Assembly Precautions for the Nichia T02 Series LEDs

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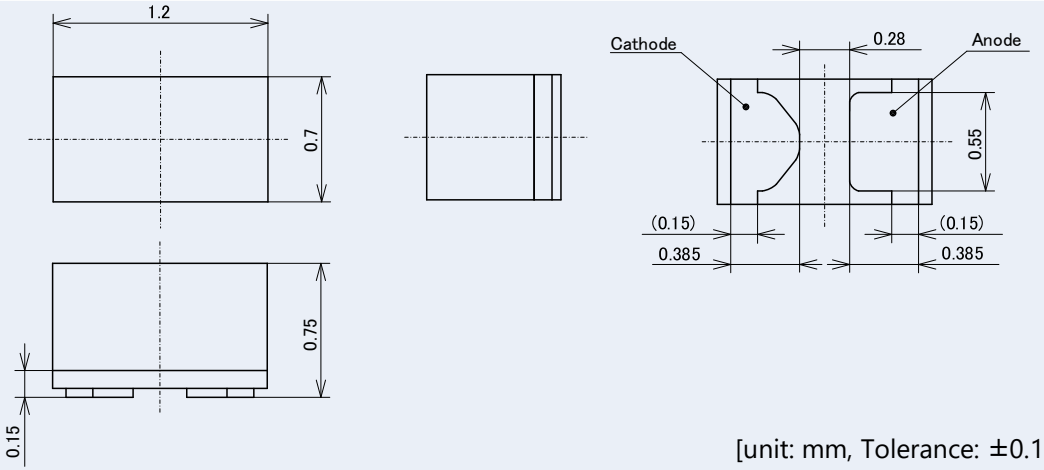
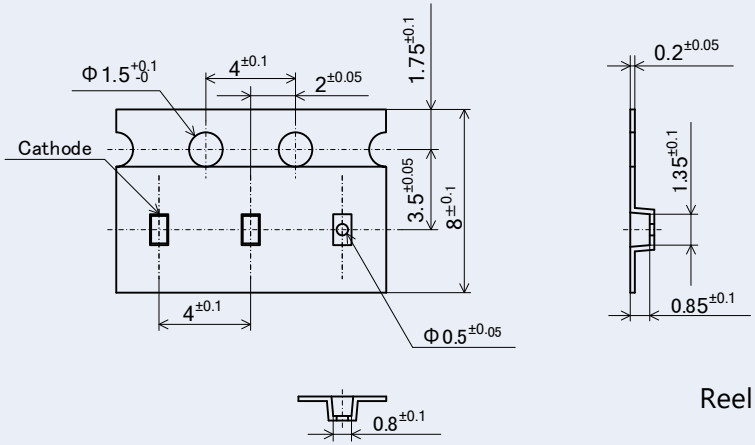
The part number NSSLT02A,NSSWT02A,NSSLT02A-V1,NSSWT02A-V1,NSSLT02A-V2,NSSWT02A-V2 in this document are the part number of our product, and do not have any relevance or similarity to other companies' products that may have trademark rights.

