



CMOS IC Application Note

Automotive, Small HSNT Package User's Guide

Rev.1.0_00

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This manual describes the features, package dimensions, recommended land, handling methods as well as marking specifications and packing specifications of the automotive, small HSNT package, for users in the semiconductor mounting technology fields.

In addition, mounting evaluation, reliability testing results and thermal resistance data are also provided as reference data.

For the quality assurance system, notes on use and electrical characteristics of ABLIC Inc. CMOS ICs, refer to our website and individual data sheets available from ABLIC Inc.

Note that recommended conditions are subject to change depending on the external materials, conditions, environment, etc.

[Target Packages]

- HSNT-4(0808)B
- HSNT-4(1010)B

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1. Features of automotive HSNT package

1.1 General description

The automotive HSNT package is a small, thin and lightweight plastic encapsulated package for surface-mounting onto printed circuit boards, which has the following features.

1.1.1 Size

(1) HSNT-4(0808)B

The package size of HSNT-4(0808)B is 0.8 mm × 0.8 mm × t0.41 mm max. This package is equal to or less than 1/3 the component area of and thinner than our other conventional compact package, SNT-4A (1.6 mm × 1.2 mm × t0.5 mm).

(2) HSNT-4(1010)B

The package size of HSNT-4(1010)B is 1.0 mm × 1.0 mm × t0.41 mm max. This package is approximately 1/2 the component area of and thinner than the SNT-4A as HSNT-4(0808)B.

The package size is small and thin, making it an optimal package for automotive equipment (accessory, car navigation system, car audio system, etc.) which requires miniaturization and lightweight.

Figure 1 and **Figure 2** show the dimensions of each automotive HSNT package.

1.1.2 Heat dissipation

Copper is used for the lead frame in order to improve package heat dissipation, and the heat sink (lead frame) is exposed out of the package back surface.

By soldering the heat sink onto the printed circuit board, the heat generated from the IC can be quickly released to the circuit board.

1.1.3 Mountability and reliability

Despite its compact size and thin shape, the automotive HSNT package fully meets the same mountability and reliability level as is applied to our other compact packages. Refer to "**5.1 Mounting evaluation results (reference values)**" and "**5.2 Reliability testing results**".

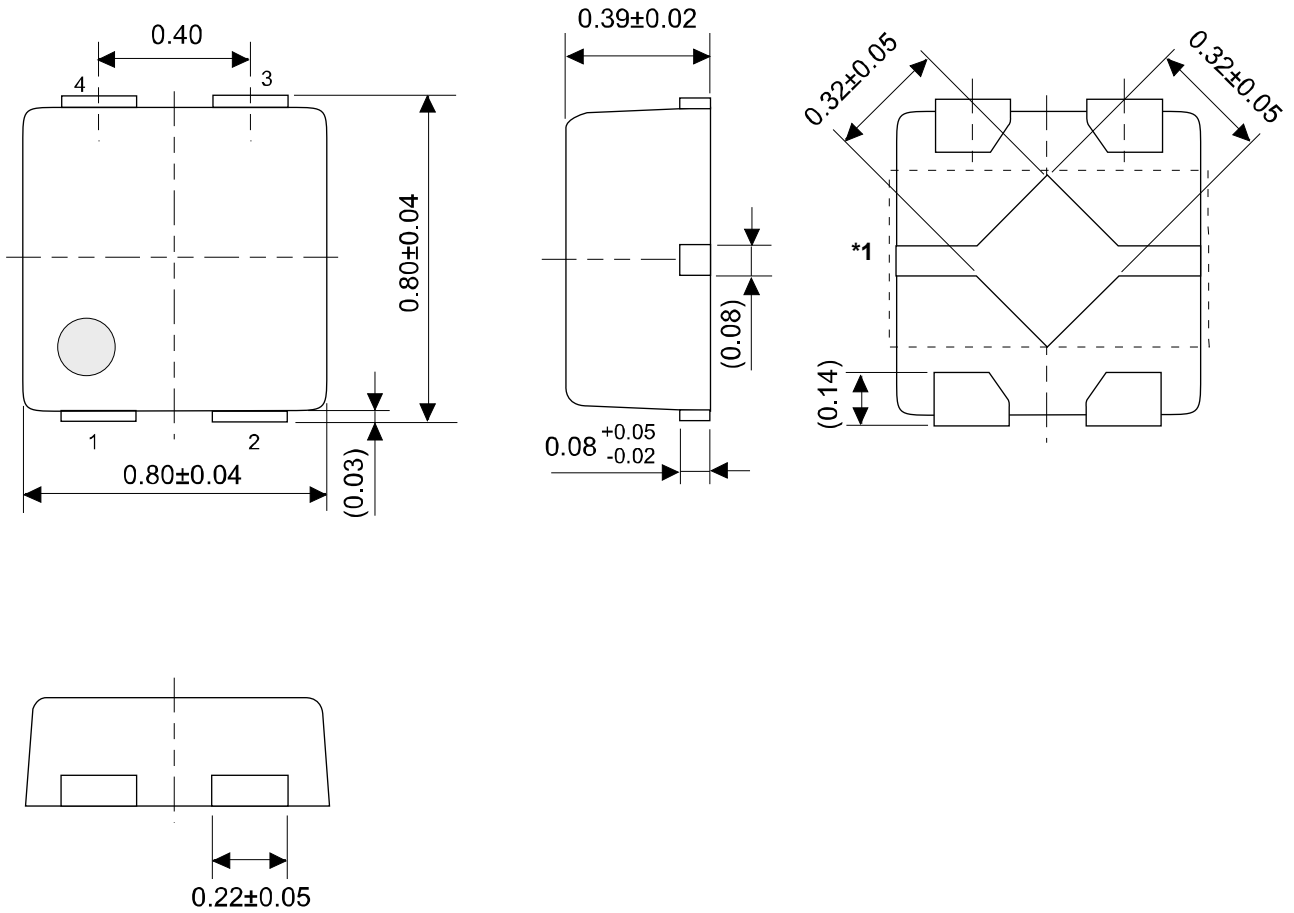
Table 1 shows specifications of the automotive HSNT package.

