



# Assembly Precautions for the Nichia NFSWT03A LED

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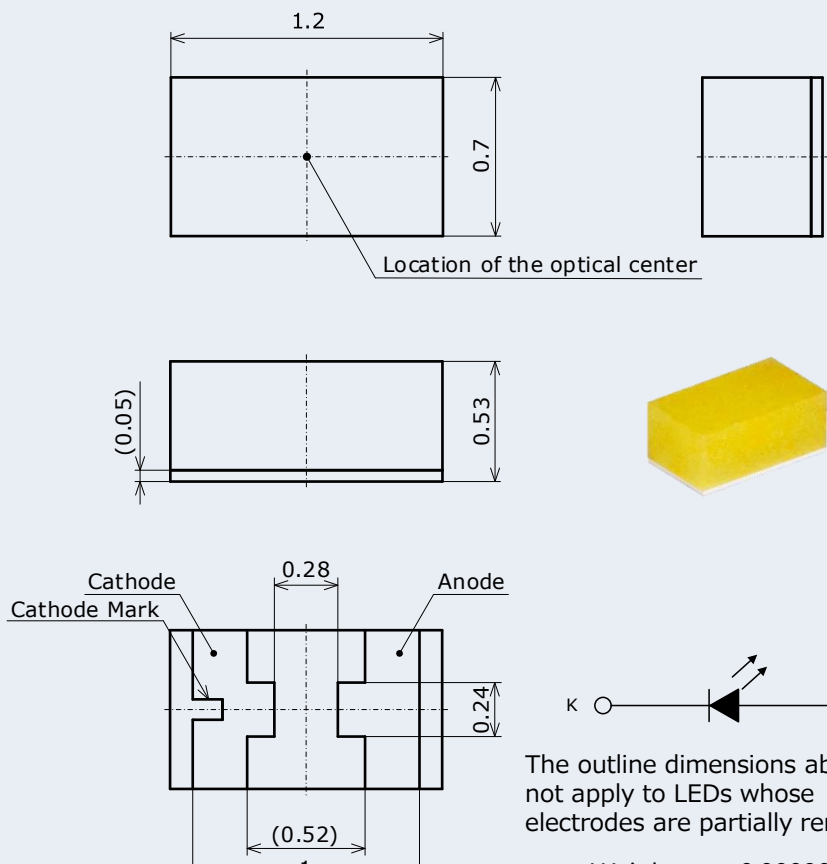
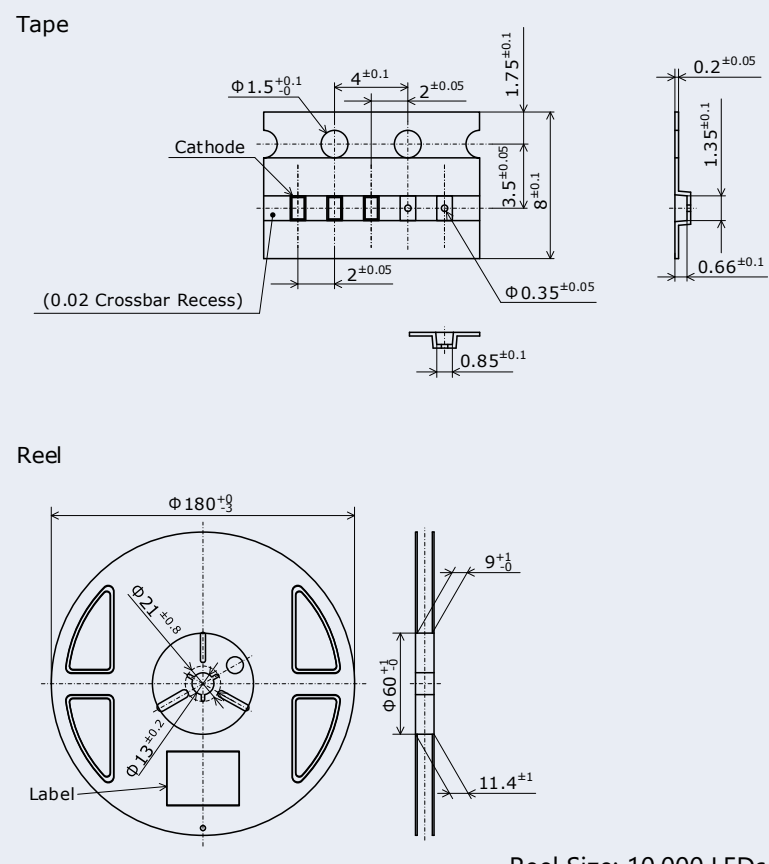
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The Nichia part numbers NFSWT03A and NSSxT02A-V2 within this document are merely Nichia's part numbers for those Nichia products and are not related nor bear resemblance to any other company's product that might bear a trademark.

