Assembly Precautions for the Nichia 270B Series LEDs

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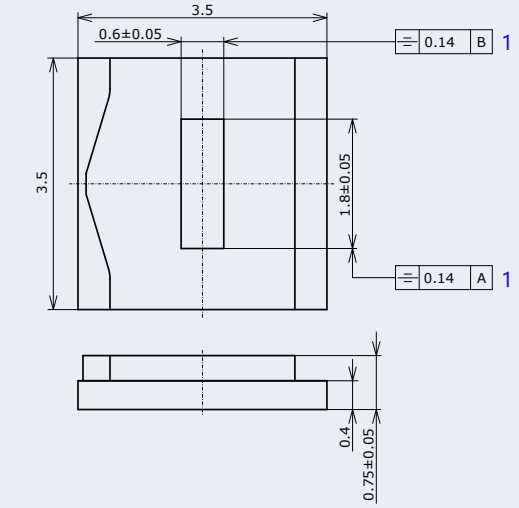
The Nichia part numbers NJ2W270B(-PF) and NJ3W270B(-PF) within this document are merely Nichia's part numbers for those Nichia products and are not related nor bear resemblance to any other company's product that might bear a trademark.

1. LED Outline Dimensions/Tape Dimensions

Table 1. NJ2W270B Product Specifications

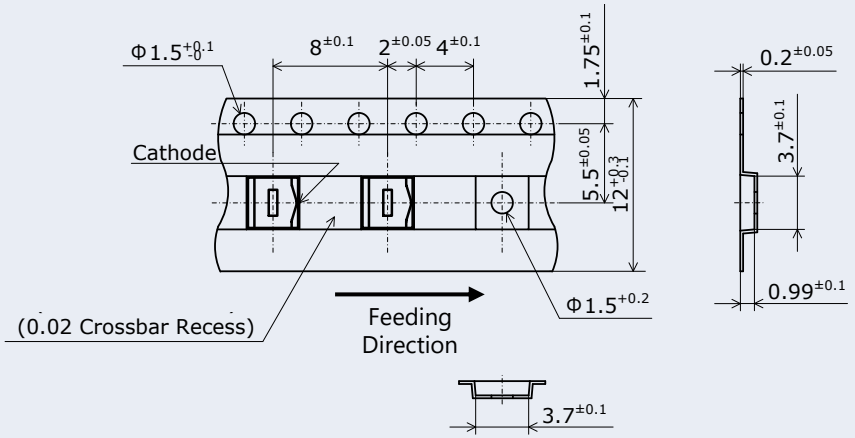
LED



Weight: typ. 0.022g

(Unit: mm, Tolerance: ±0.1mm)

Embossed Carrier Tape



Direction of the LED in the embossed carrier tape pocket: the cathode faces the feeding direction of the tape as shown in the figure above.

Reel Size: 2,000 LEDs

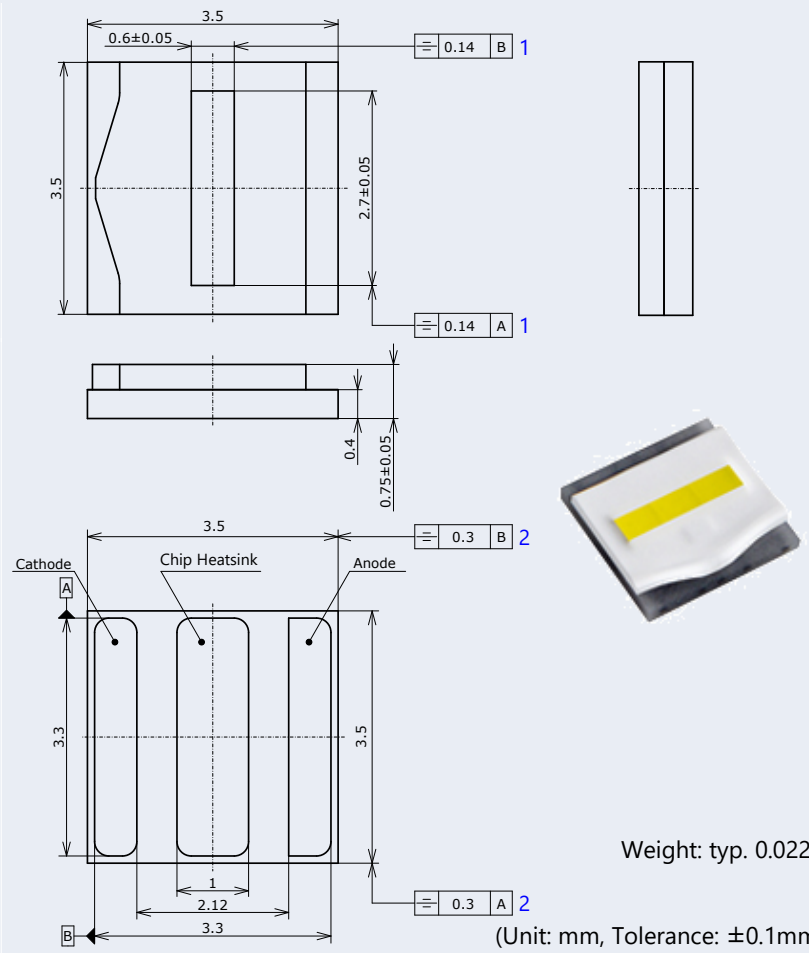
(Unit: mm)

1) The deviation of the center of the emitting area from the center of the electrodes is ≤ ±0.07mm in both the lateral and longitudinal direction.
2) The deviation of the center of the LED package from the center of the electrodes is ≤ ±0.15mm in both the lateral and longitudinal direction.