1. LED Outline Dimensions/Tape Dimensions（A, A-V1）

Table 1. Product Specifications

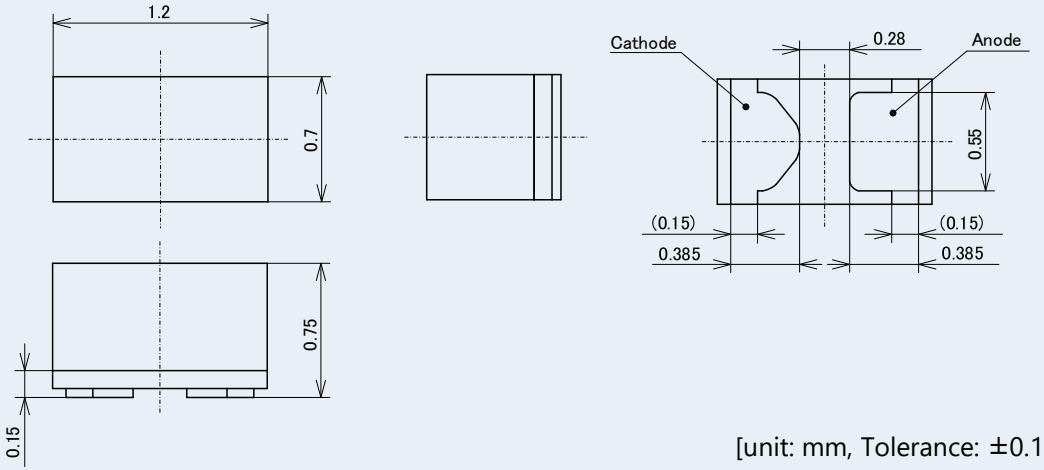
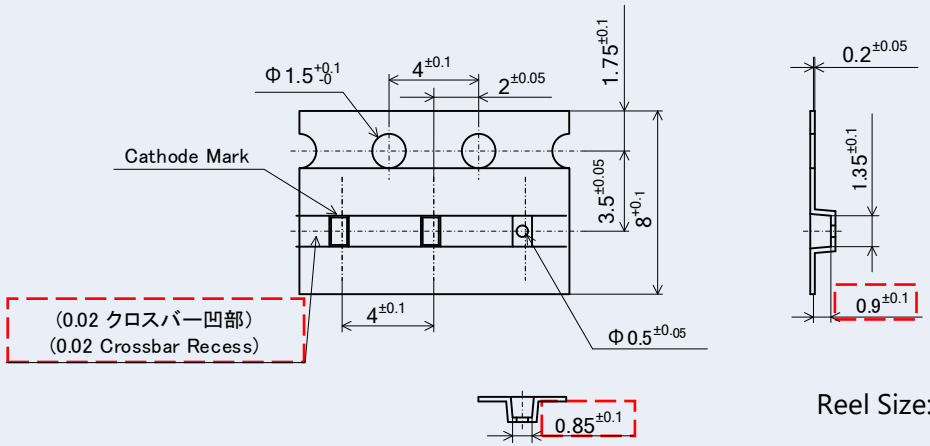
Part Number	NSSLT02A, NSSWT02A, NSSLT02A-V1, NSSWT02A-V1
LED	 [unit: mm, Tolerance: ±0.1mm]
Embossed Carrier Tape	 Reel Size: 4,000 LEDs [unit: mm]

This document contains tentative information, Nichia may change the contents without notice.

1. LED Outline Dimensions/Tape Dimensions（A-V2）

Table 2. Product Specifications

Specific feature for this series

Part Number	NSSLT02A-V2, NSSWT02A-V2
LED	 [unit: mm, Tolerance: ±0.1mm]
Embossed Carrier Tape	 Reel Size: 4,000 LEDs [unit: mm]

This document contains tentative information, Nichia may change the contents without notice.

2. Handling Precautions

Handling with bare hands

Ensure that when handling the LEDs with tweezers, excessive force is not applied to the LED. Otherwise, it may cause damage to the resin (e.g. cut, scratch, chip, crack, delamination and deformation) and the internal connection to fail causing a catastrophic failure (i.e. the LED not to illuminate).

Handling with tweezers

Ensure that when handling the LEDs with tweezers, excessive force is not applied to the LED. Otherwise, it may cause damage to the resin (e.g. cut, scratch, chip, crack, delamination and deformation) and the internal connection to fail causing a catastrophic failure (i.e. the LED not to illuminate).

ESD Precautions

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 have a reduction in the radiant flux 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.

Stacking assembled PCBs together

Do not stack assembled PCBs together. Otherwise, it may cause damage to the resin (e.g. cut, scratch, chip, crack, delamination and deformation) and the internal connection to fail causing a catastrophic failure (i.e. the LED not to illuminate).

Storage

The storage/packaging requirements for this LED are comparable to JEDEC Moisture Sensitivity Level (MSL) 2a or equivalent. Nichia used IPC/JEDEC STD-020 as a reference to rate the MSL of this LED.