| Item | HSNT-4(0808)B | HSNT-4(1010)B |
|-----------------------------------|---------------------------------|---------------------------------|
| Number of pins | 4 | 4 |
| Sealing | Resin mold | |
| Dimensions (L × W × H) | 0.8 mm × 0.8 mm × t0.41 mm max. | 1.0 mm × 1.0 mm × t0.41 mm max. |
| Pitch | 0.40 mm | 0.65 mm |
| Pin material / surface processing | Cu / Sn 100% | |
| Plating thickness | Approximately 10 μm | |
| Package weight*1 | 0.64 mg | 1.05 mg |
| MSL | JEDEC Level 1 | |

*1. There may be some variation depending on the mounted IC.

1.2 Dimensions

1.2.1 HSNT-4(0808)B

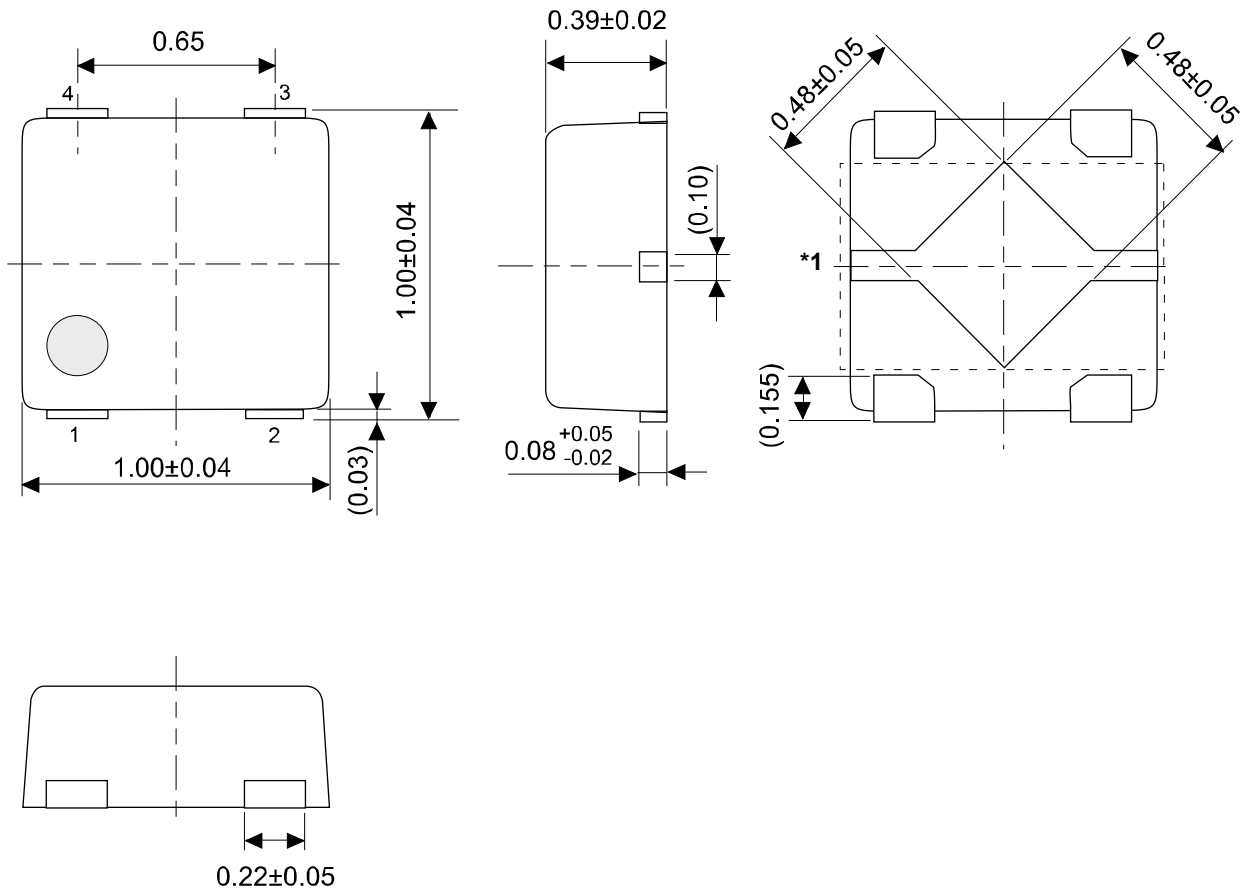


Unit: mm

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

Figure 1

1.2.2 HSNT-4(1010)B



Unit: mm

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

Figure 2

2. Components and materials of automotive HSNT package

In the automotive HSNT package, the IC is mounted on a Cu lead frame, which has epoxy-based resin molded structure. The outer lead soldered to the printed circuit board is Sn 100% plated.

Table 2 shows Package, Tape and Reel Materials.

Table 2

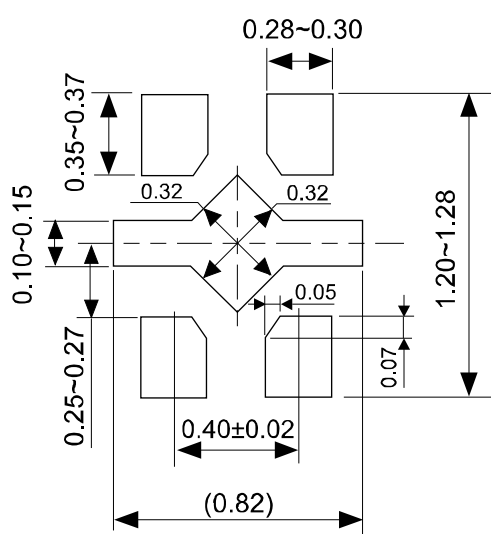
| Package and Reel Component | Material / Quality |
|----------------------------|----------------------------------|
| Molding resin | Epoxy-based resin |
| Lead frame | Cu |
| Surface processing on pins | Sn 100% |
| Bonding wire | Au (at least 99.99% pure) |
| Die bonding agent | Epoxy-based resin with Ag filler |
| Embossed tape | PS |
| Cover tape | PET |
| Reel | PS |

