NICHIA CORPORATION

SPECIFICATIONS FOR UV LED

NCSU276AT

- Pb-free Reflow Soldering Application
- Built-in ESD Protection Device
- RoHS Compliant
SPECIFICATIONS

(1) Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Absolute Maximum Rating</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forward Current</td>
<td>$I_F$</td>
<td>700</td>
<td>mA</td>
</tr>
<tr>
<td>Pulse Forward Current</td>
<td>$I_{FP}$</td>
<td>1000</td>
<td>mA</td>
</tr>
<tr>
<td>Allowable Reverse Current</td>
<td>$I_R$</td>
<td>85</td>
<td>mA</td>
</tr>
<tr>
<td>Power Dissipation</td>
<td>$P_D$</td>
<td>3.08</td>
<td>W</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>$T_{op}$</td>
<td>-10~85</td>
<td>°C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>$T_{stg}$</td>
<td>-40~100</td>
<td>°C</td>
</tr>
<tr>
<td>Junction Temperature</td>
<td>$T_J$</td>
<td>90</td>
<td>°C</td>
</tr>
</tbody>
</table>

* Absolute Maximum Ratings at $T_S=25°C$.
* $I_{FP}$ conditions with pulse width ≤10ms and duty cycle ≤10%.

(2) Initial Electrical/Optical Characteristics

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Condition</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forward Voltage</td>
<td>$V_F$</td>
<td>$I_F=500mA$</td>
<td>3.8</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>Radiant Flux</td>
<td>$\Phi_e$</td>
<td>$I_F=500mA$</td>
<td>780</td>
<td>-</td>
<td>mW</td>
</tr>
<tr>
<td>Peak Wavelength</td>
<td>$\lambda_p$</td>
<td>$I_F=500mA$</td>
<td>365</td>
<td>-</td>
<td>nm</td>
</tr>
<tr>
<td>Spectrum Half Width</td>
<td>$\Delta \lambda$</td>
<td>$I_F=500mA$</td>
<td>9.0</td>
<td>-</td>
<td>nm</td>
</tr>
<tr>
<td>Thermal Resistance</td>
<td>$R_{thJ}$</td>
<td>-</td>
<td>11.0</td>
<td>13.5</td>
<td>°C/W</td>
</tr>
</tbody>
</table>

* Characteristics at $T_S=25°C$.
* Radiant Flux value as per CIE 127:2007 standard.
* $R_{thJ}$ is the thermal resistance from the junction to the $T_S$ measurement point.
* It is recommended to operate the LEDs at a current greater than 10% of the sorting current to stabilize the LED characteristics.
## RANKS

<table>
<thead>
<tr>
<th>Item</th>
<th>Rank</th>
<th>Min</th>
<th>Max</th>
<th>Unit</th>
</tr>
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<tbody>
<tr>
<td><strong>Forward Voltage</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H2</td>
<td>4.2</td>
<td>4.4</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>H1</td>
<td>4.0</td>
<td>4.2</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>M2</td>
<td>3.8</td>
<td>4.0</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>M1</td>
<td>3.6</td>
<td>3.8</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>L2</td>
<td>3.4</td>
<td>3.6</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>L1</td>
<td>3.2</td>
<td>3.4</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td><strong>Radiant Flux</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P37d22</td>
<td>990</td>
<td>1080</td>
<td>mW</td>
<td></td>
</tr>
<tr>
<td>P37d21</td>
<td>910</td>
<td>990</td>
<td>mW</td>
<td></td>
</tr>
<tr>
<td>P36d22</td>
<td>835</td>
<td>910</td>
<td>mW</td>
<td></td>
</tr>
<tr>
<td>P36d21</td>
<td>765</td>
<td>835</td>
<td>mW</td>
<td></td>
</tr>
<tr>
<td>P35d22</td>
<td>700</td>
<td>765</td>
<td>mW</td>
<td></td>
</tr>
<tr>
<td>P35d21</td>
<td>640</td>
<td>700</td>
<td>mW</td>
<td></td>
</tr>
<tr>
<td><strong>Peak Wavelength</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U365</td>
<td>360</td>
<td>370</td>
<td>nm</td>
<td></td>
</tr>
</tbody>
</table>

* Ranking at $T_s=25°C$.
* Forward Voltage Tolerance: ±0.05V
* Radiant Flux Tolerance: ±6%
* Peak Wavelength Tolerance: ±3nm
* LEDs from the above ranks will be shipped.

The rank combination ratio per shipment will be decided by Nichia.
This product complies with RoHS Directive.