1. LED Outline Dimensions/Tape Dimensions

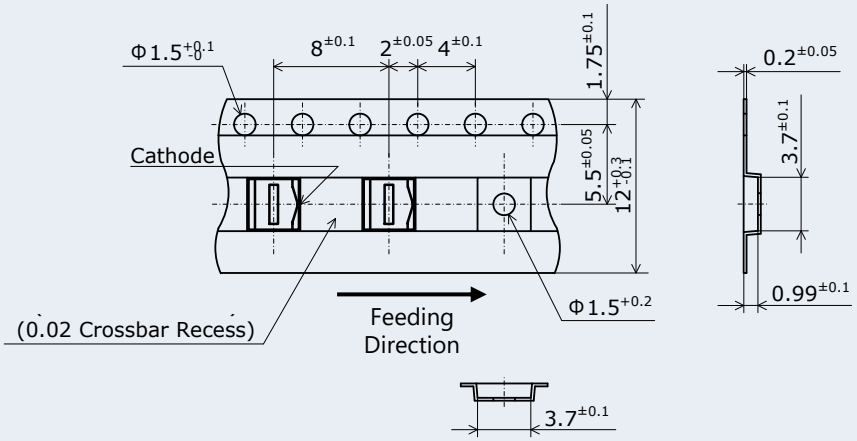
Table 2. NJ3W270B Product Specifications

LED	Embossed Carrier Tape



Weight: typ. 0.022g

(Unit: mm, Tolerance: ±0.1mm)



Direction of the LED in the embossed carrier tape pocket: the cathode faces the feeding direction of the tape as shown in the figure above.

Reel Size: 2,000 LEDs

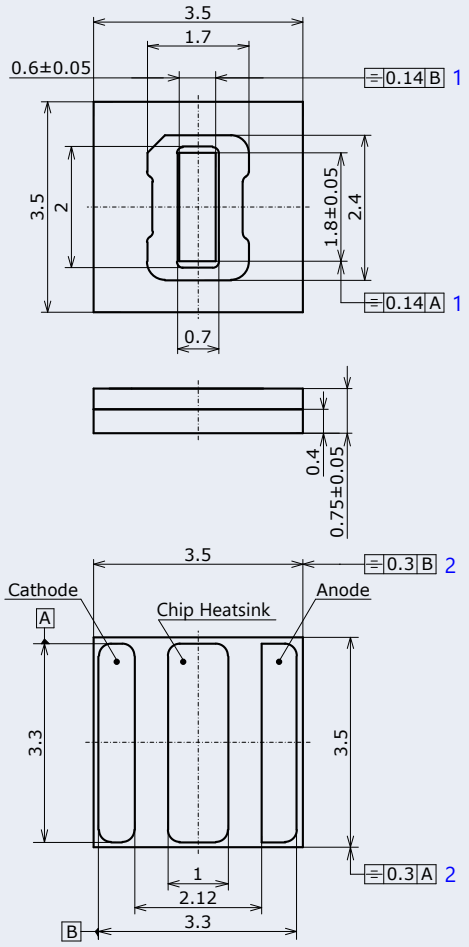
(Unit: mm)

1) The deviation of the center of the emitting area from the center of the electrodes is ≤ ±0.07mm in both the lateral and longitudinal direction.
2) The deviation of the center of the LED package from the center of the electrodes is ≤ ±0.15mm in both the lateral and longitudinal direction.

1. LED Outline Dimensions/Tape Dimensions

Table 3. NJ2W270B-PF Product Specifications

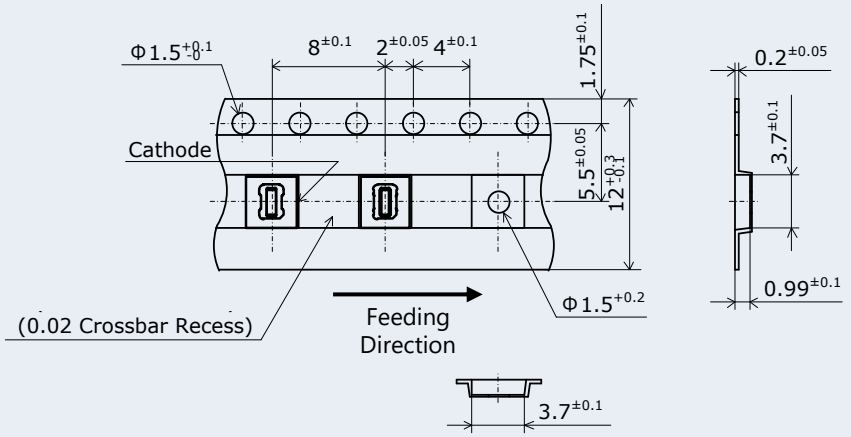
LED



Weight: typ. 0.025g

(Unit: mm, Tolerance: ±0.1mm)

Embossed Carrier Tape



Direction of the LED in the embossed carrier tape pocket: the cathode faces the feeding direction of the tape as shown in the figure above.

Reel Size: 2,000 LEDs

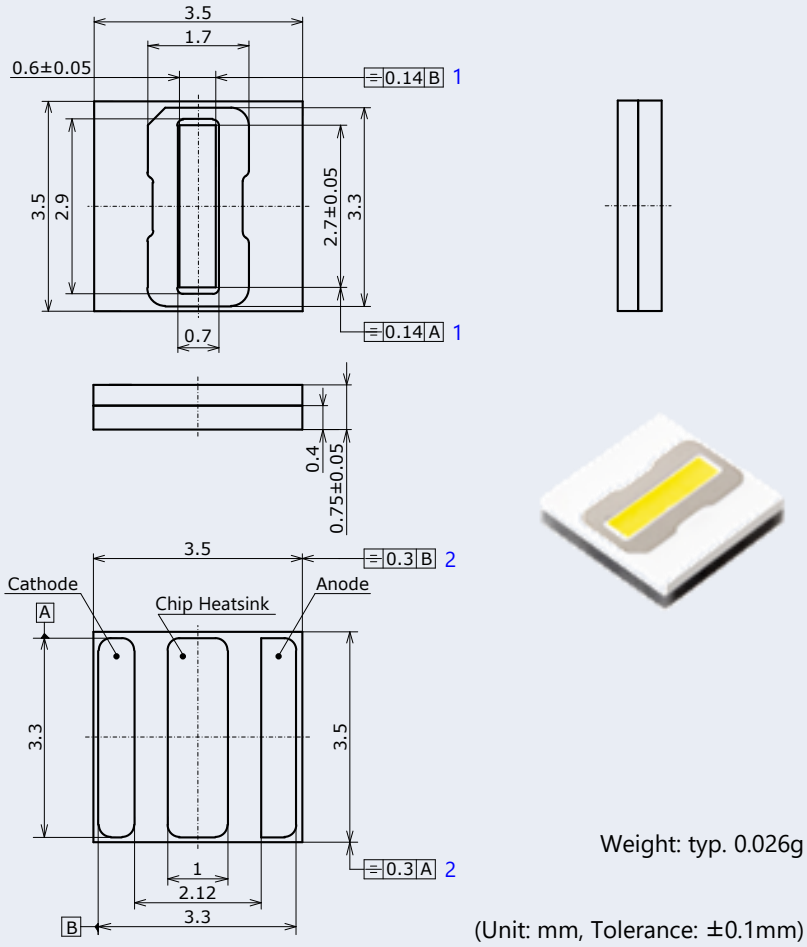
(Unit: mm)

1) The deviation of the center of the emitting area from the center of the electrodes is ≤ ±0.07mm in both the lateral and longitudinal direction.
2) The deviation of the center of the LED package from the center of the electrodes is ≤ ±0.15mm in both the lateral and longitudinal direction.