Note: Since baking is not guaranteed for the Nichia T02 Series LEDs, once the moisture-proof aluminum bag is opened ensure that soldering is completed within the storage times detailed in the applicable specification.

Table 3. Storage conditions

Conditions		Temperature	Humidity	Time
Storage	Before Opening Aluminum Bag	≤ 30°C	≤ 90% RH	Within 1 Year from Delivery Date
	After Opening Aluminum Bag	≤ 30°C	≤ 70% RH	≤ 4 weeks

Incorrect

Caution: Do not grab/hold the LEDs with tweezers around the encapsulating resin.

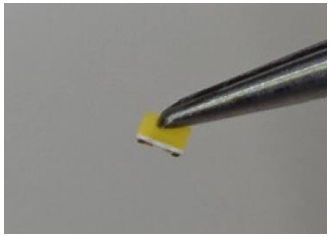


Figure 1. Example of an improper holding position

Incorrect

Caution: Do not stack assembled PCBs on top of each other.

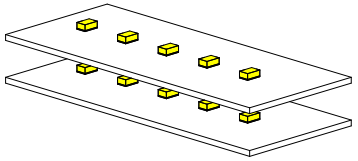
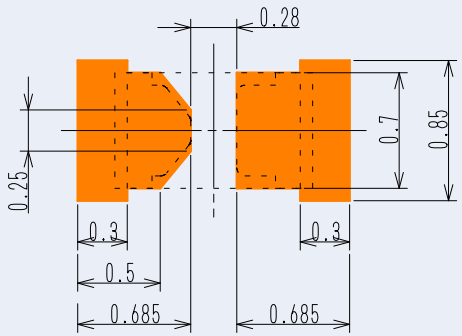
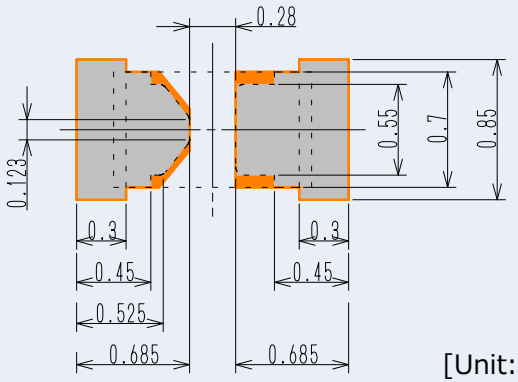


Figure 2. Example of improper stacking

3. Design Recommendations for Optimal Amount of Solder

Soldering Pad Pattern/Metal Solder Stencil Aperture

Table 4. Recommended Soldering Pad Pattern/Metal Solder Stencil Aperture

Recommended Soldering Pad Pattern	Recommended Metal Solder Stencil Aperture
 [Unit: mm]	 [Unit: mm]

•••: LED outline (outer), Electrodes (internal)
■: Soldering Pad Pattern
■: Metal Solder Stencil Aperture

Table 5. Recommended Solder/Metal Solder Stencil Conditions

Item	Recommended Conditions
Metal Solder Stencil (Thickness)	150 µm
Solder Paste (Composition)	Sn-3.0Ag-0.5Cu

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

Table 6. Cautions/Suggestions for setting up equipment

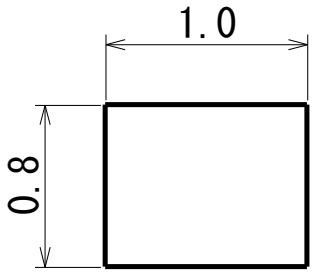
Item	Recommended Conditions/Specifications	Cautions/Suggestions
Pick-and-place machine[1]	Modular mounter	
Pick-and-place nozzle	Nozzles for 0402 (1005 metric) to 0603 (1608 metric) package components	See “Pick-and-Place Nozzle” on page 7 for the details.
Tape-and-reel feeder	Electrical (motorized) feeder Tape width: 8mm Feed length: 4mm	See “Tape-and-Reel Feeder” on page 7 for the details.
Nozzle height for pick-up operations	The contact surface of the nozzle head for pick operations should be adjusted to the same height as the edge of the embossed carrier tape pocket.	See “Recommended Nozzle Height for Pick-up Operations” on page 8 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 8 for the details.

