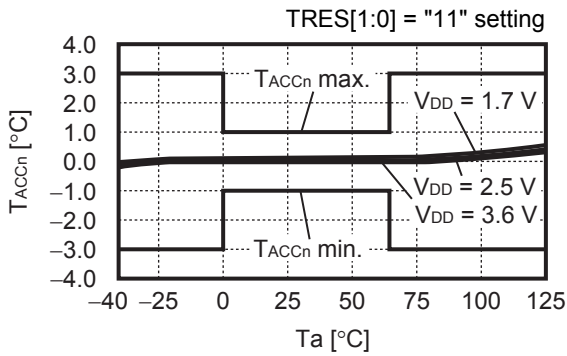


4. Low level output current (I_{OLn}) vs. Low level output voltage (V_{OL})



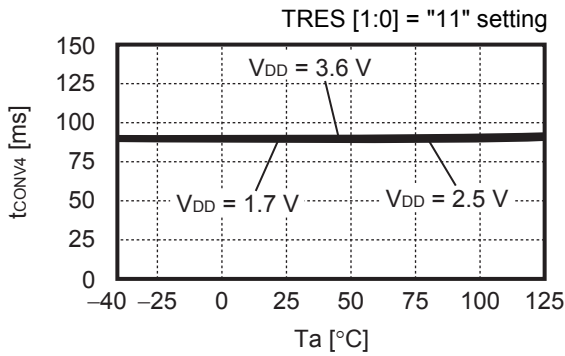
Remark $n = 1, 2$

5. Temperature accuracy (T_{ACCn}) vs. Temperature (T_a)



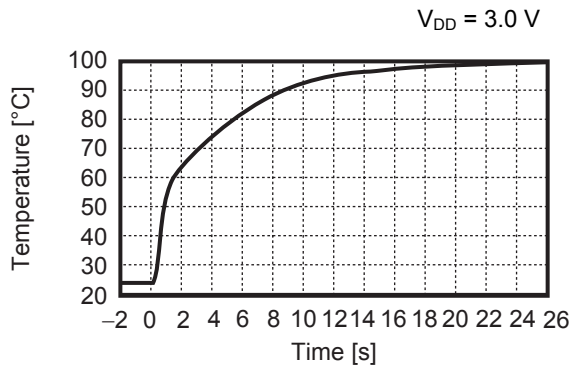
Remark n = 1, 2

6. Temperature conversion time (t_{CONV4}) vs. Temperature (T_a)

