



Assembly Precautions for the Nichia NFSWL11A-D6 LED

Table of contents

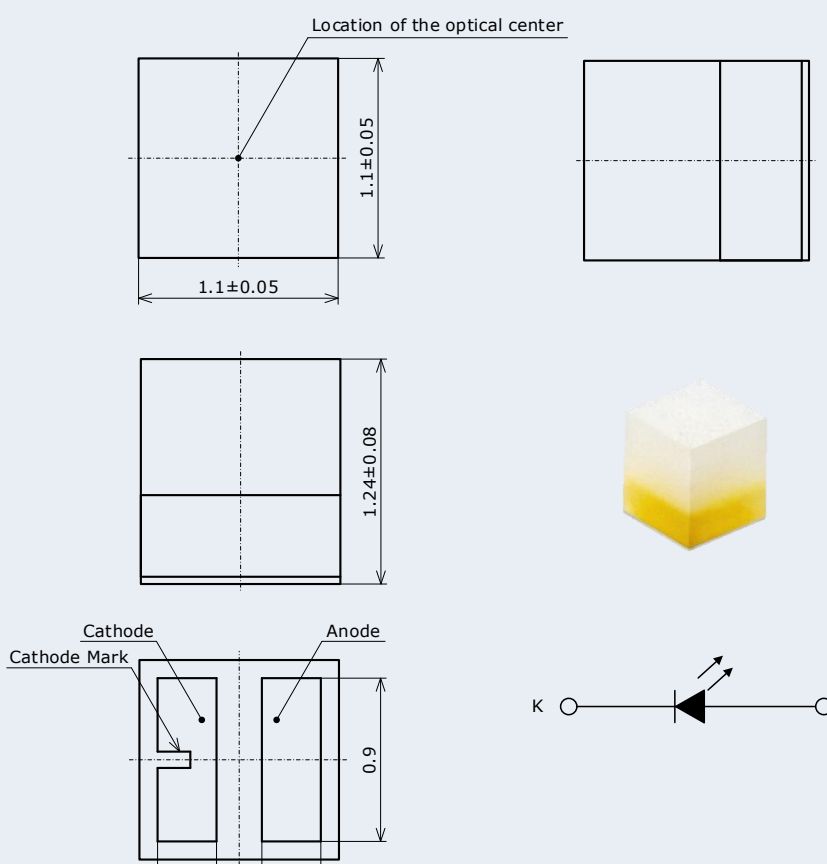
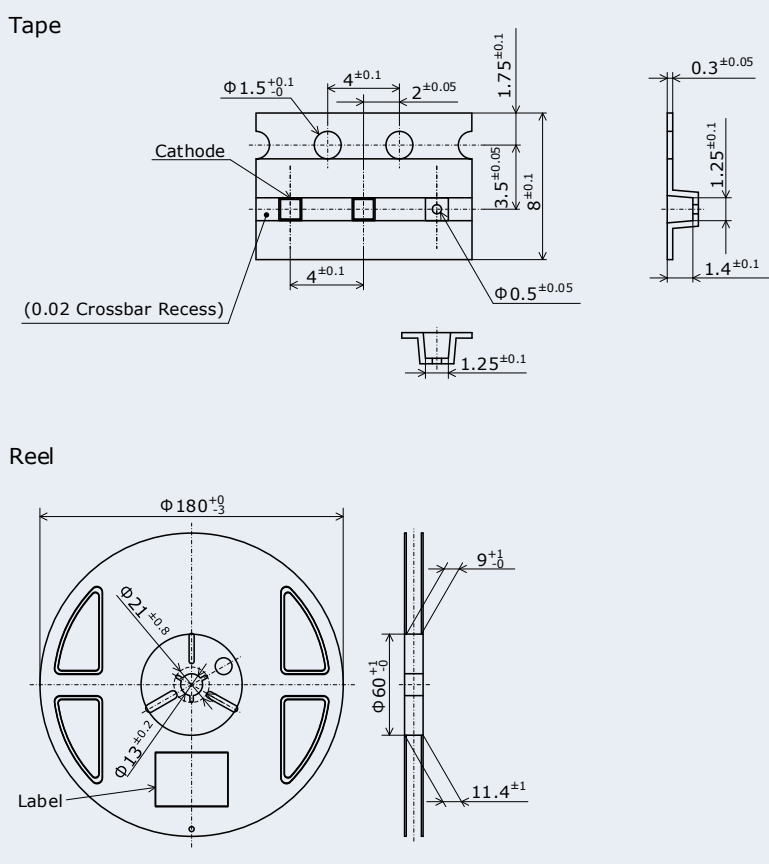
1.	<u>LED Outline Dimensions/Tape and Reel Dimensions</u>	2
2.	<u>Handling Precautions</u>	3-4
3.	<u>Design Recommendations for Optimal Amount of Solder</u>	5-6
4.	<u>Precautions when Soldering the Electrodes</u>	7
5.	<u>Precautions for Setting Up a Pick-and-Place Machine/Nozzle</u>	8-11
6.	<u>Precautions When Reflow Soldering</u>	11