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## 1. LED Outline Dimensions/Tape Dimensions

Table 1. Product Specifications

LED	Embossed Carrier Tape
 <p>Location of the optical center</p> <p>Cathode Cathode Mark Anode</p> <p>The outline dimensions above do not apply to LEDs whose electrodes are partially removed.</p> <p>Weight: typ. 0.00090g (Unit: mm, Tolerance: <math>\pm 0.1</math>mm)</p>	<p>Tape</p>  <p>Reel</p> <p>Reel Size: 10,000 LEDs (Unit: mm)</p>

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## 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.

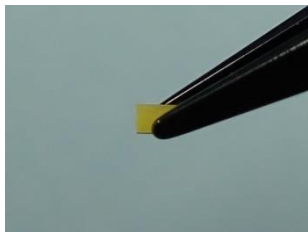
### 2-3. ESD Precautions

The LEDs are very sensitive to transient excessive voltages (e.g. ESD, lightning surge) since a protection device (e.g. Zener diode) is not incorporated in them. If this excessive voltage occurs, it may cause the LEDs to be damaged causing issues (e.g. the LEDs 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.

### 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

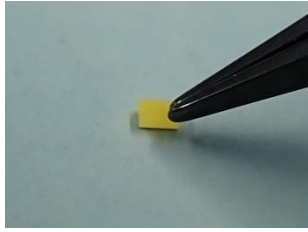


Figure 1. Correct/Incorrect Examples of Handling with Tweezers

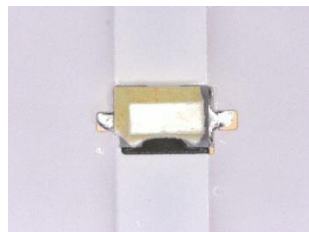


Figure 2. LED Whose Resin Has Been Removed

⊘ Incorrect



Figure 3. Stacking Assembled PCBs Together

✓ Correct



Figure 4. Assembled PCBs Stored in a PCB Holder

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## 2-5. Storage

The NFSWT03A 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.

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### 3. Design Recommendations for Optimal Amount of Solder

#### 3-1. Design Recommendations for Optimal Amount of Solder Soldering Pad Pattern/Metal Solder Stencil Aperture

Table 3. Recommended Soldering Pad Pattern/  
Metal Solder Stencil Aperture

--- LED Outline + Electrodes  
 ■ Soldering Pad Pattern  
 ■ Metal Solder Stencil Aperture