1. LED Outline Dimensions/Tape Dimensions

Table 4. NJ3W270B-PF Product Specifications

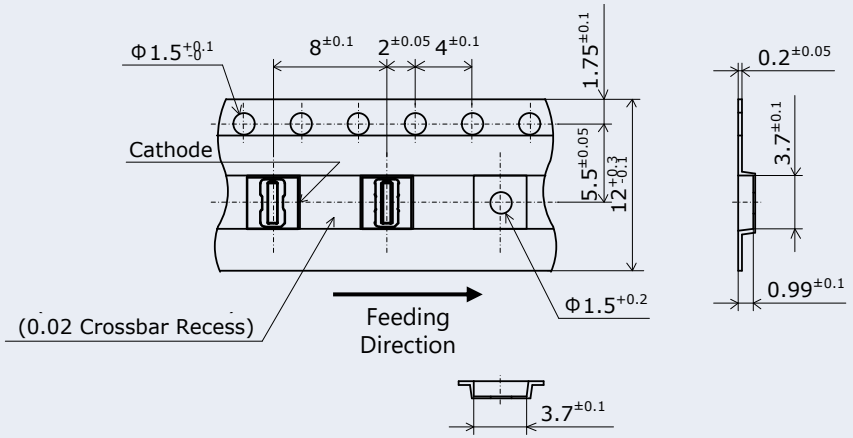
LED



Weight: typ. 0.026g

(Unit: mm, Tolerance: ±0.1mm)

Embossed Carrier Tape



Direction of the LED in the embossed carrier tape pocket: the cathode faces the feeding direction of the tape as shown in the figure above.

Reel Size: 2,000 LEDs

(Unit: mm)

1) The deviation of the center of the emitting area from the center of the electrodes is ≤ ±0.07mm in both the lateral and longitudinal direction.
2) The deviation of the center of the LED package from the center of the electrodes is ≤ ±0.15mm in both the lateral and longitudinal direction.

2. Handling Precautions

2.1 Handling with bare hands

Do not handle the LEDs with bare hands. This may contaminate the LED surface and have an effect on the optical characteristics.

2.2 Handling with tweezers

Ensure that when handling the LEDs with tweezers, grab/hold the LEDs by the sides of the ceramic substrate and ensure that excessive force is not applied to the LED. Otherwise, it may cause damage to the light emitting area and/or the silicone resin (e.g. cut, scratch, chip, crack, etc.) and have an effect on the optical characteristics and/or the reliability.

2.3 ESD Precautions

The LEDs are sensitive to transient excessive voltages (e.g. ESD, lightning surge). If this excessive voltage occurs in the circuit, it may cause the LED to be damaged causing issues (e.g. the LED to become dimmer or not to illuminate [i.e. catastrophic failure]). When handling the LEDs, ensure that necessary measures have been taken to protect them from transient excess voltages. Refer to the applicable specification for more details.

2.4 Stacking assembled PCBs together

Do not stack assembled PCBs together. Otherwise, it may cause damage to the light emitting area (e.g. cut, scratch, chip, crack, etc.) and have an effect on the optical characteristics and/or the reliability.

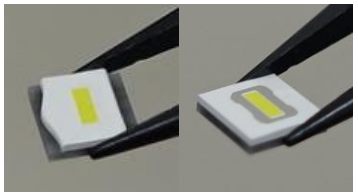
2.5 Baking

The storage/packaging requirements for the Nichia 270B Series LEDs are comparable to JEDEC Moisture Sensitivity Level (MSL) 3 or equivalent. Nichia used IPC/JEDEC STD-020 as a reference to rate the MSL of this LED. If the "After Opening" storage time has been exceeded or any pink silica gel beads are found, ensure that the LED are baked before use. Baking should only be done once.

Table 5. Storage/Baking Conditions

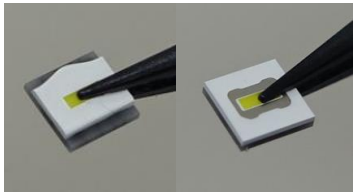
Conditions		Temperature	Humidity	Time
Storage	Before Opening Aluminum Bag	≤ 30℃	≤ 90%RH	Within 1 Year from Delivery Date
	After Opening Aluminum Bag	≤ 30℃	≤ 70%RH	≤ 168 hours
Baking		65±5℃	-	≥ 24 hours

✔ Correct



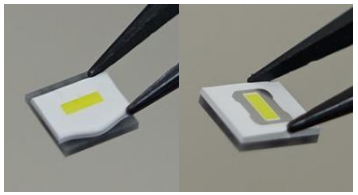
Suggestion: Grab/hold the LEDs with tweezers by the sides of the ceramic substrate.

⊘ Incorrect



Caution: Do not touch the emitting area.

⊘ Incorrect



Caution: Do not touch the silicone resin.