NFSWL11A-D6 refers to a Nichia part number. The Nichia part number within this document is merely Nichia's part number for the Nichia product and is not related nor bear resemblance to any other company's product that might bear a trademark.

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

1. LED Outline Dimensions/Tape and Reel Dimensions

Table 1. NFSWL11A-D6 Product Specifications

LED	Embossed Carrier Tape
 <p>Location of the optical center</p> <p>1.1±0.05</p> <p>1.1±0.05</p> <p>1.24±0.08</p> <p>Cathode</p> <p>Anode</p> <p>Cathode Mark</p> <p>0.9</p> <p>0.25</p> <p>0.9</p> <p>K</p> <p>A</p> <p>Weight: typ. 0.024g (Unit: mm, Tolerance: ±0.1mm)</p>	 <p>Tape</p> <p>Φ 1.5^{+0.1}₋₀</p> <p>4^{±0.1}</p> <p>2^{±0.05}</p> <p>1.75^{±0.1}</p> <p>3.5^{±0.05}</p> <p>8^{±0.1}</p> <p>Φ 0.5^{±0.05}</p> <p>0.3^{±0.05}</p> <p>1.25^{±0.1}</p> <p>1.4^{±0.1}</p> <p>(0.02 Crossbar Recess)</p> <p>1.25^{±0.1}</p> <p>Reel</p> <p>Φ 180⁺⁰₋₃</p> <p>Φ 21^{±0.8}</p> <p>Φ 13^{±0.2}</p> <p>Label</p> <p>9⁺¹₀</p> <p>Φ 60⁺⁰₀</p> <p>11.4^{±1}</p> <p>Reel Size: 3,000 LEDs (Unit: mm)</p>

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

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,
- this may cause the LED to deform causing a catastrophic failure (i.e. the LED not to illuminate),

2-2. Handling with Tweezers

The resin of this LED is very soft. The surface of the resin may be damaged (e.g. cut, scratch, chip, crack, delamination, and deformation) when it is touched while the LED is being handled. Also, if force is applied to the resin, it may cause a catastrophic failure; ensure that when handling the LED with tweezers, excessive force is not applied to the LED.

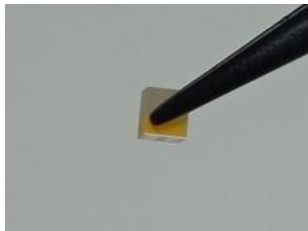
2-3. ESD Precautions

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.