3. Recommended land dimensions and mask aperture dimensions for solder printing of each automotive HSNT package

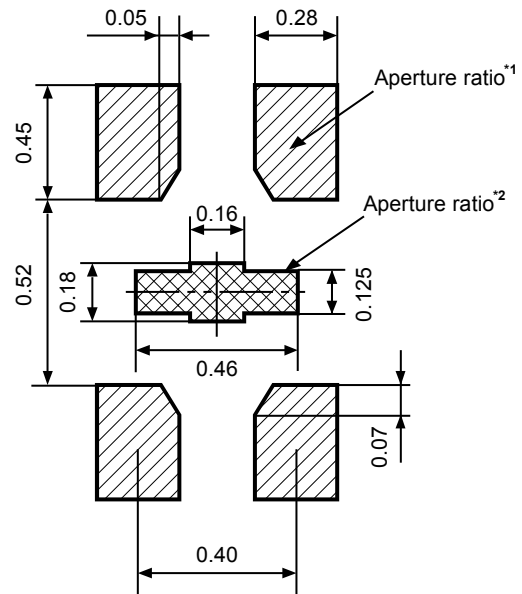
The figures below show the recommended land dimensions and mask aperture dimensions for each automotive HSNT package.

Caution The dimension values in the figures are not design values for circuit board land and masks, but finished dimensions. Design the figures according to the following dimensions with reference to the circuit board and mask manufacturing tolerances.

3.1 HSNT-4(0808)B



Unit: mm



Unit: mm

*1. Mask aperture ratio of the lead mounting part is 120%.

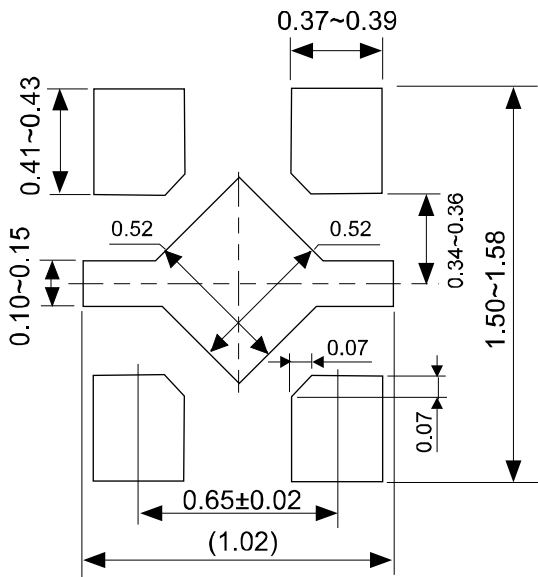
*2. Mask aperture ratio of the heat sink mounting part is approximately 40%.

Remark Mask thickness: t0.12 mm

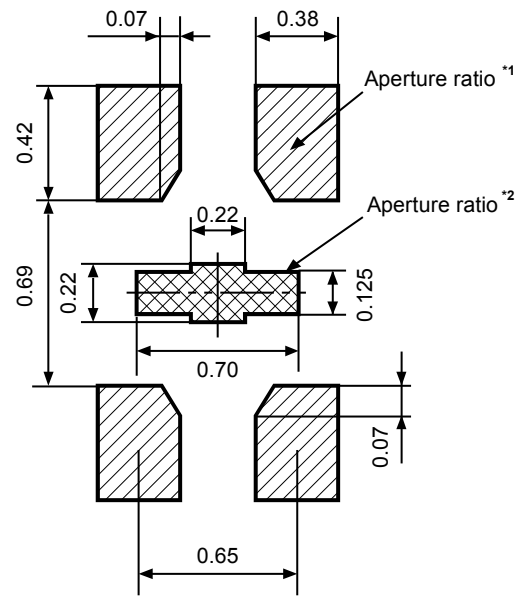
Figure 3 Recommended Land Dimensions

Figure 4 Recommended Mask Aperture Dimensions

3.2 HSNT-4(1010)B



Unit: mm



Unit: mm

*1. Mask aperture ratio of the lead mounting part is 100%.

*2. Mask aperture ratio of the heat sink mounting part is approximately 40%.

Remark Mask thickness: t0.12 mm

Figure 5 Recommended Land Dimensions

Figure 6 Recommended Mask Aperture Dimensions

4. Handling and mounting methods of automotive HSNT package

4.1 Storage

Like other plastic packages, the automotive HSNT package tends to absorb moisture from the ambient air. If too much moisture is absorbed, the moisture may expand during solder mounting, which may cause delamination between the IC chip and the package or cracks the resin mold.

In addition, if stored in high temperature or high humidity environments, the package lead plating solder wettability may deteriorate or the adhesive strength of the carrier tape and cover tape may change.

Store at the room temperature and humidity shown below.

Storage conditions: Ta = 5°C to 30°C, RH = 40% to 70%

It is recommended the package be used within 1 year of delivery.

4.2 Cautions when mounting

4.2.1 Printing process

The automotive HSNT package has very small land dimensions on the printed circuit board. Therefore, it requires very precise printing with cream solder.

(1) Printing machine

The recommended printing accuracy of the printing machine is as follows.

Cream solder printing accuracy: $\pm 20 \mu\text{m}$ or less

(2) Solder printing mask

(a) Mask aperture ratio

- Aperture ratio of lead mounting part

The recommended mask aperture ratios to ensure sufficient solder are as follows.

HSNT-4(0808)B: 120%

HSNT-4(1010)B: 100%

- Aperture ratio of heat sink mounting part

It is recommended to reduce the mask aperture ratio to approximately 40%.