Figure 1. Correct/Incorrect Examples of Handling with Tweezers

3. Design Recommendations for Optimal Amount of Solder

Soldering Pad Pattern/Metal Solder Stencil Aperture

Table 6. Recommended Soldering Pad Pattern/Metal Solder Stencil Aperture

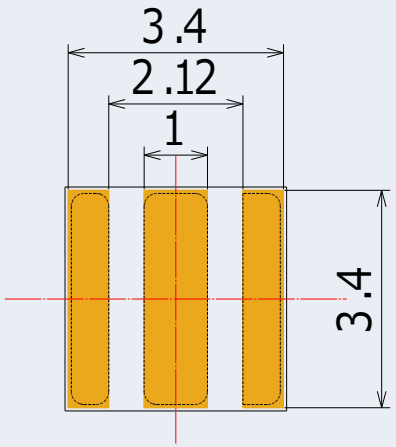
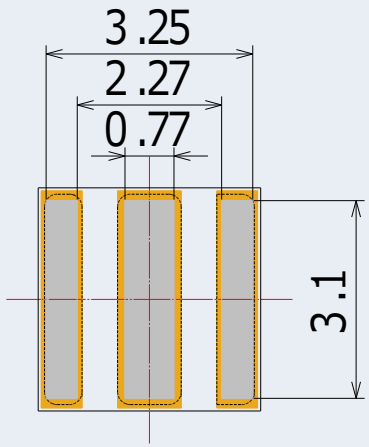
Recommended Soldering Pad Pattern	Recommended Metal Solder Stencil Aperture
 (Unit: mm)	 (Unit: mm)

Table 7. Recommended Solder/Metal Solder Stencil Conditions

Item	Recommended Conditions
Metal Solder Stencil (Thickness)	100 (μm)
Solder Paste (Composition)	Sn-3.0Ag-0.5Cu

4. Precautions for Setting Up a Pick-and-Place Machine/Nozzle

Table 8. Cautions/Suggestions for Setting Up Equipment

Item	Recommended Conditions/Specifications	Cautions/Suggestions
Pick-and-place machine	Modular mounter	See the note below this table.
Pick-and-Place Nozzle	Using a nozzle with a rubber tip specifically designed for the LEDs is recommended. (see Figure 2)	See "Pick-and-Place Nozzle" on Page 9 for the details.
Tape-and-reel feeder	Electrical (motorized) feeder Tape width: 12mm Feeder pitch: 8mm	See "Tape-and-Reel Feeder" on Page 10 for the details.
Nozzle height for pick-up operations	The contact surface of the nozzle head for pick operations should be adjusted to 0.2mm below the edge of the embossed carrier tape pocket.	See "Recommended Nozzle Height for Pick-up Operations" on Page 10 for the details.
Nozzle height for placement operations (i.e. placement depth)	0.2mm for placement depth	See "Recommended Nozzle Height for Placement Operations (Placement Depth)" on Page 11 for the details.
Imaging-based Automatic Inspection	Using the electrode as a reference is recommended to locate the center of the LED.	See "Imaging-based Automatic Inspection" on Page 11 for the details.

Note:

- The recommended conditions/specifications above have been determined under the following verification conditions:
  Pick-and-place machine (modular mounter):
  - YS100 High-Speed General-Purpose Modular (manufactured by Yamaha Motor Co., Ltd.)

4.1 Pick-and-Place Nozzle

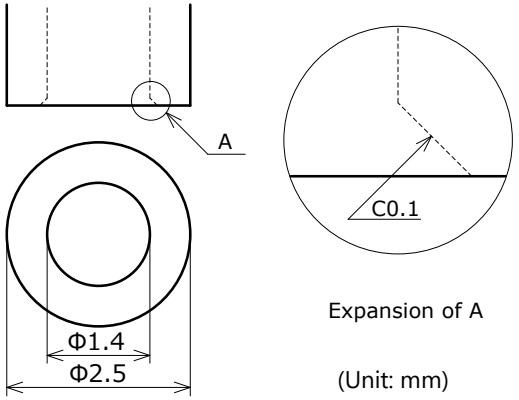


Figure 2. Recommended Nozzle Dimensions

1. Figure 2 shows the recommended dimensions for the pick-and-place nozzle.
   The recommended material of the nozzle tip (i.e. the suction part) is rubber.
   - Ensure that the size, shape, and material of the nozzle tip are appropriate for the LEDs. Otherwise, this may damage the LED (i.e. scratch, chip, crack, etc.), affecting the optical characteristics and/or the reliability. This may also lead to an incorrect pick up (i.e. the LED is picked up in a tilted position).

2. When setting the LED pick-up position, ensure that the center of the nozzle and the center of the emitting area of the LED are aligned (See Figure 3). Do not apply excessive force to the emitting area when picking up the LED.
   - If the nozzle does not pick up the LED at the center of the emitting area, and/or if excessive force is applied to the LED, this may damage the LEDs (i.e. scratch, chip, crack, etc.), affecting the optical characteristics and/or the reliability. This may also lead to an incorrect pick up (i.e. the LED is picked up in a tilted position).

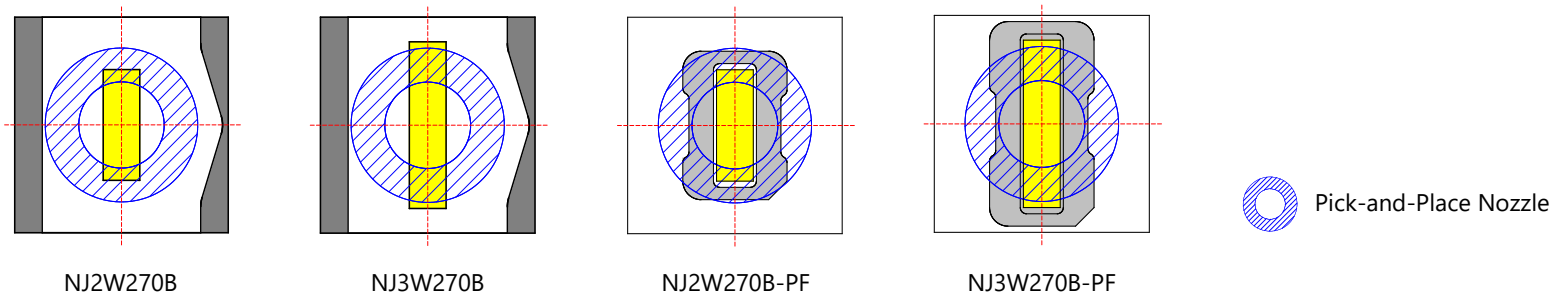


Figure 3. Examples of Recommended Nozzle Dimensions and LED Pick-up Positions for the Nichia 270B Series LEDs