2-4. . Handling Assembled PCBs

The resin of this LED is very soft. The surface of the resin may be damaged (e.g. cut, scratch, chip, crack, delamination, and deformation) when it is touched while the LED is being handled. After soldering the LED to a PCB, ensure that the resin does not have contact with any object when handling the assembled PCBs. Also, do not stack assembled PCBs together. Otherwise, it may cause damage to the resin (e.g. cut, scratch, chip, crack, removal from the PCB, etc.) causing a catastrophic failure. Nichia recommends that assembled PCBs are stored in a PCB magazine rack, a PCB holder, etc.

✓ Correct



⊘ Incorrect



Figure 1. Correct/Incorrect Examples of Handling with Tweezers

⊘ Incorrect

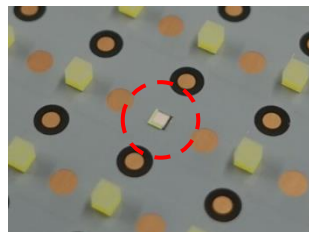


Figure 2. LED Whose Resin Has Been Removed



Figure 3. Stacking Assembled PCBs Together

✓ Correct



Figure 4. Assembled PCBs Stored in a PCB Holder

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

2-5. Storage

The NFSWL11A LED is comparable to JEDEC Moisture Sensitivity Level (MSL) 2a or equivalent. Refer to IPC/JEDEC STD-020 for detailed information regarding the MSL. Once the moisture-proof aluminum bag is open, ensure that the LED is soldered to a PCB within the range of the conditions below. To store any remaining unused LEDs, use a hermetically sealed container with silica gel desiccants. Nichia recommends placing them back to the original moisture-proof bag and reseal it.

Table 2. Storage Conditions

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

2-6. Packing Assembled PCBs

The resin of this LED is very soft; it may be removed from the PCB if it comes in contact with a packing material. When packing assembled PCBs for transportation, it must be ensured that the resin will not have contact with any packing materials by using a tray, etc. that is designed accordingly. Do not pack assembled PCBs directly into an antistatic bag or with antistatic bubble wrap.

 **Incorrect**



Figure 5. Assembled PCB that is Wrapped with Antistatic Bubble Wrap

 **Incorrect**



Figure 6. Assembled PCB that is Packed in an Antistatic Bag

 **Correct**



Figure 7. Example of a Tray

2-7. Repair/Rework for Assembled PCBs

The electrodes of this LED are very small; once the LEDs are soldered to a PCB, Nichia does not recommend repairing/reworking the assembled PCBs. If it must be done, ensure that it is done properly (i.e. the amount of solder, LED mounting technique, temperature control, etc. are appropriate). Otherwise, it may cause a solder joint failure, tilted LED on the PCB, discoloration of the PCB, etc.

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

3. Design Recommendations for Optimal Amount of Solder

Soldering Pad Pattern/Metal Solder Stencil Aperture

3-1. PCB to assemble the LED

This LED has a wide directivity; light emitted from the LED hits the PCB and/or solder resist and it may cause the PCB/solder resist to discolor, crack, etc. around the soldering pad pattern. When selecting a PCB and solder resist, perform a sufficient verification in advance with the conditions/environments in which the chosen application containing the LED will actually be used.

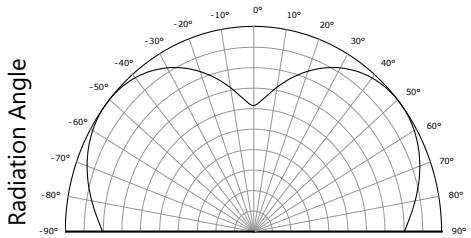


Figure 8. Directivity

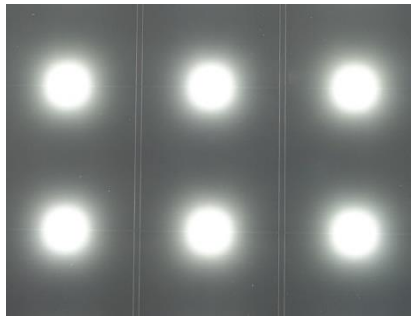


Figure 9. Illuminated LEDs

Table 3. Evaluation Result for the Appearance of PCBs after High Temperature Operation (For Reference Purposes)