If a large volume of solder is printed onto this part, the package may float, and the mounting failure may occur.

Mask aperture ratio of the heat sink part may need to be adjusted depending on the mask thickness, etc.

Remark The heat sink is exposed out of the package back surface in order to improve heat dissipation of automotive HSNT package.

It is recommended that the heat sink and printed circuit board be soldered together to improve heat dissipation and mounting strength.

(b) Mask aperture processing

Use of a mask with a smoothed mask aperture wall surface and good solder releasability is recommended.

(3) Cream solder

Use a cream solder with good printability. The recommended solder particle diameter is as follows.

Solder particle diameter: 15 μm to 25 μm or less

Remark Printability and solder meltability will differ depending on the solder used and printing conditions. Please confirm the status in advance.

4.2.2 Mounting process

The automotive HSNT package size is very small, so accuracy of mounting on the printed circuit board is important.

The recommended mounting accuracy of the mounter is as follows.

Mounting accuracy: $\pm 50 \mu\text{m}$ or less

Use a tape feeder with small vibration during tape feed.

If tape feeder vibration is large, it may result in the package flying off of the tape or the posture changing within the tape pocket. Confirm the status in the pocket before package pickup.

Also confirm that the pickup nozzle sucks the package in the correct posture.

4.2.3 Reflow process

The automotive HSNT package is very small and light, so it may be affected by temperature variations and airflow in the reflow oven.

Make sure the temperature is applied to each HSNT package lead evenly. Moreover, optimize the airflow.

It is confirmed that the automotive HSNT package can be mounted in an air atmosphere, but if a more stable mounting situation is desired, a nitrogen atmosphere is recommended (oxygen concentration: 1000 ppm or less is recommended).

4.3 Rinse

When rinse-free flux is applied, rinsing is not necessary. It may cause corrosion when residue of the active agents remained in the flux. Good selection of flux is indispensable to avoid corrosion.

Avoid chlorinated and chlorofluorocarbon-based solvents, and use specialized flux rinsing agents, isopropyl alcohol, pure water, etc. for rinse. Avoid high temperature, rapid heating, and rapid cooling for rinsing agents and drying temperatures.

If performing ultrasonic cleaning, do the processing in the shortest possible time, and ensure the products being cleaned do not resonate.

4.4 Other special notes

- Design the printed circuit board with a flat surface for mounting the automotive HSNT package.
This is a flat lead type package, so if the package mounting surface of the printed circuit board is uneven, then the package may incline and defects may appear in the lead's soldering.
Also pay much attention to printed circuit board curvature.
- Lead soldering appearance
Cu, which is the lead frame material, is exposed on the lead cut surface.
Solder may not wet on this area, but this is not an issue with actual use.
There is not difference in mounting strength based on if there is any solder wetting on the lead cut surface.
Mounting evaluations implemented by our company is cleared.
Refer to "**5.1 Mounting evaluation results (reference values)**".
- When mounting this package on the perimeter of the circuit board, do not subject to any shock during the circuit board splitting process.
The package solder connection could be damaged by any vibration or curvature during circuit board splitting.
- Even if mounted exactly as noted in this user's guide, satisfactory mounting results may not be obtained depending on customer mounting conditions (mounting equipment, circuit board, mask conditions, reflow conditions, solder material, etc.).
In such cases, it is necessary to adjust the mounting conditions to achieve the mounting status required by the customer.
This user's guide proposes recommended conditions based on our company's evaluation results.

5. Evaluation results of automotive HSNT package

5.1 Mounting evaluation results (reference values)

5.1.1 Mounting evaluation results (reference values)

Table 3

| Evaluation Item | Result | Main Condition |
|---|--|---|
| (1) Solderability | ○ (r/n = 0/11) Wetting time = 3 s or less | Wetting Balance Method Solder: Sn-3.0Ag-0.5Cu Solder vat temperature: 245°C |
| (2) Push strength test for soldering joint | ○ (r/n = 0/22) HSNT-4(0808)B: 20 N HSNT-4(1010)B: 22 N Values are reference values. | Test methods are based on JEITA ED-4702C. Criteria: No peeling, etc., when 5 N pressure is applied for 10 seconds (visual inspection) Reference data: Pressed with jig from side of package to test for breaking strength. |
| (3) PCB bending stress test (cyclic bend test) | ○ (r/n = 0/11) HSNT-4(0808)B: Pass HSNT-4(1010)B: Pass | Bend amount: 1 mm, PCB thickness: 1 mm Repetitions: 5000 times Bend span: 90 mm (refer to JEITA ED-4702C) Criteria: Resistance value fluctuation must not exceed twice the initial value. Must be without visual defects. |
| (4) PCB bending stress test (monotonic bend test) | ○ (r/n = 0/11) HSNT-4(0808)B: Pass HSNT-4(1010)B: Pass | Maximum bend amount: 3 mm, PCB thickness: 1 mm Bend span: 90 mm (refer to JEITA ED-4702C) Criteria: Resistance value fluctuation must not exceed twice the initial value. Must be without visual defects. |
| (5) Drop | ○ (r/n = 0/11) HSNT-4(0808)B: Pass HSNT-4(1010)B: Pass | Automotive HSNT mounting boards are fixed to a 100-g jig. Dropped 30 times from a 170 cm height (6 faces × 5 times each) Drop surface: Concrete or steel plate Criteria: Resistance value fluctuation must not exceed twice the initial value. Must be without visual defects. |
| (6) Solder joint reliability | ○ (r/n = 0/22) HSNT-4(0808)B: Pass HSNT-4(1010)B: Pass | Temperature cycle: -65°C to 150°C, 1000 cycles Resistance value after testing must not exceed twice the initial value. Must be without visual defects. |

Remark In tests (3) to (6), a daisy chain was formed in the package to confirm that the resistance value did not increase.