4.2 Tape-and-Reel Feeder

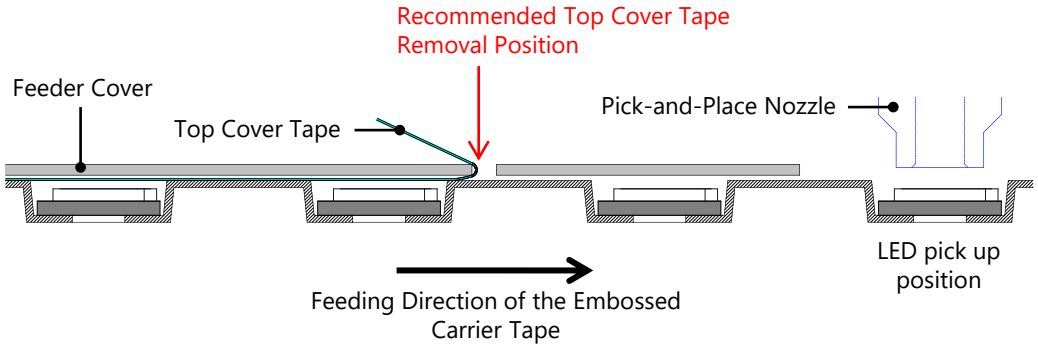


Figure 4. Top Cover Tape Removal Position

1. Recommended setting for the tape-and-reel feeder.
   Tape width: 12mm
   Feeder pitch: 8mm
2. Use a tape-and-reel feeder that ensures it does not create excessive vibrations causing assembly issues.
   Example: Electrical (motorized) feeder
3. It is recommended to remove the top cover tape at the recommended position shown in Figure 4.

4.3 Recommended Nozzle Height for Pick-up Operations

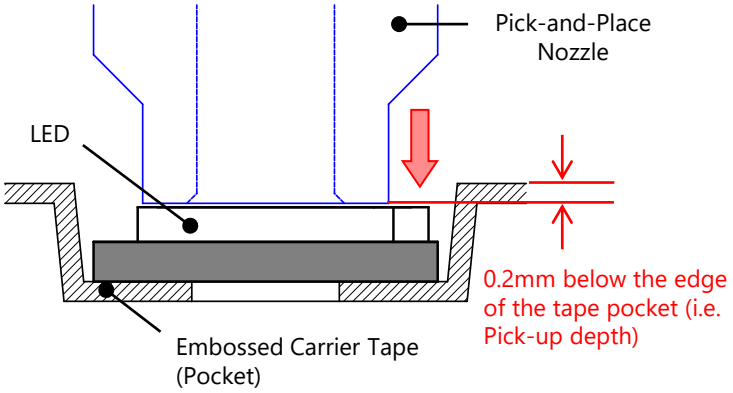


Figure 5. Recommended Nozzle Height for Pick-up Operations

1. Ensure that the nozzle goes down onto the LED in the tape pocket until the tip touches the flat surface around the lens.
   Pick-up depth: 0.2mm
   Note: If the reference level for the nozzle setting is at the edge of the tape pocket.
2. The recommended nozzle height for pick-up operations has been determined by Nichia under the verification conditions (See Table 8) and may not function as expected with some other pick-and-place machines. If the pick-up operations are unstable even with using the recommended nozzle height, adjust the nozzle height appropriate for the pick-and-place machine being used.
   If the pick point of the nozzle is too high,
   - it may cause insufficient suction power leading to picking errors (e.g. the nozzle's failure to pick/lift the LED into the air, incorrect picking causing the LED to tilt when in the air).

   If the pick point of the nozzle is too low,
   - it may cause issues (e.g. causing the embossed carrier tape to shake, causing the tape pocket to deform) leading to picking failure.

4.4 Recommended Nozzle Height for Placement Operations (Placement Depth)

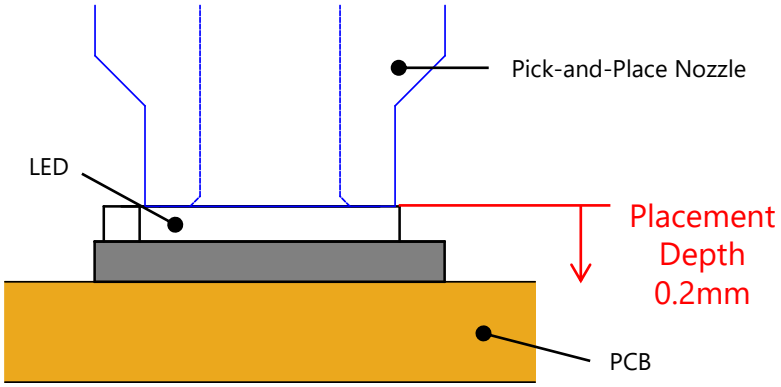


Figure 6. Recommended Nozzle Height for Placement (Placement Depth)

1. The nozzle should further press the LED 0.2mm onto the PCB from the height where the LED first touches solder paste.

   If the release point of the nozzle is too high,
   - it may cause placement issues (e.g. the LED to stick to the nozzle after placement, the LED to be mounted in an incorrect place/rotated position, the LED to become soldered to the PCB in a tilted position, etc.).

   If the release point of the nozzle is too low,
   - excessive forces may be applied to the LED during placement and it may cause the LED to become damaged.

4.5 Imaging-based Automatic Inspection

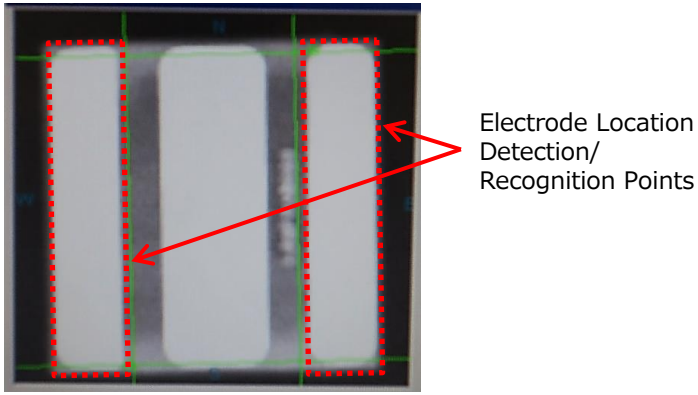


Figure 7. Recommended Reference Points to Detect, Recognize, or Locate the Electrodes

1. Nichia recommends using the electrodes as a reference to locate the center of the LED.
2. If the imaging device has trouble detecting/recognizing the electrodes, adjust the settings (i.e. the brightness of the light, etc.) of the pick-and-place machine.