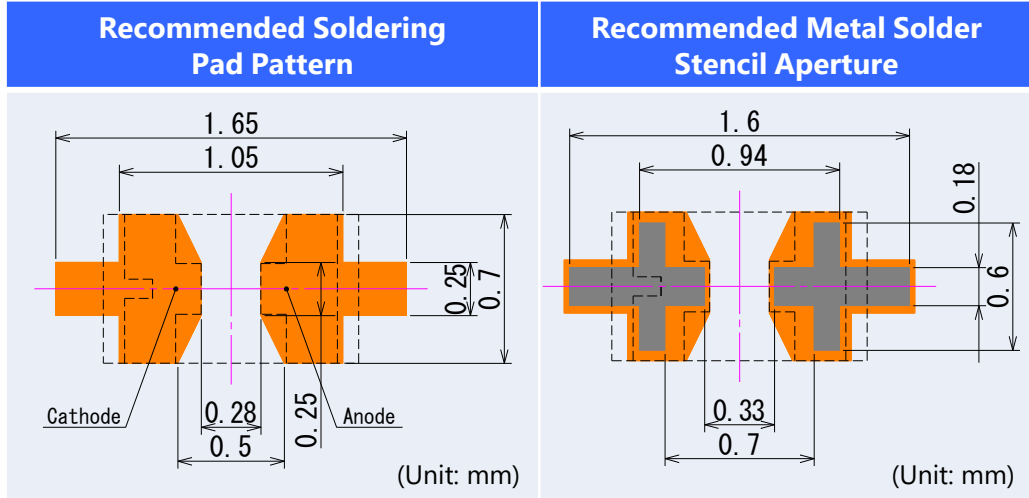


Table 4. Recommended Solder/Metal Solder Stencil Conditions

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

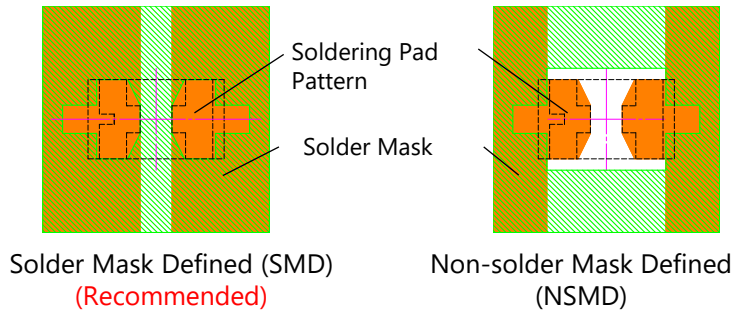


Figure 8. Copper Layer Designs to Create the Soldering Pad Pattern

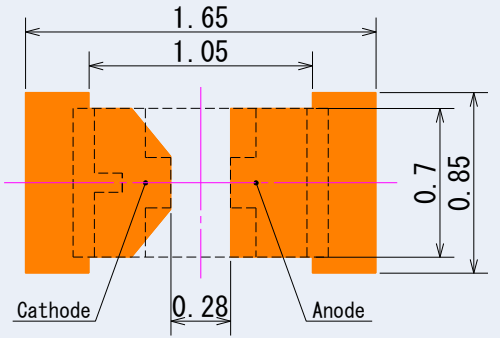
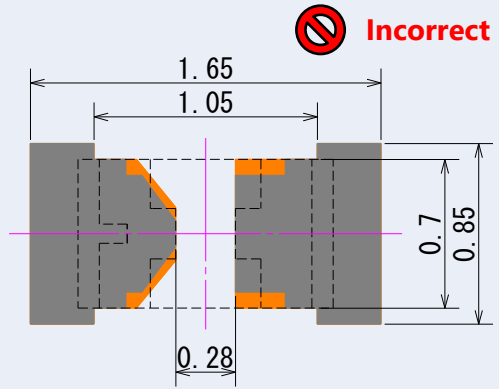
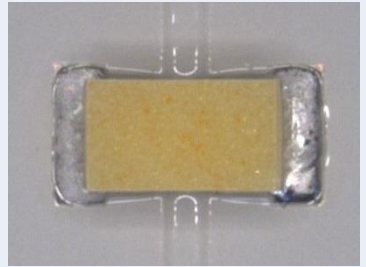
- The recommended soldering pad pattern, metal solder stencil aperture, and thickness of the metal solder stencil provided in Tables 3 and 4 have been determined under Nichia’s conditions: ensure that there are no issues with the chosen assembly conditions prior to use.
- If a soldering pad pattern that is different from Nichia’s recommendation (see Table 3) is used, the distance between the anode and cathode should be as recommended (i.e. 0.28mm). 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. See Figure 8.