PCB Used	High Temperature Operation: 100°C, I _F =250mA			Comments
	0h	500h	1000h	
FR4/CEM3				<ul style="list-style-type: none"> The PCB base material was slightly discolored. Results will vary depending on the copper layer design (i.e. SMD vs NSMD)¹. If an FR4/CEM3 PCB is used for the LEDs under high temperatures, the base material may significantly discolor.
Flexible				<ul style="list-style-type: none"> The PCB base material was significantly discolored. The PCB base material discolored even at room temperature. Do not use a flexible PCB for this LED.

¹ Nichia recommends Solder Mask Defined (SMD) for the copper layer design.

Table 4. Evaluation Result for the Appearance of Solder Resist after High Temperature Operation (For Reference Purposes)

Solder Resist Used	High Temperature Operation: 100°C, I _F =250mA			Comments
	0h	500h	1000h	
Alkaline Developable				<ul style="list-style-type: none"> The solder resist was slightly discolored. Nichia recommends using a high-reflective and light-resistant solder resist.
UV curable				<ul style="list-style-type: none"> The solder resist was significantly discolored. Nichia does not recommend using UV curable solder resist.

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

3-2. Design Recommendations for Optimal Amount of Solder Soldering Pad Pattern/Metal Solder Stencil Aperture

Table 5. Recommended Soldering Pad Pattern/
Metal Solder Stencil Aperture

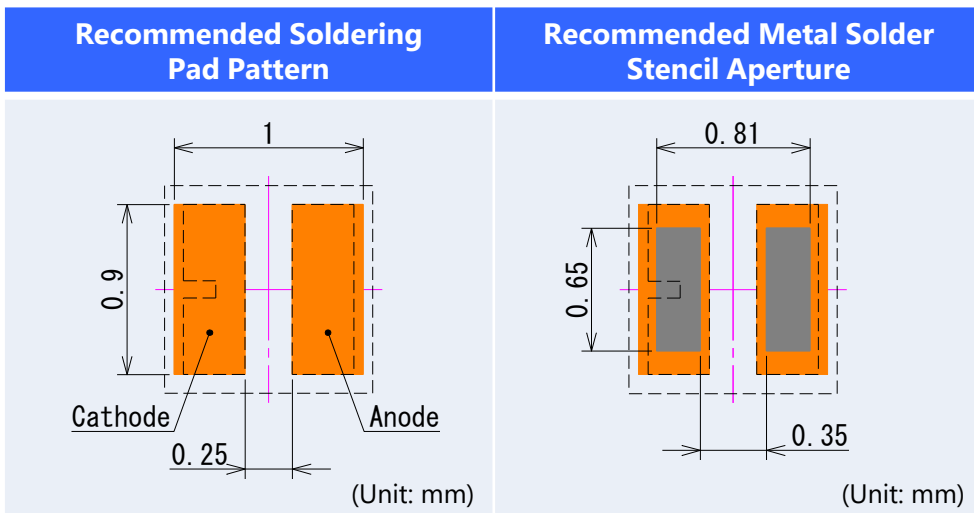
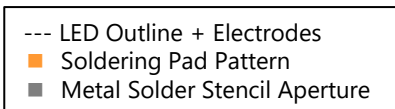