5. Precautions When Reflow Soldering

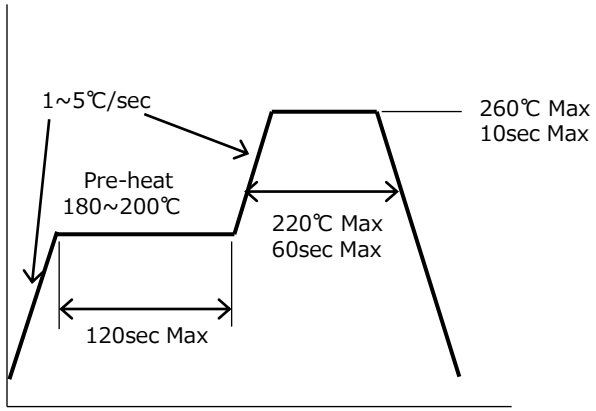


Figure 8. Recommended Reflow Soldering Condition (Lead-free Solder)

1. Reflow soldering must not be performed more than twice.
2. Nichia recommends using the reflow soldering conditions detailed in Figure 8 to the left; use the recommended reflow conditions specified by the manufacturer of the solder paste being used if it works better for the chosen application.

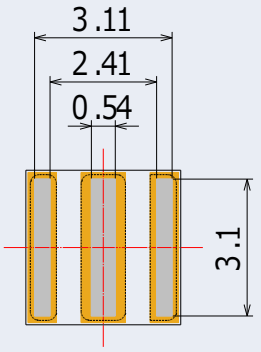
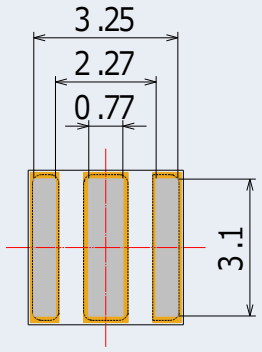
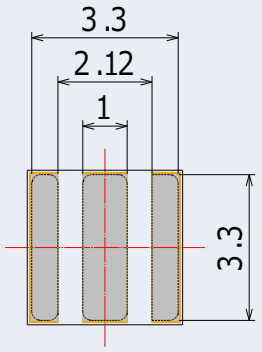
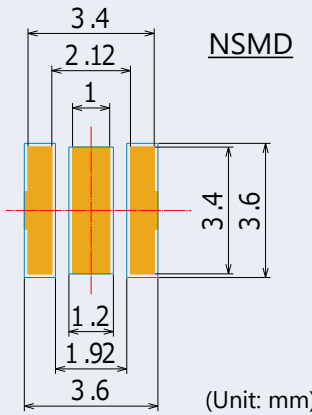
   Note: To ensure that these reflow conditions have no negative effect on the LEDs, perform sufficient verification prior to use.
3. When cooling the LEDs from the peak temperature a gradual cooling slope is recommended; do not cool the LEDs rapidly.
4. During reflow soldering, the heat and atmosphere in the reflow oven may cause the optical characteristics to degrade. In particular, reflow soldering performed with an air atmosphere may have a greater negative effect on the optical characteristics than if a nitrogen atmosphere is used; Nichia recommends using a nitrogen reflow atmosphere.

6. Evaluation of the Effect of Solder Volume

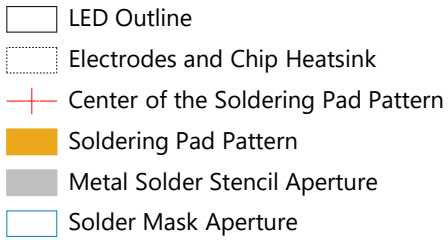
Nichia evaluated the effect of solder volume for reflow-soldering the LEDs (i.e. the parallel/angular deviations and self-alignment performance) using different solder volumes (i.e. three aperture ratios and three thicknesses for the metal solder stencil) including the recommended amount. For details, see Table 9.

The evaluation results provided herein were obtained under Nichia's evaluation conditions/environments; Nichia makes no guarantee that customers will see the same results for their chosen application. Perform a sufficient verification to ensure that there are no issues with the chosen conditions/environments.

Table 9. Solder Volumes and Soldering Pad Patterns

Thickness \ Aperture Ratio[3]	53%	75% (Nichia's Recommendation)	100%	Soldering Pad Pattern
80µm				
100µm (Nichia's Recommendation)				
120µm				

[3] Aperture Ratio = Area of Aperture/(Areas of the Electrodes + Area of Chip Heatsink)



LED Part No. Evaluated: NJ2W270B

Sample Size for the Placement Accuracy Evaluation: 320 LEDs per Condition

6. Evaluation of the Effect of Solder Volume (Continued)

Table 10. Evaluation Results (＊) Nichia's Recommendation

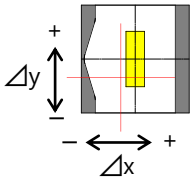
Solder Volume	Thickness	80μm			100μm (＊)			120μm			Note
	Aperture Ratio	53%	75%	100%	53%	75% (＊)	100%	53%	75%	100%	
6-1. Placement Accuracy in the x and y Directions	⊿x	◎	◎	◎	◎	◎	◎	◎	◎	◎	See Page 15 for details.
	⊿y	◎	○	○	◎	○	▲	◎	○	×	
6-2. Placement Accuracy in the Angular Direction	⊿θ	○	○	○	○	○	○	○	○	○	
6-3. Self-Alignment Performance in the x and y Directions[4]		▲	○	◎	▲	◎	◎	○	◎	◎	See Page 16 for details.
6-4. Self-Alignment Performance in the Angular Direction[4]		×	○	○	×	○	◎	○	○	◎	See Page 17 for details.

◎ : Very Good ○ : Good ▲ : Not Good × : Bad

[4] The self-alignment performance evaluation is relative to the placement accuracy that was seen when the LED was soldered without intentionally being shifted/rotated.