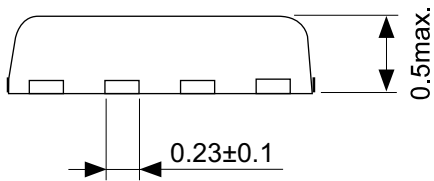
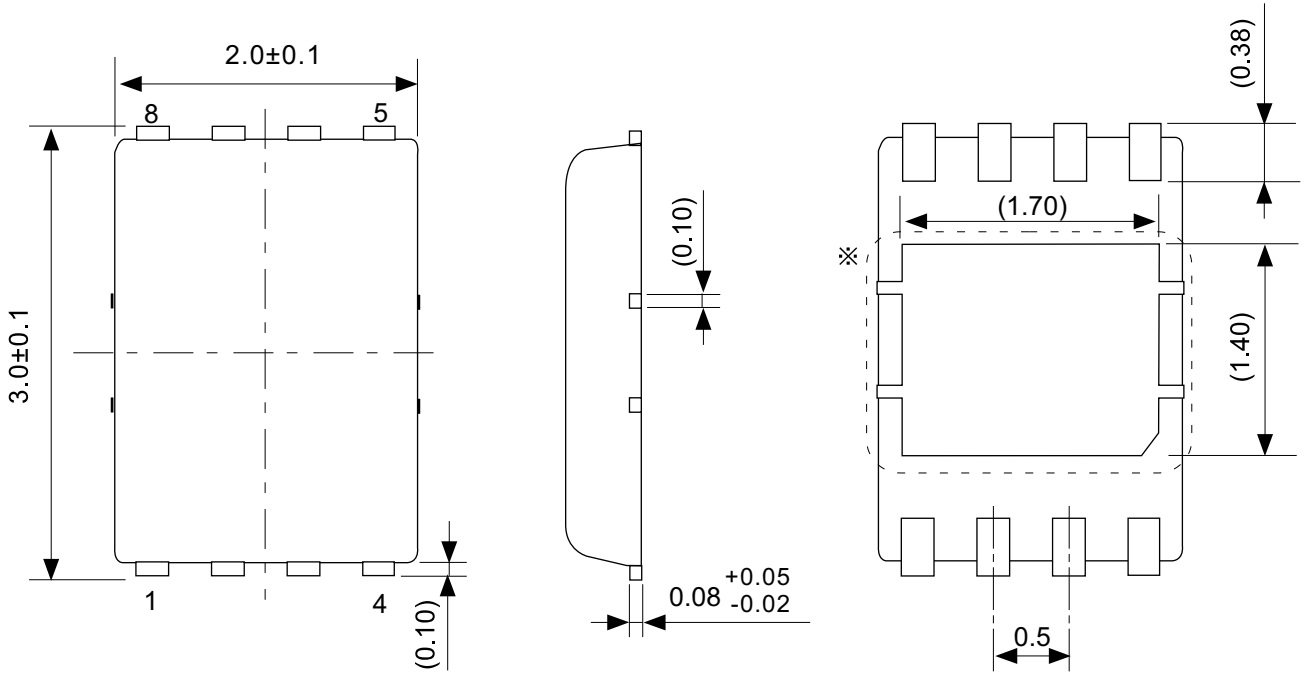


7. Thermal response time (Temperature vs. Time)

When HSNT-8(2030) mounted on the evaluation board is put into the liquid of +100°C from the air of +25°C.



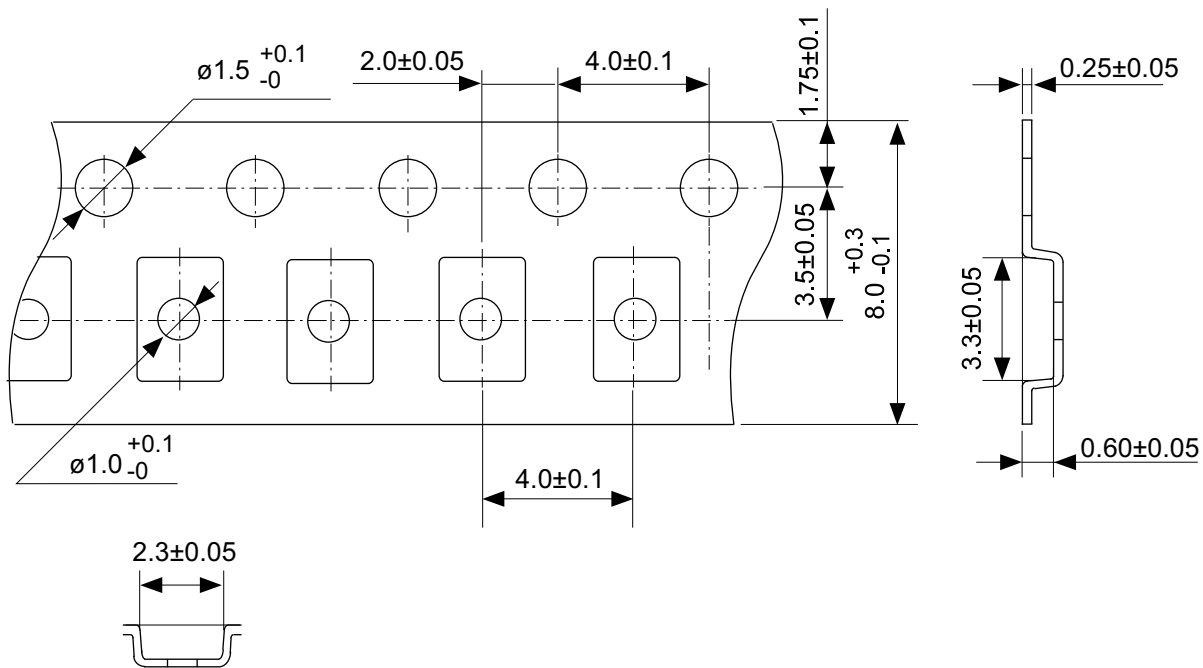
Remark Evaluation board
 Dimensions: 22 mm × 21 mm
 Thickness: 1.6 mm