Table 6. Recommended Solder/Metal Solder Stencil Conditions

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

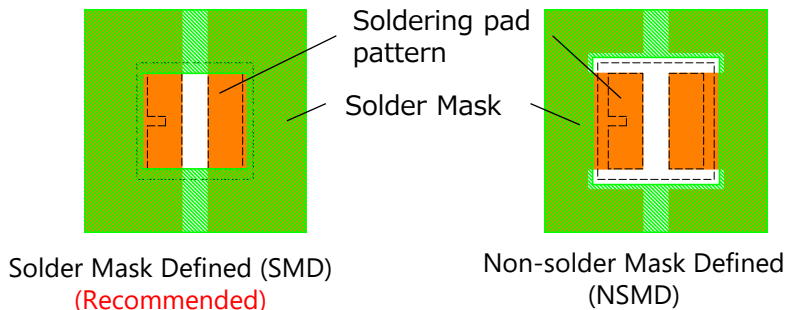


Figure 10. Copper Layer Designs to Create the Soldering Pad Pattern

- The recommended soldering pad pattern, metal solder stencil aperture, and thickness of the metal solder stencil provided in Tables 5 and 6 have been determined under Nichia's conditions: ensure that there are no issues with the chosen assembly conditions prior to use.
- If a soldering pad pattern that is different from Nichia's recommendation (see Table 5) is used, the distance between the anode and cathode should be as recommended (i.e. 0.25mm). Otherwise, it may cause a solder joint failure leading to emission failure and/or a performance/reliability degradation of the LEDs.
- There are two types of copper layer designs to create the soldering pad pattern: Non-Solder Mask Defined (NSMD) and Solder Mask Defined (SMD). For this LED, Nichia recommends SMD to protect the PCB from the light that hits the PCB.

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

4. Precautions when Soldering the Electrodes

4-1. Electrodes of the LED

This LED has large electrodes to improve the placement accuracy (see Figure 11); if solder paste is not applied to a sufficient area between the electrodes and soldering pad pattern, it may cause the heat dissipation performance of the LED to be reduced resulting in reduced reliability (see Figure 12). To achieve the performance that is specified in the applicable specification of the LED, ensure that the electrodes are soldered to the PCB properly.

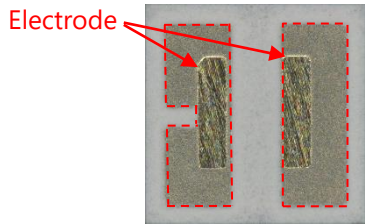


Figure 11. Appearance of the Electrodes

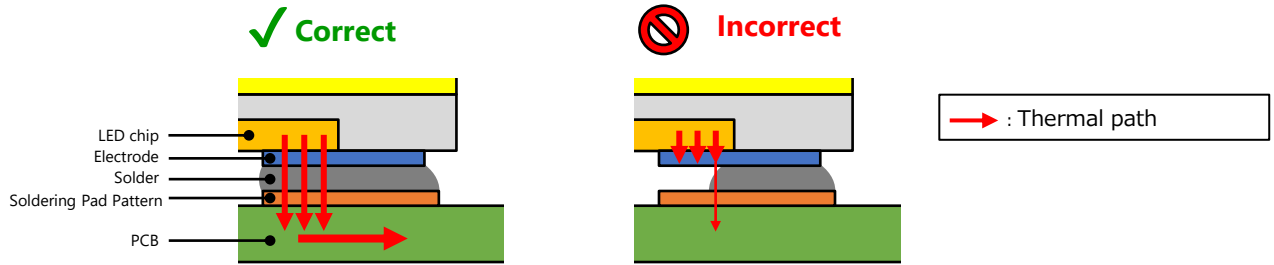


Figure 12. LED Heat Dissipation Reference Images for the LED

4-2. Recommended Ratio of the Solder Joint Area to the Area of the Electrode

To achieve the specification's performance for the LED, Nichia recommends each of the electrodes is soldered to the PCB with solder paste covering $\geq 75\%$ of the electrode. Ensure that an adequate area is covered by solder paste using an X-ray examination, etc. The ratio of the solder joint area to the area of the electrode is calculated using the equation below.

$$\text{Ratio of the solder joint area to the area of the electrode} = \frac{\text{Area of the solder joint except for non-bonding area (e.g. voids)}}{\text{Area of the electrode}} \times 100$$

Nichia did not confirm any solder joint failure leading to a performance/reliability degradation of the LEDs under Nichia's evaluation conditions. Perform a verification with the chosen conditions to ensure that the ratio of the solder joint area to the area of the electrode is sufficient.