<Mounting Evaluation Conditions>

- Printed circuit board for evaluation
 - FR4, 4 layers, double-sided
 - Thickness = 1.0 mm
 - Surface processing of mounting land: Gold plating
- Packages are preprocessed before each test (before PCB mounting).
 - Preconditioning = 105°C, 100%, 1.2 atm, 8-hour storage
- Print mask
 - Mask thickness: 120 μm
 - Aperture ratio: Refer to "3. Recommended land dimensions and mask aperture dimensions for solder printing of each automotive HSNT package".
- Reflow conditions
 - Refer to "5.1.2 Reflow profile at mounting evaluation" for profile.
 - Atmosphere: Air
- Solder
 - Composition: Sn-3Ag-0.5Cu
 - Solder particle diameter: 15 μm to 25 μm

5. 1. 2 Reflow profile at mounting evaluation

Reflow conditions vary depending on factors such as the reflow oven and the specifications of printed circuit board to be used. The following figure shows the reflow profile used by ABLIC Inc. when evaluating mounting.

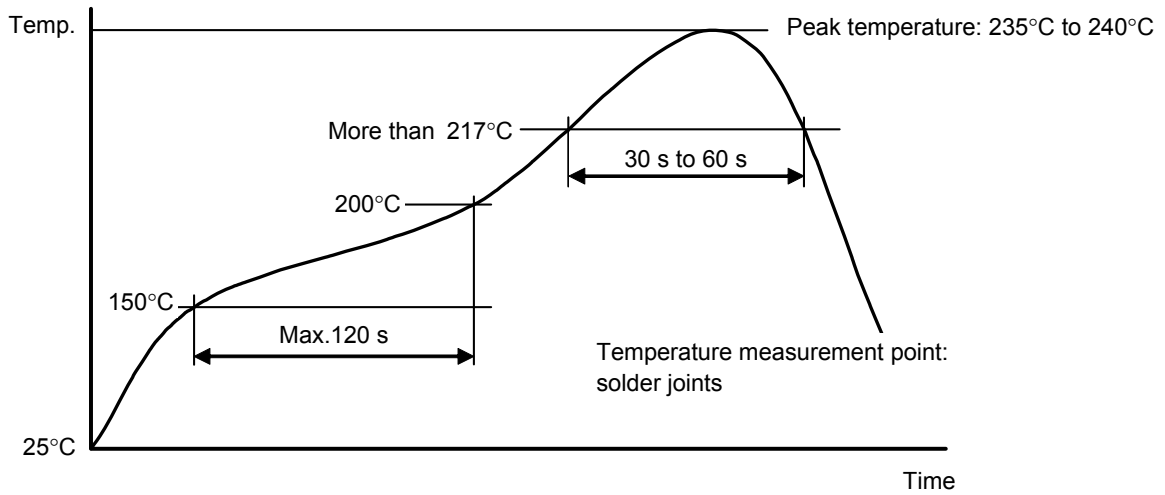


Figure 7 Reflow Profile for Mounting Evaluation

5.2 Reliability testing results

5.2.1 Reliability testing results

Table 4 shows some reliability testing results of the automotive HSNT package. Reliability testing results for each product can be downloaded from our company's website. Select desired series names on the "**Datasheet Search**" page.

| Test Item | Test Condition | Criteria | Result |
|--|---|---|--------|
| High temperature storage | Ta = 150°C, 2000 h | Must meet product standards. | Pass |
| Low temperature storage | Ta = -65°C, 2000 h | | Pass |
| Temperature cycle (gas phase) | Ta = 150°C ⇔ -65°C, 30 minutes each, 500 cycles | | Pass |
| Thermal shock (liquid phase) | Ta = 150°C ⇔ -65°C, 5 minutes each, 100 cycles | | Pass |
| Solder thermal resistance (reflow) | T = 260°C max., 10 s, 3 times (Refer to reflow profile for thermal resistance evaluation) | Must meet product standards. Must be without visible defects. | Pass |
| Whisker 1 (room temperature storage) | Ta = 30°C, RH = 60%, 4000 h | Whisker length must be 40 μm or less. | Pass |
| Whisker 2 (temperature cycle) | Ta = -40°C ⇔ 85°C, 1500 cycles | Whisker length must be 45 μm or less. | Pass |
| Whisker 3 (high-temperature high-humidity storage) | Ta = 55°C, RH = 85%, 4000 h | Whisker length must be 40 μm or less. | Pass |

5.2.2 Reflow profile for thermal resistance evaluation

The temperature rise may be different in the resin and a terminal part due to the reflow soldering. It is necessary to check the package surface temperature (resin) before setting the temperature profile.

Figure 8 shows the reflow profile for thermal resistance evaluation.

Confirm the heat resistance of the package shown below. (Based on **JEDEC J-STD-020**)