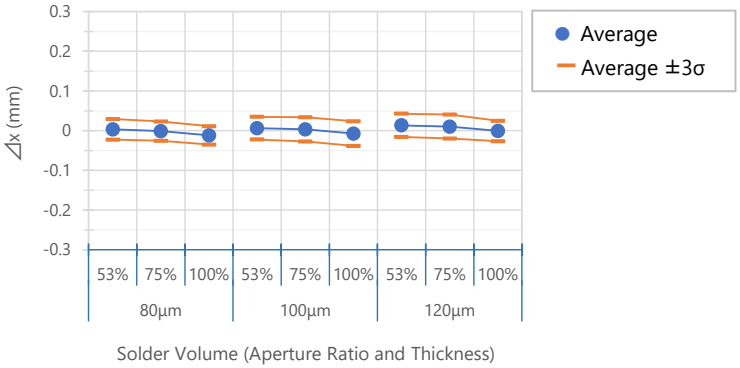
6-1. Placement Accuracy in x and y Directions

Nichia evaluated the placement accuracy of the reflow-soldered LEDs in the x and y directions from the center of the soldering pad pattern using different solder volumes (i.e. three aperture ratios and three thicknesses for the metal solder stencil). The amount of the deviation from the center of the soldering pad pattern in the x and y directions are described as ⊿x and ⊿y respectively.

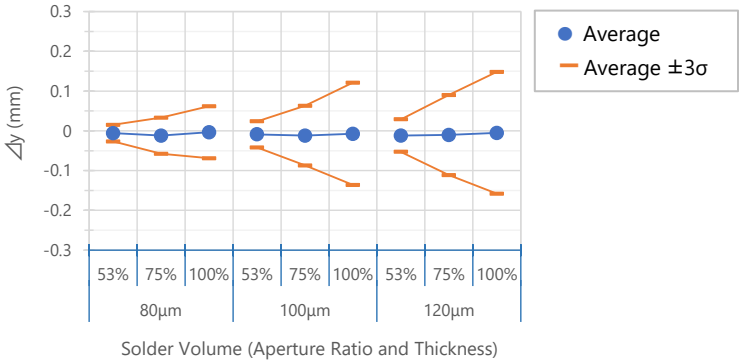


＋ : Center of the LED Package

＋ : Center of the Soldering Pad Pattern



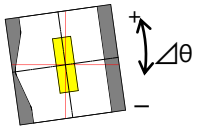
・There was no significant difference seen in the average and the deviation of ⊿x of the evaluated LEDs per condition.



・The deviation of ⊿y of the evaluated LEDs became larger as the solder volume increased.

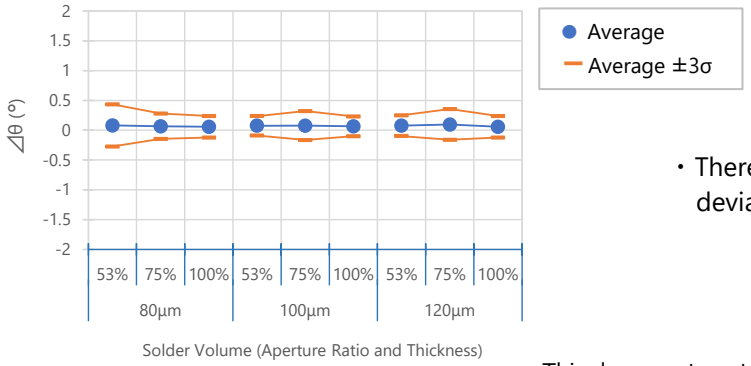
6-2. Placement Accuracy in the Angular Direction

Nichia evaluated the placement accuracy of the reflow-soldered LEDs in the angular direction from the reference axis of the soldering pad pattern using different solder volumes (i.e. three aperture ratios and three thicknesses for the metal solder stencil). The amount of the deviation from the reference axis in the angular direction is described as ⊿θ.



＋ : Reference Axis of the LED Package

＋ : Reference Axis of the Soldering Pad Pattern

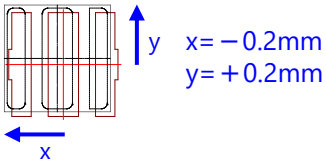


・There was no significant difference seen in the average and the deviation of ⊿θ of the evaluated LEDs per condition.

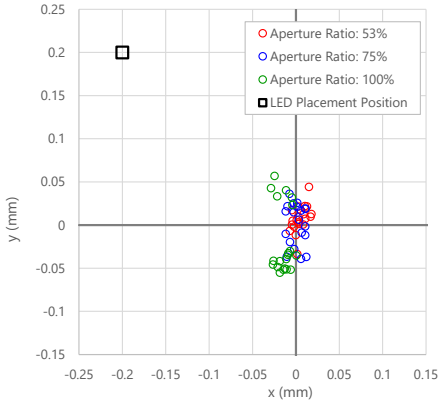
6-3. Self-alignment Performance in the x and y Directions

Nichia evaluated the self-alignment performance of the reflow-soldered LEDs using different solder volumes (i.e. three aperture ratios and three thicknesses for the metal solder stencil): the evaluation LEDs were placed on specified points (i.e. x = -0.2mm and y = +0.2mm/x = +0.2mm and y = +0.2mm from the center of the soldering pad pattern). Sample Size: 20 LEDs per condition

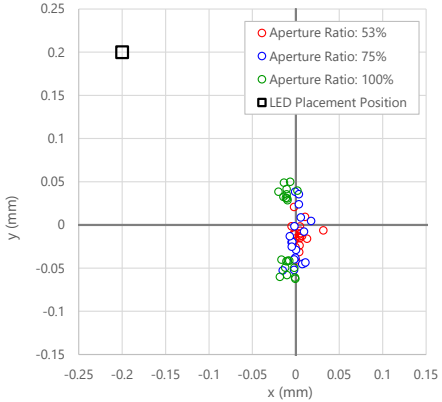
Evaluated LED Placement Position 1



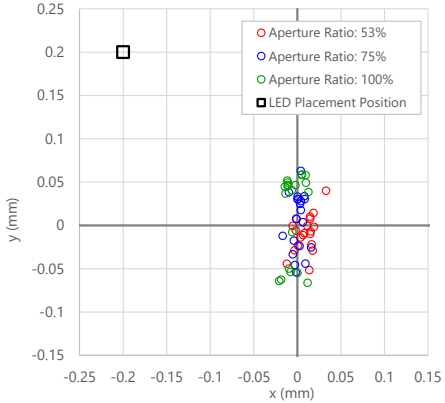
□ : Soldering Pad Pattern
＋ : Center of the Soldering Pad Pattern
＋ : Center of the Evaluated LED Placement Position