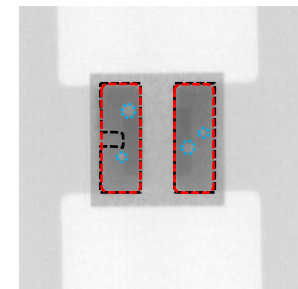
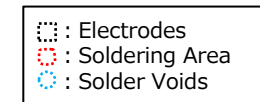


Figure 13. Example of an X-ray Image

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

Table 7. Cautions/Suggestions for Setting Up Equipment

Item	Recommended Conditions/Specifications	Cautions/Suggestions
Pick-and-Place Machine	Modular mounter	The recommended conditions/specifications herein have been determined using YS100 High-Speed General-Purpose Modular (manufactured by Yamaha Motor Co., Ltd.).
Pick-and-Place Nozzle	Use a nozzle that is appropriate for the dimensions of the LED.	See "5-1. Pick-and-Place Nozzle" on Page 9 for details.
Tape-and-Reel Feeder	Electrical (motorized) feeder Tape width: 8mm Feeder pitch: 4mm	See "5-2. Tape-and-Reel Feeder" on Page 9 for details.
Top Cover Tape Removal Position	Sufficiently far away from the LED pick-up position.	See "5-2. Tape-and-Reel Feeder" on Page 9 for details.
Nozzle Height for Pick-up Operations	The contact surface of the nozzle head for pick operations should be adjusted to the height of the edge of the embossed carrier tape pocket.	See "5-3. Recommended Nozzle Height for Pick-up Operations" on Page 10 for details.
Nozzle Height for Placement Operations (i.e. Placement Depth)	0.2mm for placement depth	See "5-4. Recommended Nozzle Height for Placement Operations (Placement Depth)" on Page 10 for details.
Imaging-based Automatic Inspection	To locate the center of the LED, using the outline as a reference is recommended.	See "5-5. Imaging-based Automatic Inspection" on Page 10 for details.

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

5-1. Pick-and-Place Nozzle

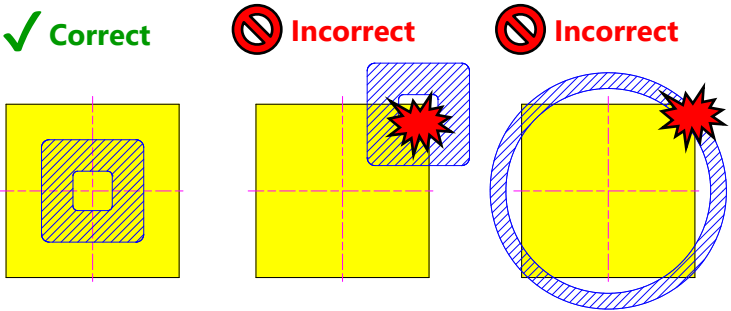


Figure 14. Examples of Correct/Incorrect Nozzle Dimensions

1. Use a pick-and-place nozzle that is smaller than the outline dimensions of the LED (i.e. 1.1mm x 1.1mm). Ensure that the LED is picked up at the center of the emitting surface.
2. If the size and shape of the nozzle tip are not appropriate for the LED or if the nozzle does not pick up the LED at the center of the emitting surface, this may damage the LED (i.e. chipped, deformed, etc.) and/or lead to an incorrect pick up (i.e. the LED is picked up in a tilted position).
3. Ensure that the maximum force applied to the LED during the pick-up and placement operations does not exceed 5N.

5-2. Tape-and-Reel Feeder

It is **recommended** to remove the top cover tape at a point sufficiently far away from the LED pick-up position.