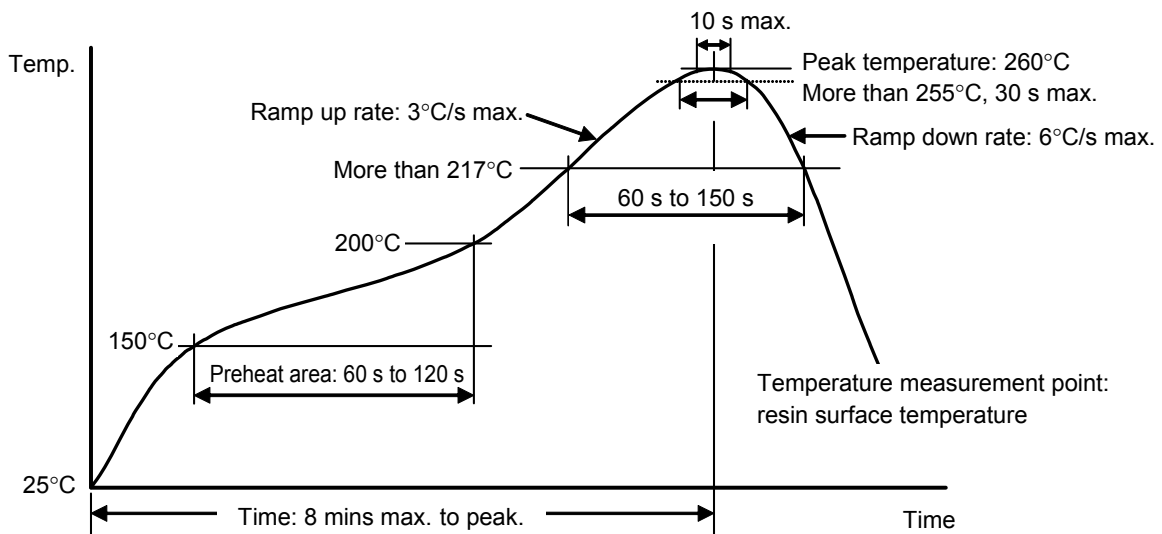


Figure 8 Reflow Profile for Thermal Resistance Evaluation

5.3 Thermal resistance and power dissipation (reference values)

5.3.1 Thermal resistance

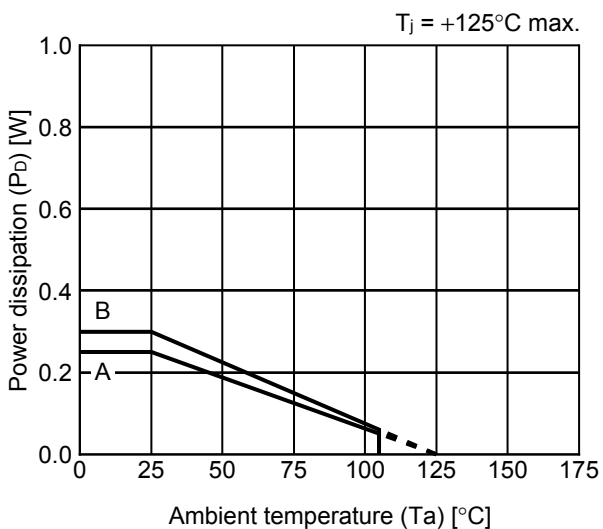
Table 5

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit | |
|--|---------------|---------------|---------|------|------|------|------|
| Junction-to-ambient thermal resistance*1 | θ_{JA} | HSNT-4(0808)B | Board A | – | 402 | – | °C/W |
| | | | Board B | – | 336 | – | °C/W |
| | | | Board C | – | – | – | °C/W |
| | | | Board D | – | – | – | °C/W |
| | | | Board E | – | – | – | °C/W |
| | | HSNT-4(1010)B | Board A | – | 378 | – | °C/W |
| | | | Board B | – | 317 | – | °C/W |
| | | | Board C | – | – | – | °C/W |
| | | | Board D | – | – | – | °C/W |
| | | | Board E | – | – | – | °C/W |

*1. Test environment: compliance with JEDEC STANDARD JESD51-2A

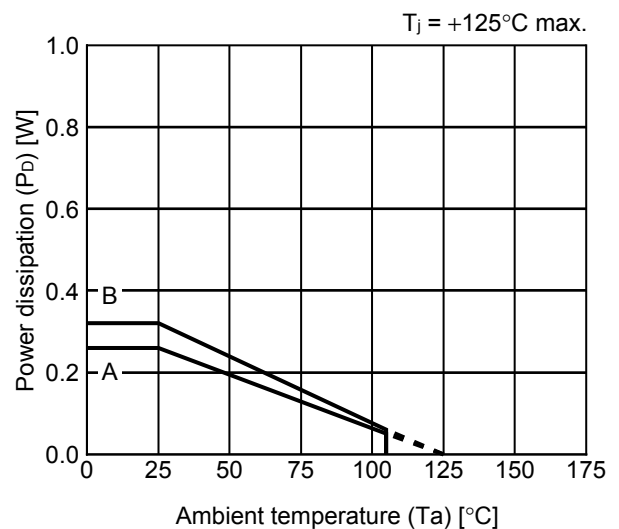
5.3.2 Power dissipation

HSNT-4(0808)B



| Board | Power Dissipation (P_D) |
|-------|-----------------------------|
| A | 0.25 W |
| B | 0.30 W |
| C | – |
| D | – |
| E | – |

HSNT-4(1010)B

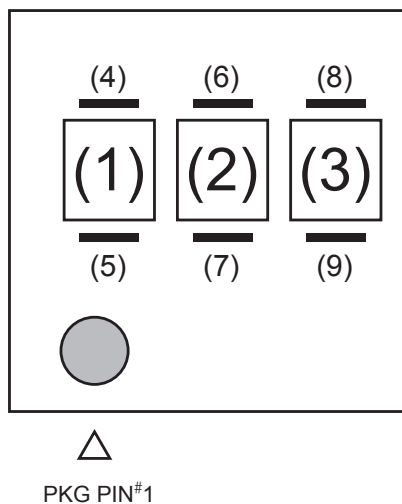


| Board | Power Dissipation (P_D) |
|-------|-----------------------------|
| A | 0.26 W |
| B | 0.32 W |
| C | – |
| D | – |
| E | – |

6. Marking specifications of each automotive HSNT package

Marking specifications of each automotive HSNT package are shown below.

6.1 HSNT-4(0808)B



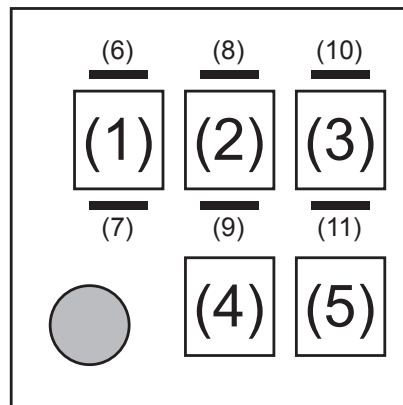
(1) to (3) : Product code

(4) , (5) : Year of assembly (bar)

(6) to (9) : Month of assembly (bar)

Figure 9

6.2 HSNT-4(1010)B



PKG PIN#1

(1) to (3) : Product code

(4) , (5) : Lot No.