Protection Device

<table>
<thead>
<tr>
<th>項目 Item</th>
<th>内容 Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>パッケージ材質 Package Materials</td>
<td>セラミックス Ceramics</td>
</tr>
<tr>
<td>レンズ材質 Lens Materials</td>
<td>シリコーン樹脂 Silicone Resin</td>
</tr>
<tr>
<td>電極材質 Electrodes Materials</td>
<td>金メッキ Au-plated</td>
</tr>
<tr>
<td>質量 Weight</td>
<td>0.034g (TYP)</td>
</tr>
</tbody>
</table>
**SOLDERING**

- **Recommended Reflow Soldering Condition (Lead-free Solder)**

![Temosure graph](image)

- **Recommended Soldering Pad Pattern**

![Temosure graph](image)

* This LED is designed to be reflow soldered on to a PCB. If dip soldered or hand soldered, Nichia cannot guarantee its reliability.
* Reflow soldering must not be performed more than twice.
* Avoid rapid cooling. Ramp down the temperature gradually from the peak temperature.
* Nitrogen reflow soldering is recommended. Air flow soldering conditions can cause optical degradation, caused by heat and/or atmosphere.
* This product uses silicone resin for the lens and internal pre-coating resin; the silicone resin is soft. If pressure is applied to the lens, it may cause the lens to be damaged, chipped, and/or delaminated. If the lens is damaged, chipped and/or delaminated, then the internal connections may be damaged and the reliability may decrease. Ensure that pressure is not applied to the lens.
* If an automatic pick and place machine is used for the LEDs, use a pick up nozzle that does not affect the lens.

**Recommended conditions:**

Using a nozzle specifically designed for the LEDs is recommended. (See the nozzle drawing below).

* Ensure that the nozzle does not come in contact with the lens when it picks up an LED.
If this occurs, it may cause internal disconnection causing the LED not to illuminate.
* Repairing should not be done after the LEDs have been soldered.
  It should be confirmed beforehand whether the characteristics of the LEDs will or will not be damaged by repairing.
* When soldering, do not apply stress to the LED while the LED is hot.
* The recommended soldering pad pattern is designed for attachment of the LED without problems.
  When precise mounting accuracy is required, such as high-density mounting, ensure that the size and shape of the pad are suitable for the circuit design.
* When flux is used, it should be a halogen free flux. Ensure that the manufacturing process is not designed in a manner where the flux will come in contact with the LEDs.
* Make sure that there are no issues with the type and amount of solder that is being used.
**TAPE AND REEL DIMENSIONS**

**Teaping Tape**

- **Cathode Mark**
  - $\Phi 1.5 \pm 0.1$
  - $3.7 \pm 0.1$

- **Reel Size**
  - 330
  - 17.5
  - 13.5

- **Label**
  - $\Phi 80$
  - $0.13$

**Trailer and Leader**

- **Trailer**
  - Minimum 160mm (Empty Pockets)
  - Leader 160mm MIN (Empty Pockets)

- **Loaded Pockets**
  - LED

- **Leader**
  - Minimum 400mm
  - Leader with Top Cover Tape 100mm MIN (Empty Pocket)
  - Leader without Top Cover Tape 400mm MIN

**Remarks**

* Number is 1 reel which contains 3500 pieces.

  - Reel Size: 3500pcs

* The tape packing method complies with JIS C 0806 (Packaging of Electronic Components on Continuous Tapes).

* When the tape is rewound due to work interruptions, no more than 10N should be applied to the embossed carrier tape. The LEDs may stick to the top cover tape.

* During normal work, it is recommended to fasten the embossed carrier tape with 10N or more.

* It is possible that the LEDs may stick to the top cover tape.
PACKAGING - TAPE & REEL

Reels are shipped with desiccants in heat-sealed moisture-proof bags.

Desiccants

Seal

Moisture-proof Bag

If not provided, it will not be indicated on the label.

* Customer part number

For details, see "LOT NUMBERING CODE" in this document.

* Lot number

* LED radiation

Avoid exposure to beam. Class 3B LED product.

* Environmental management

RoHS

* Nichia LED

* Shipping

Do not expose to water. The box is not water-resistant.

Warning and Explanatory Labels

LED Radiation

Avoid exposure to beam. Class 3B LED product.

* Management

RoHS

* Nichia LED

* Environmental management

RoHS

* Nichia LED

* Management

RoHS

* Nichia LED

* Environmental management

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* Environmental management

RoHS
**LOT NUMBERING CODE**

Lot Number is presented by using the following alphanumeric code.