Note:

[1] 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.)
- BM231 NE-EJM1C Modular Placement Machine (manufactured by Panasonic Smart Factory Solutions Co., Ltd.)

4-1. Pick-and-Place Nozzle



[Unit: mm]

Figure 3. Reference Nozzle Dimensions

- Ensure that an appropriate nozzle is used for the LEDs. Note: For reference purposes, Figure 3 (left) provides the outline dimensions of the nozzles used for the verification (See Table 6 Note).
- Pick-and-place nozzles for 0402 (1005 metric) to 0603 (1608 metric) package components may be appropriate for the LEDs. However, since it may vary depending on the pick-and-place machine, sufficient verification should be performed to ensure there are no issues with the nozzle being used.
- The placement force applied by the nozzle on the LEDs must be ≤ 3.5N.

4-2. Tape-and-Reel Feeder

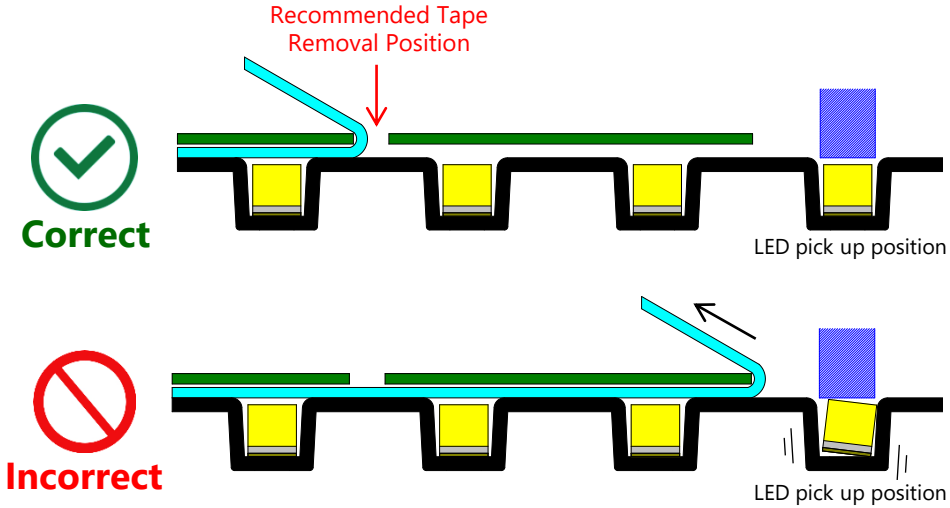


Figure 4. Examples of Correct/Incorrect Top Cover Tape Removal Positions

- Recommended setting for the tape-and-reel feeder.

  Tape width: 8mm
  Feed length: 4mm

- Use a tape-and-reel feeder that ensures it does not create excessive vibrations causing assembly issues.

  Example: Electrical (motorized) feeder

- If LEDs in the embossed carrier tape pockets are not in the correct position when picked by the nozzle, reduce the feed speed.
- When removing the top cover tape, it should be done at a point sufficiently far away from the target LED (See Figure 4 for the details). Otherwise, it can shake the embossed carrier tape and cause the LED to move within the tape pocket or outside of the tape pocket.