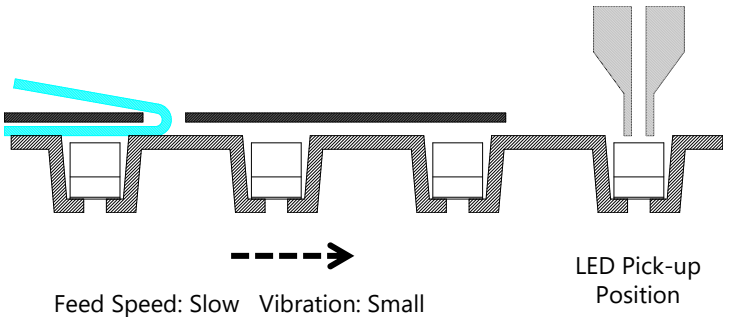


Figure 15. Top Cover Tape Removal Position

1. For the tape-and-reel feeder, the tape width is set to 8mm and the feeder pitch is set to 4mm.
2. Use a tape-and-reel feeder that ensures it does not create excessive vibrations causing assembly issues (e.g. an electrical [motorized] feeder).
 - When the tape feeder feed rate is fast, the LEDs in the embossed carrier tape pockets may not be in the correct position when picked by the nozzle; it may be improved by reducing the tape feeder feed rate.
3. It is recommended to remove the top cover tape at a point sufficiently far away from the LED pick-up position.

5-3. Recommended Nozzle Height for Pick-up Operations

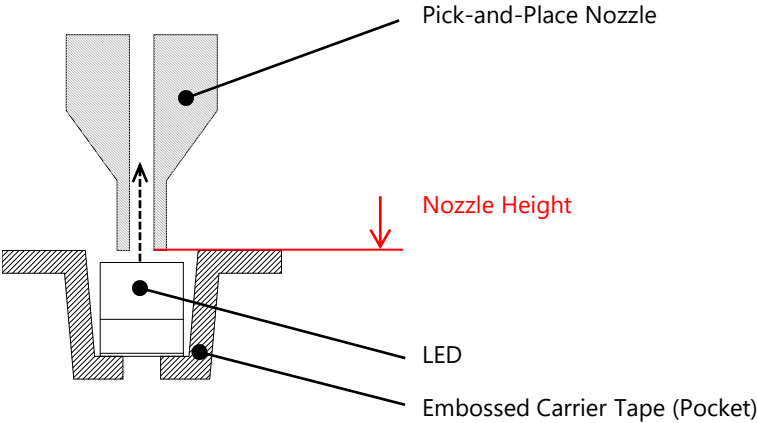


Figure 16. Recommended Nozzle Height for Pick-up Operations

5-4. Recommended Nozzle Height for Placement Operations (Placement Depth)

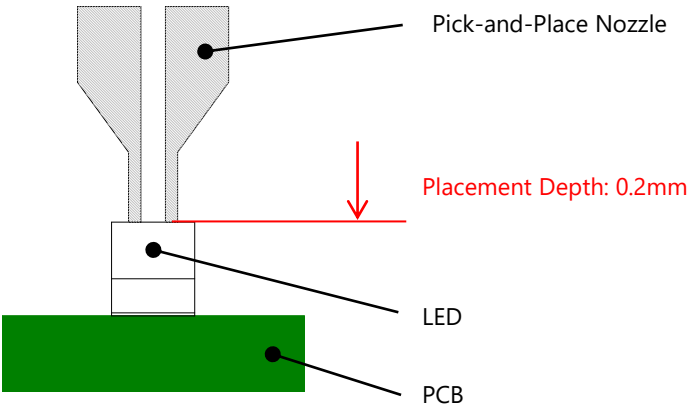


Figure 17. Recommended Nozzle Height for Placement (Placement Depth)

1. Ensure that the nozzle only goes down to the top edge of the tape pocket and does not directly come into contact with the LED.