YMxxxx - RRR

<table>
<thead>
<tr>
<th>Year</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>G</td>
</tr>
<tr>
<td>2017</td>
<td>H</td>
</tr>
<tr>
<td>2018</td>
<td>I</td>
</tr>
<tr>
<td>2019</td>
<td>J</td>
</tr>
<tr>
<td>2020</td>
<td>K</td>
</tr>
<tr>
<td>2021</td>
<td>L</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Month</th>
<th>M</th>
<th>Month</th>
<th>M</th>
</tr>
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<tbody>
<tr>
<td>1</td>
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<td>7</td>
<td>7</td>
</tr>
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<td>2</td>
<td>2</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>10</td>
<td>A</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>11</td>
<td>B</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>12</td>
<td>C</td>
</tr>
</tbody>
</table>

xxxx-Nichia's Product Number

RRR-Ranking by Wavelength, Ranking by Radiant Flux, Ranking by Forward Voltage
DERATING CHARACTERISTICS

Ambient Temperature vs Allowable Forward Current

Solder Temperature (Anode Side) vs Allowable Forward Current

Duty Ratio vs Allowable Forward Current

\[ R_{\text{th}} = 19.1 \, \text{°C/W} \]

\[ T_A = 25 \, \text{°C} \]
OPTICAL CHARACTERISTICS

* 本特性は参考です。
All characteristics shown are for reference only and are not guaranteed.

NCSU276A
管理番号 No. STS-DA7-5728

**発光スペクトル**
*Spectrum*

！ 相対放射強度
Relative Radiant Intensity (a.u.)

波長
Wavelength (nm)

**指向特性**
*Directivity*

！ 相対放射強度
Relative Radiant Intensity (a.u.)

* 本特性はピーク波長ランクU365に応対しています。
The graphs above show the characteristics for U365 LEDs of this product.
FORWARD CURRENT CHARACTERISTICS / TEMPERATURE CHARACTERISTICS

* 本特性は参考です。
All characteristics shown are for reference only and are not guaranteed.

* 本特性はピーク波長ランクU365に対応しています。
The graphs above show the characteristics for U365 LEDs of this product.
FORWARD CURRENT CHARACTERISTICS / TEMPERATURE CHARACTERISTICS

* 本特性は参考です。
  All characteristics shown are for reference only and are not guaranteed.

egin{itemize}
  
  
  
  

顺電流-ピーク波長特性
Forward Current vs Peak Wavelength

\[ T_a = 25 \degree C \]

周囲温度-ピーク波長特性
Ambient Temperature vs Peak Wavelength

\[ I_{FP} = 500 \text{mA} \]

* 本特性はピーク波長ランクU365に対応しています。
  The graphs above show the characteristics for U365 LEDs of this product.
## RELIABILITY

### (1) Tests and Results

<table>
<thead>
<tr>
<th>Test</th>
<th>Reference Standard</th>
<th>Test Conditions</th>
<th>Test Duration</th>
<th>Failure Criteria</th>
<th>Units Failed/Tested</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistance to Soldering Heat</td>
<td>JEITA ED-4701</td>
<td>$T_{3d}=260°C$, 10sec, 2reflows, Precondition: 30°C, 70%RH, 168hr</td>
<td></td>
<td>#1</td>
<td>0/10</td>
</tr>
<tr>
<td>(Reflow Soldering)</td>
<td>300 301</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature Cycle</td>
<td>JEITA ED-4701</td>
<td>-40°C (30min)~25°C (5min)~100°C (30min)~25°C (5min)</td>
<td>100cycles</td>
<td>#1</td>
<td>0/10</td>
</tr>
<tr>
<td></td>
<td>100 105</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Temperature Storage</td>
<td>JEITA ED-4701</td>
<td>$T_a=100°C$</td>
<td>1000hours</td>
<td>#1</td>
<td>0/10</td>
</tr>
<tr>
<td></td>
<td>200 201</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Temperature Storage</td>
<td>JEITA ED-4701</td>
<td>$T_a=-40°C$</td>
<td>1000hours</td>
<td>#1</td>
<td>0/10</td>
</tr>
<tr>
<td></td>
<td>200 202</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Room Temperature Operating</td>
<td>$T_a=25°C$, $I_F=700mA$</td>
<td></td>
<td>1000hours</td>
<td>#1</td>
<td>0/10</td>
</tr>
<tr>
<td>Life</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Temperature Operating</td>
<td>$T_a=85°C$, $I_F=60mA$</td>
<td></td>
<td>1000hours</td>
<td>#1</td>
<td>0/10</td>
</tr>
<tr>
<td>Life</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature Humidity</td>
<td></td>
<td></td>
<td>1000hours</td>
<td>#1</td>
<td>0/10</td>
</tr>
<tr>
<td>Operating Life</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Temperature Operating</td>
<td>$T_a=-10°C$, $I_F=500mA$</td>
<td></td>
<td>1000hours</td>
<td>#1</td>
<td>0/10</td>
</tr>
<tr>
<td>Life</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vibration</td>
<td>JEITA ED-4701</td>
<td>200m/s², 100<del>2000</del>100Hz, 4cycles, 4min, each X, Y, Z</td>
<td>48minutes</td>
<td>#1</td>
<td>0/10</td>
</tr>
<tr>
<td></td>
<td>400 403</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrostatic Discharges</td>
<td>JEITA ED-4701</td>
<td>HBM, 2kV, 1.5kΩ, 100pF, 3pulses, alternately positive or negative</td>
<td></td>
<td>#1</td>
<td>0/10</td>
</tr>
<tr>
<td></td>
<td>300 304</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**NOTES:**
1) $R_{θJA}≈19.1°C/W$
2) Measurements are performed after allowing the LEDs to return to room temperature.