4-3. Recommended Nozzle Height for Pick-up Operations

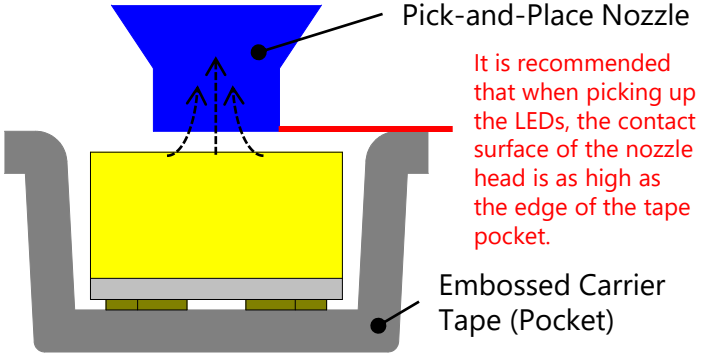


Figure 5. Recommended Nozzle Height for Pick-up Operations

- Adjust the pick-and-place nozzle to ensure that the contact surface is positioned at the same height as the edge of the pocket to pick up the LED (i.e. recommended nozzle height for pick-up operations).
- The recommended nozzle height for pick-up operations has been determined by Nichia under the verification conditions (See Table 5 Note) 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 failures.

4-4. Recommended Nozzle Height for Placement Operations (Placement Depth)

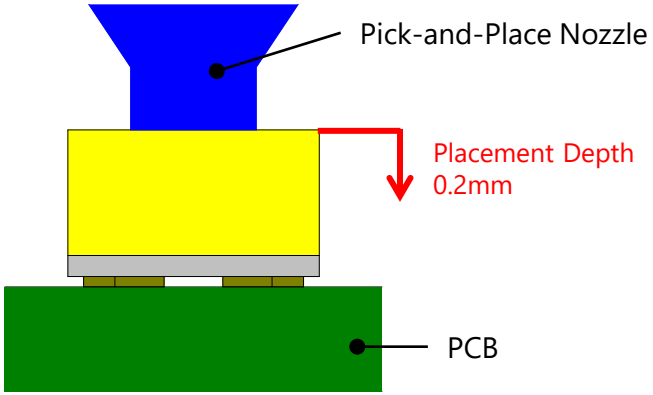


Figure 6. Recommended Nozzle Height for Placement (Placement Depth)

- Adjust the nozzle height to ensure that the nozzle applies an additional force (i.e. placement depth of 0.2mm) to the LED after the LED has come in contact with the PCB.

  If the release point of the nozzle is too high,
  - it may cause placement issues (e.g. LED's sticking to the nozzle after placement) or cause the LED to delaminate from the PCB after reflow soldering.

  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 break.

4-5. Imaging-based Automatic Inspection

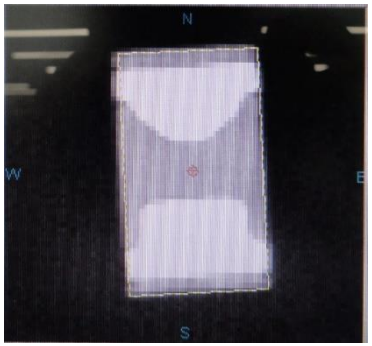


Figure 7. Example of automatic position recognition from an image: the machine extracts information from the image and adjusts the nozzle position to account for the positional deviation of the LED being picked.

- For accurate placement of the LEDs, use an automatic imaging-based recognition technology to correct misalignments.

5. Precautions When Reflow Soldering

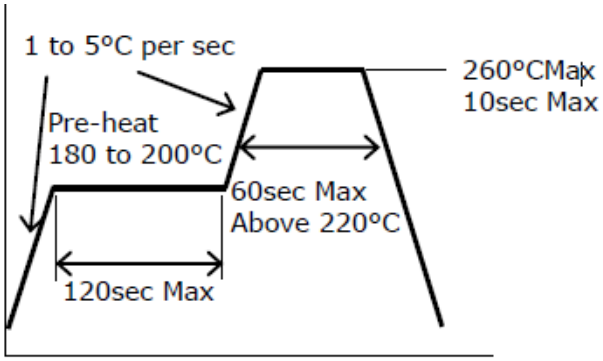


Figure 8. Recommended Reflow Soldering Condition (Lead-free Solder)

- Reflow soldering must not be performed more than twice.
- Using the recommended reflow soldering conditions (See Figure 8 to the left) as a reference, modify if necessary, the recommended reflow conditions specified by the manufacturer of the solder paste being used.