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## 3-2. Considerations for When Using the Recommended Mounting Conditions for the NSSxT02A-V2 with the NFSWT03A LEDs

- ... LED Outline + Electrodes
- Soldering Pad Pattern
- Metal Solder Stencil Aperture

Table 5. NFSWT03A LED Mounted on a PCB Using the Recommended Mounting Conditions for the NSSxT02A-V2 LEDs

Recommended Soldering Pad Pattern for NSSxT02A-V2	Recommended Metal Solder Stencil Aperture for NSSxT02A-V2	The NFSWT03A LED Mounted on a PCB with a Metal Solder Stencil Thickness of 150μm.
 <p>(Unit: mm)</p>	 <p>(Unit: mm)</p>	 <p>The solder volume is excessive, this may cause a crack in the resin. If the recommended conditions for the NSSxT02A-V2 LEDs are used for the NFSWT03A LED, Nichia recommends a metal solder stencil thickness of 100μm.</p>

## 3-3. 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.

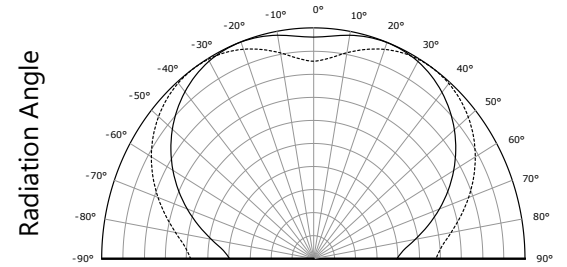


Figure 9. Directivity

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### 4. Precautions when Soldering the Electrodes

#### 4-1. Electrodes of the LED

This LED has large electrodes compared to its compact package size to improve the placement accuracy (see Figure 10); 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 11). To achieve the performance that is specified in the applicable specification of the LED, ensure that the electrodes are soldered to the PCB properly.

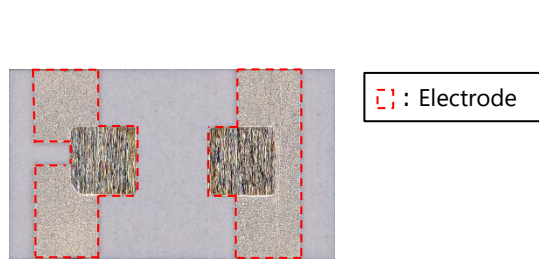


Figure 10. Appearance of the Electrodes

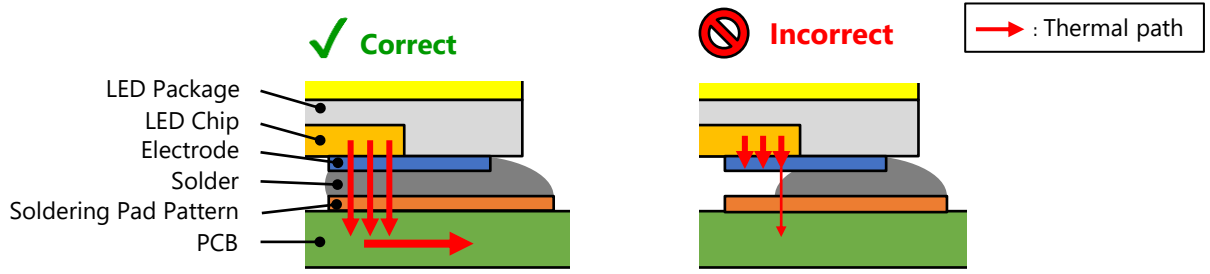


Figure 11. LED Heat Dissipation Reference Images for the LED

#### 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.

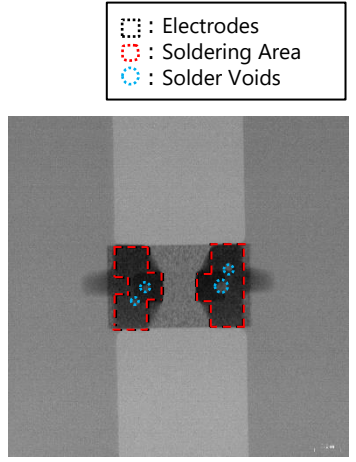


Figure 12. Example of an X-ray Image

### 5. 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	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	Immediately before pick-up	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	Using the electrode as a reference is recommended to locate the center of the LED.	See "5-5. Imaging-based Automatic Inspection" on Page 11 for details.