### (2) Failure Criteria

<table>
<thead>
<tr>
<th>Criteria #</th>
<th>Items</th>
<th>Conditions</th>
<th>Failure Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>Forward Voltage($V_F$)</td>
<td>$I_F=500mA$</td>
<td>$&gt;\text{Initial value} \times 1.1$</td>
</tr>
<tr>
<td>#1</td>
<td>Radiant Flux($Φ_E$)</td>
<td>$I_F=500mA$</td>
<td>$&lt;\text{Initial value} \times 0.7$</td>
</tr>
</tbody>
</table>
CAUTIONS

(1) Storage

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Temperature</th>
<th>Humidity</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage Before Opening</td>
<td>≤30°C</td>
<td>≤90%RH</td>
<td>Within 1 Year</td>
</tr>
<tr>
<td>After Opening Aluminum Bag</td>
<td>≤30°C</td>
<td>≤90%RH</td>
<td>≤168hours</td>
</tr>
<tr>
<td>Baking</td>
<td>65±5°C</td>
<td>-</td>
<td>≥24hours</td>
</tr>
</tbody>
</table>

- Product complies with JEDEC MSL 3 or equivalent. See IPC/JEDEC STD-020 for moisture-sensitivity details.
- Absorbed moisture in LED packages can vaporize and expand during soldering, which can cause interface delamination and result in optical performance degradation. Products are packed in moisture-proof aluminum bags to minimize moisture absorption during transportation and storage. Included silica gel desiccants change from blue to red if moisture had penetrated bags.
- After opening the moisture-proof aluminum bag, the products should go through the soldering process within the range of the conditions stated above. Unused remaining LEDs should be stored with silica gel desiccants in a hermetically sealed container, preferably the original moisture-proof bags for storage.
- After the "Period After Opening" storage time has been exceeded or silica gel desiccants are no longer blue, the products should be baked. Baking should only be done once.
- Although the leads or electrode pads (anode and cathode) of the product are plated with gold, prolonged exposure to a corrosive environment might cause the gold plated the leads or electrode pads to tarnish, and thus leading to difficulties in soldering. If unused LEDs remain, they must be stored in a hermetically sealed container. Nichia recommends using the original moisture-proof bag for storage.
- Do not use sulfur-containing materials in commercial products. Some materials, such as seals and adhesives, may contain sulfur. The contaminated plating of LEDs might cause an open circuit. Silicone rubber is recommended as a material for seals. Bear in mind, the use of silicones may lead to silicone contamination of electrical contacts inside the products, caused by low molecular weight volatile siloxane.
- To prevent water condensation, please avoid large temperature and humidity fluctuations for the storage conditions.
- Do not store the LEDs in a dusty environment.
- Do not expose the LEDs to direct sunlight and/or an environment where the temperature is higher than normal room temperature.
(2) Directions for Use

- When designing a circuit, the current through each LED must not exceed the Absolute Maximum Rating. Operating at a constant current per LED is recommended. In case of operating at a constant voltage, Circuit B is recommended.
  - If the LEDs are operated with constant voltage using Circuit A, the current through the LEDs may vary due to the variation in Forward Voltage characteristics of the LEDs.