Note: The reference level for the nozzle setting is at the top edge of the tape pocket.

2. The recommended nozzle height for pick-up operations has been determined by Nichia under the verification conditions 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 and/or damage to the LED.

1. After the LED is mounted onto solder paste on the PCB, the nozzle should further press the LED 0.2mm into the PCB.

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 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.

5-5. Imaging-based Automatic Inspection

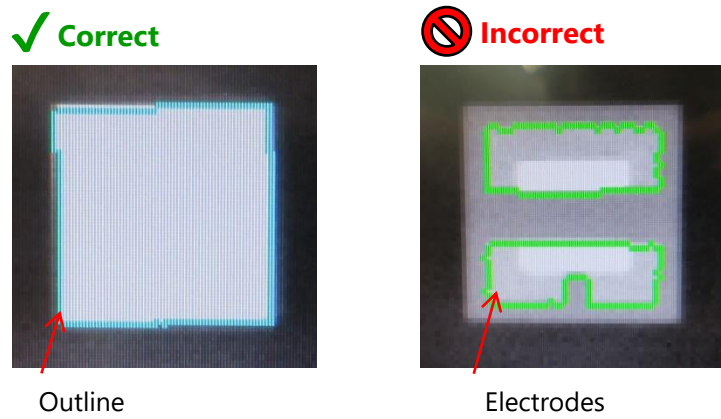


Figure 18. Correct/Incorrect reference Points to Locate the Center of the LED

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

6. Precautions When Reflow Soldering

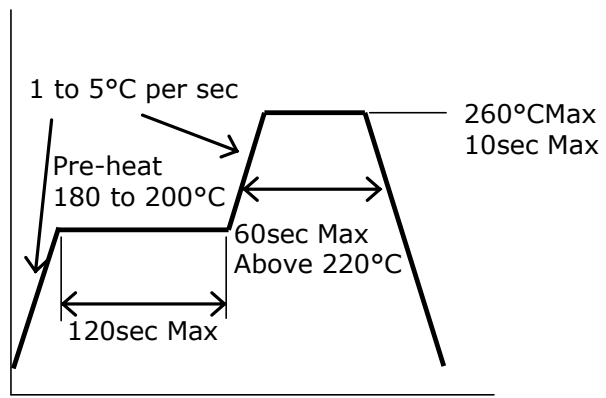


Figure 19. Recommended Reflow Soldering Condition (Lead-free Solder)

1. Reflow soldering must not be performed more than twice.
2. Using the recommended reflow soldering conditions (See Figure 19 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.

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.

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

Disclaimer

This application note is a controlled document of Nichia Corporation (Nichia) published to provide technical information/data for reference purposes only. By using this application note, the user agrees to the following:

- This application note has been prepared solely for reference on the subject matters incorporated within it and Nichia makes no guarantee that customers will see the same results for their chosen application.
- The information/data contained herein are only typical examples of performances and/or applications for the product. Nichia does not provide any guarantees or grant any license under or immunity from any intellectual property rights or other rights held by Nichia or third parties.
- Nichia makes no representation or warranty, express or implied, as to the accuracy, completeness or usefulness of any information contained herein. In addition, Nichia shall not be liable for any damages or losses arising out of exploiting, using, or downloading or otherwise this document, or any other acts associated with this document.
- The content of this application note may be changed without any prior or subsequent notice.
- Copyrights and all other rights regarding the content of this document are reserved by Nichia or the right holders who have permitted Nichia to use the content. Without prior written consent of Nichia, republication, reproduction, and/or redistribution of the content of this document in any form or by any means, whether in whole or in part, including modifications or derivative works hereof, is strictly prohibited.

NICHIA CORPORATION 491 Oka, Kaminaka-Cho, Anan-Shi,
TOKUSHIMA 774-8601, JAPAN
<http://www.nichia.co.jp> Phone: +81-884-22-2311 Fax: +81-884-21-0148

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