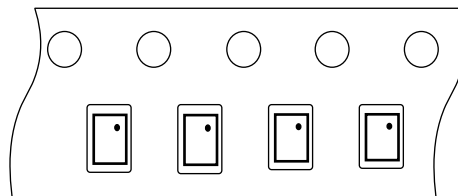
No. PP008-A-P-SD-2.0

※ The heat sink of back side has different electric potential depending on the product.
Confirm specifications of each product.
Do not use it as the function of electrode.

| | |
|-------------------|-------------------------------|
| TITLE | DFN-8/HSNT-8-A-PKG Dimensions |
| No. | PP008-A-P-SD-2.0 |
| ANGLE | |
| UNIT | mm |
| ABLIC Inc. | |



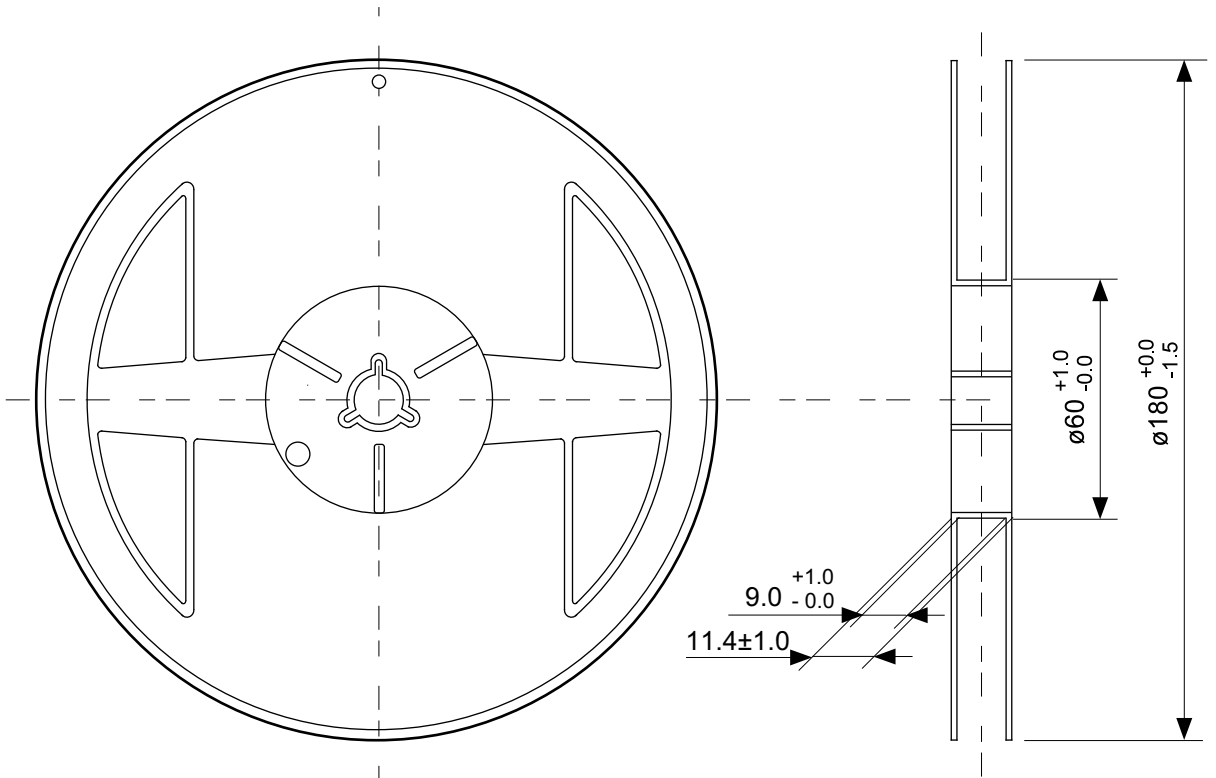
4 3 2 1
5 6 7 8



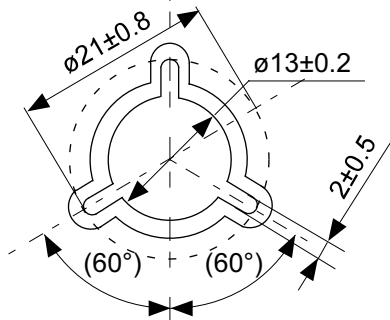
→
Feed direction

No. PP008-A-C-SD-1.0

| | |
|-------------------|-----------------------------|
| TITLE | DFN-8/HSNT-8-A-Carrier Tape |