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## 5-1. Pick-and-Place Nozzle

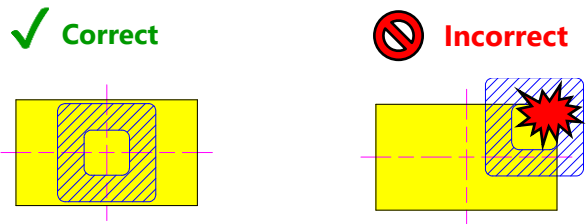


Figure 13. Examples of Correct/Incorrect Nozzle Dimensions

1. Use a pick-and-place nozzle that is smaller than the outline dimensions of the LED (i.e. 1.2mm x 1.7mm). 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

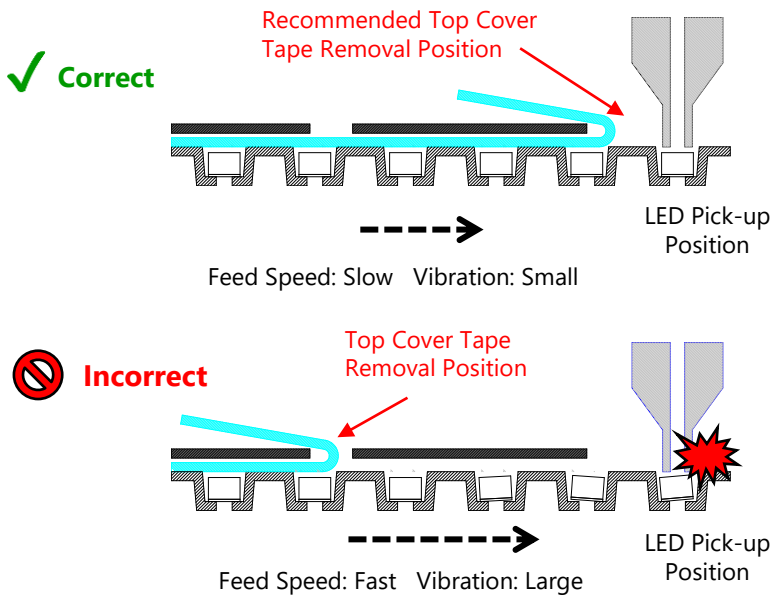


Figure 14. Recommended/Not Recommended Top Cover Tape Removal Positions

1. For the tape-and-reel feeder, the tape width is set to 8mm and the feeder pitch is set to 2mm.
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 the recommended position shown in Figure 14 (i.e. immediately before LED pick-up).
  - If the top cover tape is removed at a point far away from the LED pick-up position, it may cause issues such as the LEDs falling out of the embossed carrier tape pocket or flipping over within the embossed carrier tape pocket.

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

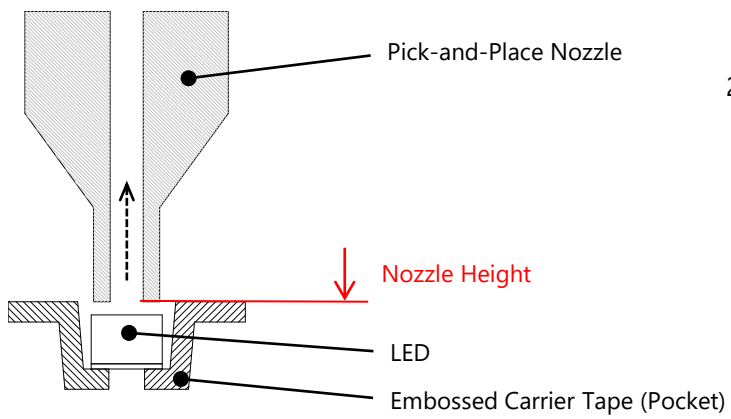


Figure 15. Recommended Nozzle Height for Pick-up Operations

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.