(6) , (7) : Year of assembly (bar)

(8) to (11) : Month of assembly (bar)

Figure 10

7. Packing specifications of each automotive HSNT package

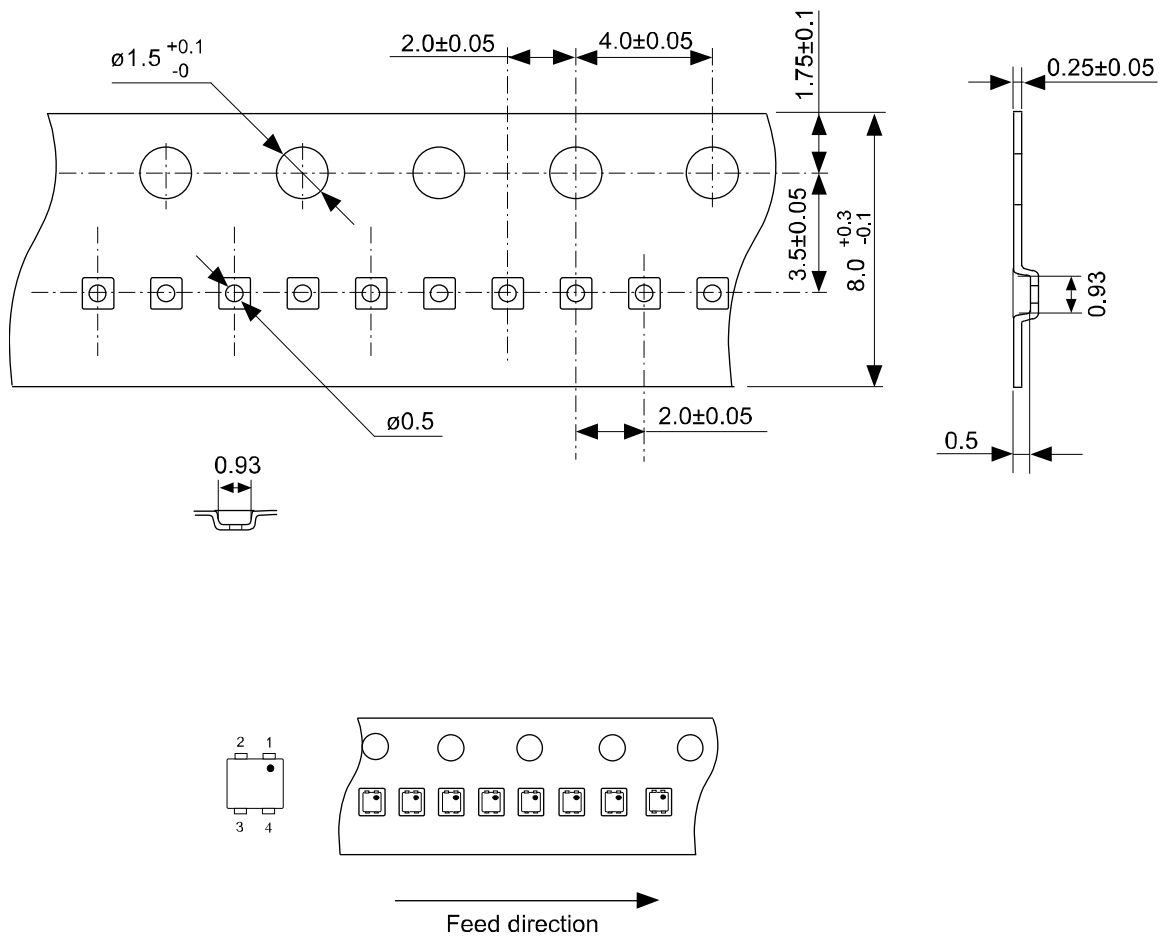
The reel specifications and packing form of each automotive HSNT package are shown below.