Metal Solder Stencil Thicknesses: 80µm

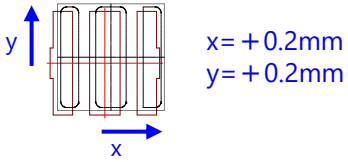


Metal Solder Stencil Thicknesses: 100µm

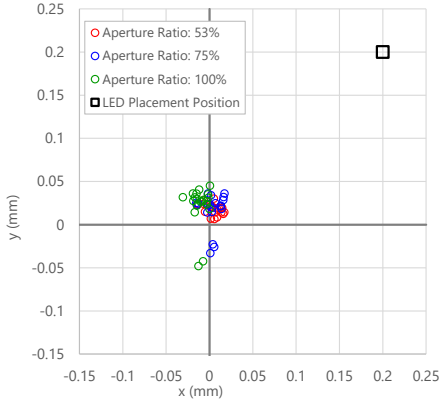


Metal Solder Stencil Thicknesses: 120µm

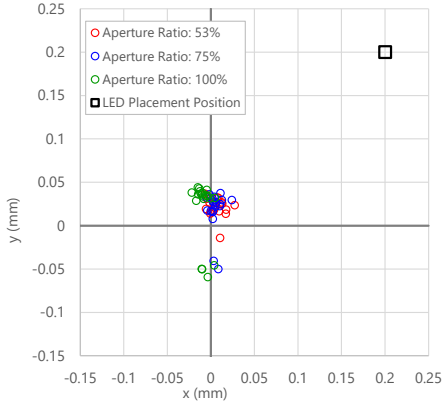
Evaluated LED Placement Position 2



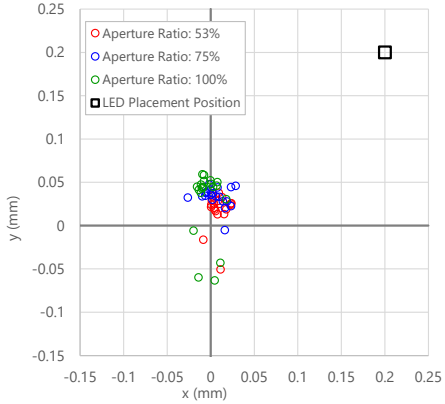
□ : Soldering Pad Pattern
＋ : Center of the Soldering Pad Pattern
＋ : Center of the Evaluated LED Placement Position



Metal Solder Stencil Thicknesses: 80µm



Metal Solder Stencil Thicknesses: 100µm



Metal Solder Stencil Thicknesses: 120µm

・Except for the two conditions with the least solder volume[5], the self-alignment performance was good; the LEDs moved to positions that were sufficiently close to the correct one (i.e. the amount of the deviation was almost the same as the evaluation results of the evaluation 6-1. See section 6-1.) by themselves during reflow soldering.

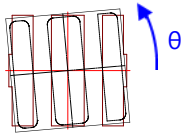
[5] The conditions with the metal solder stencil thickness of 80/100µm and the aperture ratio of 53%

6-4. Self-alignment Performance in the Angular Direction

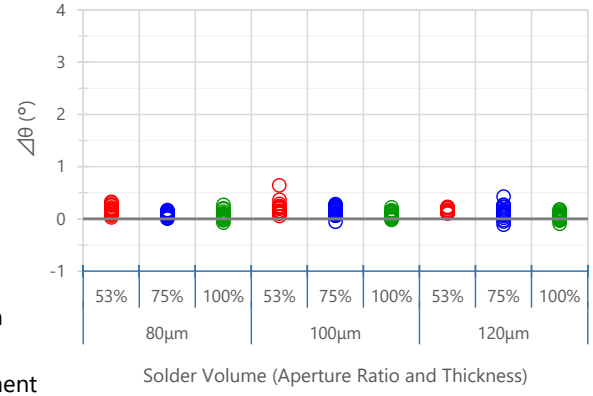
Nichia evaluated the self-alignment performance of the reflow-soldered LEDs using different solder volumes (i.e. three aperture ratios and three thicknesses for the metal solder stencil): the evaluation LEDs were intentionally rotated (i.e. ⊿θ = +5/10° from the reference axis whose origin was the center of the soldering pad pattern).
Sample Size: 20 LEDs per condition

Evaluated LED Placement Position 3

θ=+5° Rotated

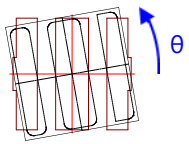


□ : Soldering Pad Pattern
＋ : Reference Axis of the Soldering pad pattern
＋ : Reference Axis of the Evaluated LED Placement Position

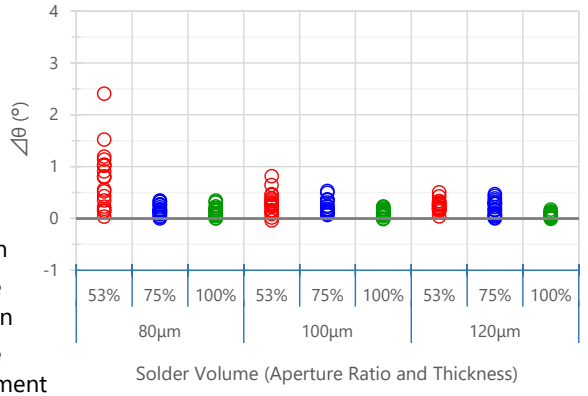


Evaluated LED Placement Position 4

θ=+10° Rotated



□ : Soldering Pad Pattern
＋ : Reference Axis of the Soldering pad pattern
＋ : Reference Axis of the Evaluated LED Placement Position



- The self-alignment performance was low in the two conditions with the least solder volume[6]; the LEDs did not move to positions that were sufficiently close to the correct one (i.e. the amount of the deviation was obviously greater than the evaluation results of the evaluation 6-2. See section 6-2.) by themselves during reflow soldering.

  [6] The conditions with the metal solder stencil thickness of 80/100μm and the aperture ratio of 53%

- As shown in the evaluation results above, Nichia has concluded that the larger the solder volume is, the better the self-alignment performance will be.

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