  Note:
  To ensure that these reflow conditions have no negative effect on the LEDs, perform sufficient verification prior to use.
- When cooling the LEDs from the peak temperature a gradual cooling slope is recommended; do not cool the LEDs rapidly.
- 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

6-1. Evaluation Method/Conditions

The effect of solder volume on the workmanship of the reflow-soldered LEDs (e.g. LED emission failure, number of solder balls) was evaluated using nine different evaluation configurations (i.e. three aperture ratios, three stencil thicknesses) to control the amount of solder paste.

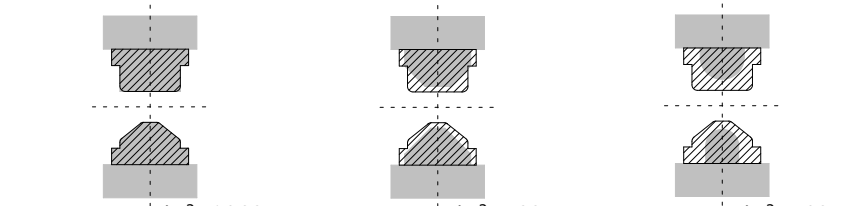
PCB[2] specifications:

Single-sided CEM-3
PCB thickness: 1.0mm
Copper layer thickness: 35µm

Metal Solder Stencil Thicknesses:

120µm, 150µm, 180µm

Metal Solder Stencil Aperture Patterns:



Aperture ratio[3]: 100% (Nichia's recommendation) | Aperture ratio[3]: 70% | Aperture ratio[3]: 40%

■ : Metal solder stencil aperture pattern
▨ : LED electrodes

6-2. Evaluation Results

There were no assembly-related issues (e.g. emission failure, solder ball) with the evaluation conditions (i.e. volume of the solder paste) used. For more details, refer to Tables 7, 8 and 9 on the next page.

Note:
[2] Nichia's recommended soldering pad pattern was used.
[3] Aperture ratio [%]: Area of the solder directly beneath the electrodes / area of the electrodes

6-2. Evaluation Results (continued)

Table 7. Stencil Thickness: 120µm Evaluation Result

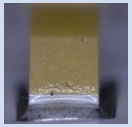
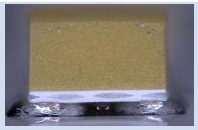
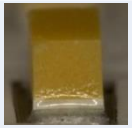
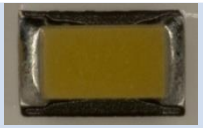
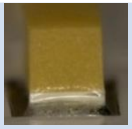
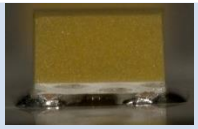
Aperture Ratio	Top	Side A	Side B
100%			
70%			
40%			

Table 8. Stencil Thickness: 150µm Evaluation Result

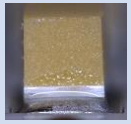
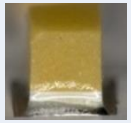
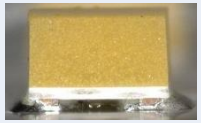
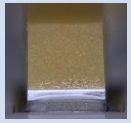
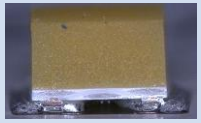
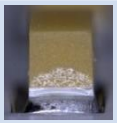
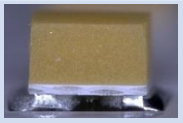
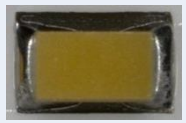
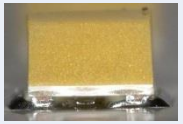
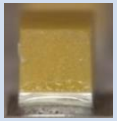
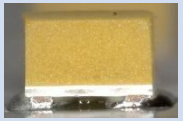
Aperture Ratio	Top	Side A	Side B
100%			
70%			
40%			