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

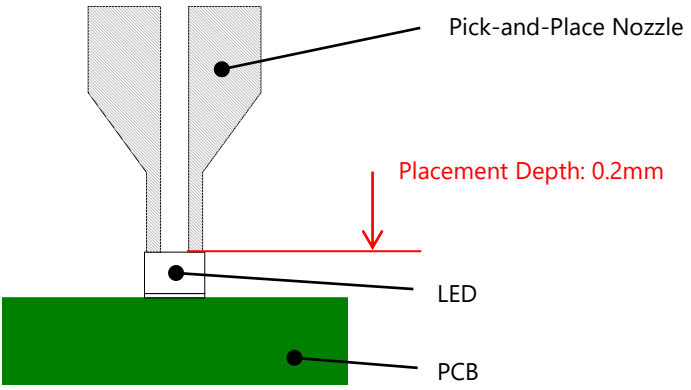


Figure 16. Recommended Nozzle Height for Placement (Placement Depth)

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.

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## 5-5. Imaging-based Automatic Inspection

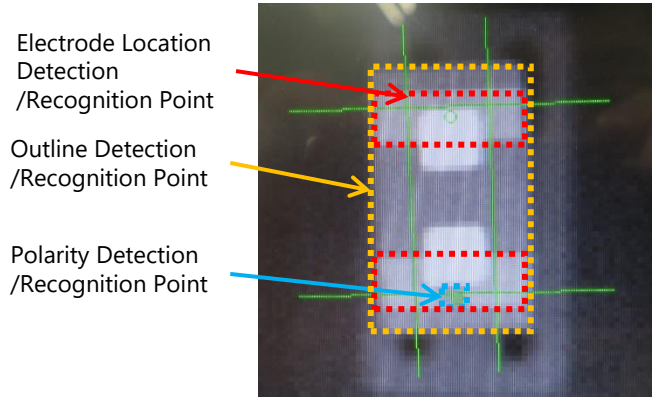


Figure 17. Correct/Incorrect reference Points to Locate the Center of the LED

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 LED, adjust the settings (i.e. the brightness of the light, etc.) of the pick-and-place machine.
3. If an automatic polarity detector is used for the LEDs to determine the polarity, set up the imaging device to detect the cathode mark; it is enclosed with a blue dotted line in Figure 17. The equipment will detect the difference in brightness at the cathode mark and at the area around it to determine the polarity.
4. If the imaging device has trouble detecting/recognizing the LED by the electrodes, use the outlines of the LED as a reference to locate the center of the LED; with this method, the polarity of the LED may not be able to be determined.

## 6. Precautions When Reflow Soldering

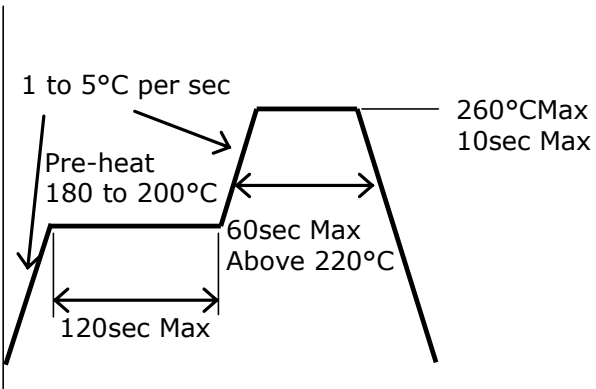


Figure 18. Recommended Reflow Soldering Condition (Lead-free Solder)

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.

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**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

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