7.1 Packed units

HSNT-4(0808)B, HSNT-4(1010)B: 10000 / reel

7.2 Embossed tape specifications

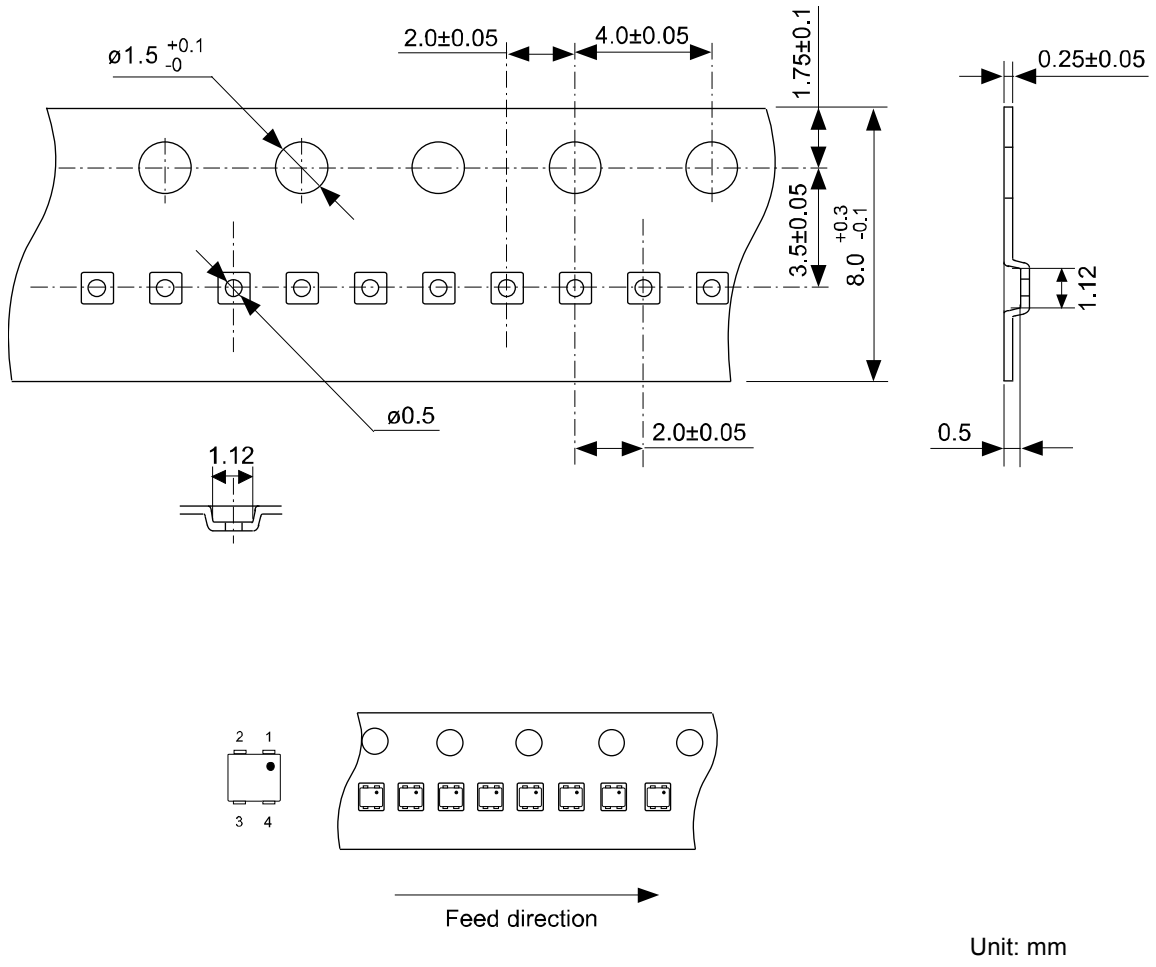
7.2.1 HSNT-4(0808)B



Unit: mm

Figure 11

7.2.2 HSNT-4(1010)B



Unit: mm

Figure 12

7.3 Reel specifications

The reel drawings of HSNT-4(0808)B and HSNT-4(1010)B are shown below.

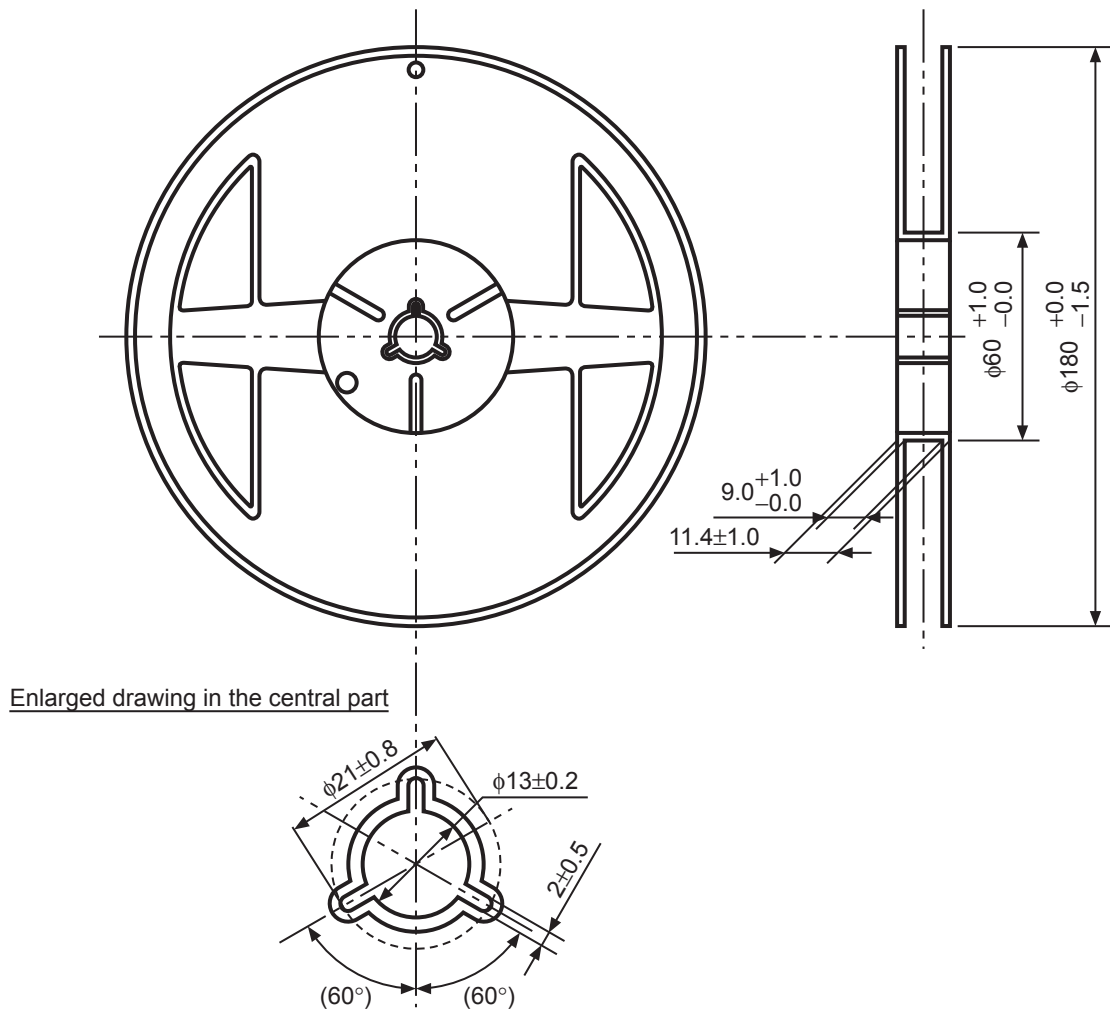


Figure 13

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