Table 9. Stencil Thickness: 180µm Evaluation Result

Aperture Ratio	Top	Side A	Side B
100%			
70%			
40%			

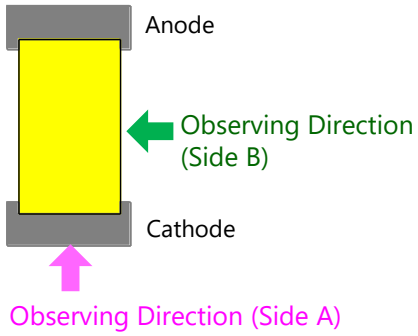


Figure 9. Observation Direction

7. Evaluation of Self-Alignment Performance

7-1. Evaluation Method/Conditions

The self-alignment performance of the LEDs was evaluated using the following evaluation method/conditions:

PCB[3] specifications:

Single-sided CEM-3
PCB thickness: 1.0mm
Copper layer thickness: 35µm

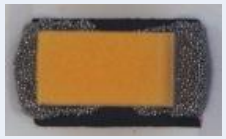
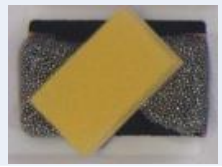
Metal Solder Stencil specifications:

Stencil thickness: 150µm (Nichia's recommendation)
Aperture pattern: See Table 3 or the applicable specification
(Nichia's recommended metal solder stencil aperture)

7-2. Evaluation Results

The LEDs with the deviations above moved to the correct position (i.e. the center of the soldering pad pattern) by themselves during reflow soldering (i.e. surface tension-driven self-alignment) and no issues (e.g. causing the LED not to illuminate) were observed. For more details, refer to Table 10 below.

Table 10. Results of evaluating the self-aligning performance

	Correct Position	Deviation from the soldering pad pattern center				
		x Direction +0.2mm	y Direction +0.2mm	x,y Direction +0.2mm	θ Direction +30°	θ Direction +45°
Appearance before reflow soldering						
Appearance after reflow soldering						

8. Evaluation of the Solder Joint Shear Strength

8-1. Evaluation Method/Conditions

The shear force was applied to the side of the LED using a test jig and the shear strength was measured.

PCB[3] specifications:

Single-sided CEM-3
PCB thickness: 1.0mm
Copper layer thickness: 35µm

Metal Solder Stencil specifications:

Stencil thickness: 150µm (Nichia's recommendation)
Aperture pattern: See Table 3 or the applicable specification
(Nichia's recommended metal solder stencil aperture)

8-2. Evaluation Results

The solder joint strength was sufficient due to the following reasons:
- All the tested LEDs had damaged packages (See Figure 11 below)
- No delamination was observed at the interface between the solder and PCB (i.e. soldering pad)

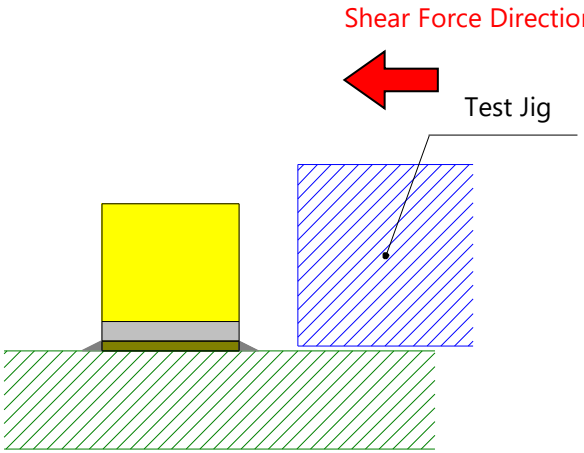


Figure 10. How the Shear Force was Applied

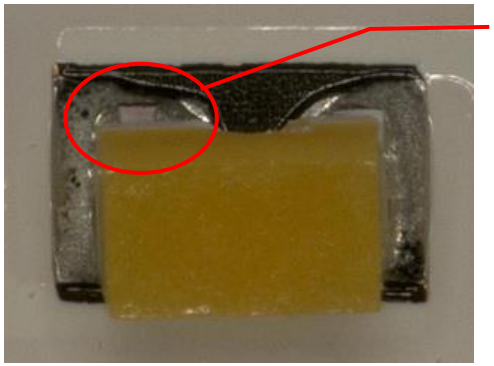


Figure 11. LED Appearance After the Test

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