| No. | PP008-A-C-SD-1.0 |
| ANGLE | |
| UNIT | mm |
| | |
| ABLIC Inc. | |

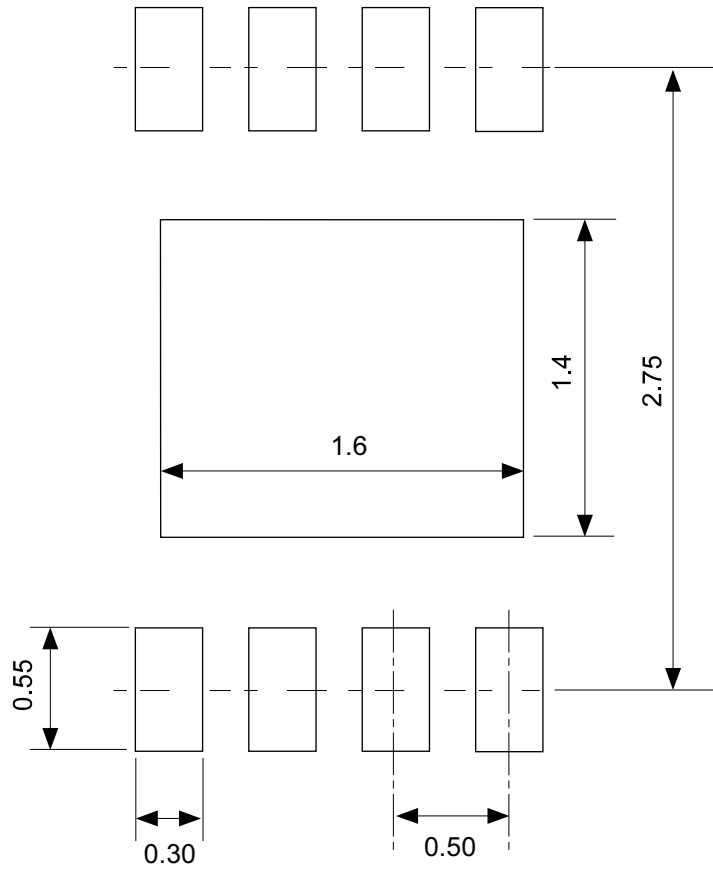


Enlarged drawing in the central part



No. PP008-A-R-SD-1.0

| | | | |
|-------------------|---------------------|------|-------|
| TITLE | DFN-8/HSNT-8-A-Reel | | |
| No. | PP008-A-R-SD-1.0 | | |
| ANGLE | | QTY. | 5,000 |
| UNIT | mm | | |
| | | | |
| ABLIC Inc. | | | |



No. PP008-A-L-SD-1.0

| | |
|-------------------|--|
| TITLE | DFN-8/HSNT-8-A -Land Recommendation |
| No. | PP008-A-L-SD-1.0 |
| ANGLE | |
| UNIT | mm |
| | |
| ABLIC Inc. | |

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