![Circuit Diagram]

- This product should be operated using forward current. Ensure that the product is not subjected to either forward or reverse voltage while it is not in use. In particular, subjecting it to continuous reverse voltage may cause migration, which may cause damage to the LED die. When used in displays that are not used for a long time, the main power supply should be switched off for safety.
- It is recommended to operate the LEDs at a current greater than 10% of the sorting current to stabilize the LED characteristics.
- Ensure that excessive voltages such as lightning surges are not applied to the LEDs.
- For outdoor use, necessary measures should be taken to prevent water, moisture and salt air damage.
- This product also emits visible light. If the LEDs are used as a light source in applications such as sensors, etc. take into consideration the emission that is in the visible light spectrum.
- If this product is stored and/or used constantly under high temperature and high humidity conditions, it may accelerate the deterioration of the die; this may cause the radiant flux to decrease. If the LEDs are stored and/or used under these conditions, sufficient verification must be done prior to use to ensure there are no issues for the chosen application.
- This product uses a silicone resin for the lens. Depending on the operating/environmental conditions the silicone lens may have cracks due to deterioration resulting from being exposed to the UV light, this may have an adverse effect on the optical characteristics; perform sufficient verification to ensure that there are no issues for the chosen application.

(3) Handling Precautions

- Do not handle the LEDs with bare hands as it will contaminate the LED surface and may affect the optical characteristics: it might cause the LED to be deformed and/or the wire to break, which will cause the LED not to illuminate.
- When handling the product with tweezers, be careful not to apply excessive force to the resin. Otherwise, The resin can be cut, chipped, delaminate or deformed, causing wire-bond breaks and catastrophic failures.
- Dropping the product may cause damage.
- Do not stack assembled PCBs together. Failure to comply can cause the resin portion of the product to be cut, chipped, delaminated and/or deformed. It may cause wire break to lead, leading to catastrophic failures.

(4) Design Consideration

- Although Nichia recommends using a copper PCB for this product, customer is advised to verify the PCB with the products before use. Stress during soldering can cause the glass lens to break and/or the solder joints to crack.
- PCB warpage after mounting the products onto a PCB can cause the package to break. The LED should be placed in a way to minimize the stress on the LEDs due to PCB bow and twist.
- The position and orientation of the LEDs affect how much mechanical stress is exerted on the LEDs placed near the score lines. The LED should be placed in a way to minimize the stress on the LEDs due to board flexing.
- Board separation must be performed using special jigs, not using hands.
- If an aluminum PCB is used, customer is advised to verify the PCB with the products before use. Thermal stress during use can cause the solder joints to crack.
- When substances commonly found in ink adhere to the resin of this product, it may reduce the radiant flux and may change the material properties. Materials, such as dustproof glass, should be used to protect the LEDs.
(5) Electrostatic Discharge (ESD)

- The products are sensitive to static electricity or surge voltage. ESD can damage a die and its reliability.
  
  When handling the products, the following measures against electrostatic discharge are strongly recommended:
  
  Eliminating the charge
  - Grounded wrist strap, ESD footwear, clothes, and floors
  - Grounded workstation equipment and tools
  - ESD table/shelf mat made of conductive materials
  
- Ensure that tools, jigs and machines that are being used are properly grounded and that proper grounding techniques are used in work areas. For devices/equipment that mount the LEDs, protection against surge voltages should also be used.
- If tools or equipment contain insulating materials such as glass or plastic, the following measures against electrostatic discharge are strongly recommended:
  - Dissipating static charge with conductive materials
  - Preventing charge generation with moisture
  - Neutralizing the charge with ionizers

- The customer is advised to check if the LEDs are damaged by ESD when performing the characteristics inspection of the LEDs in the application. Damage can be detected with a forward voltage measurement at low current (≤1mA).
  
  Failure Criteria: \( V_F < 2.0 \text{V} \) at \( I_F = 0.5 \text{mA} \)

(6) Thermal Management

- Proper thermal management is an important when designing products with LEDs. LED die temperature is affected by PCB thermal resistance and LED spacing on the board. Please design products in a way that the LED die temperature does not exceed the maximum Junction Temperature (\( T_J \)).
  
- Drive current should be determined for the surrounding ambient temperature (\( T_A \)) to dissipate the heat from the product.
  
- The following equations can be used to calculate the junction temperature of the products.

\[
\begin{align*}
1) \quad T_J &= T_A + R_{JA} \cdot W \\
2) \quad T_J &= T_S + R_{JS} \cdot W \\
\end{align*}
\]

\*\( T_J \): LED junction temperature: °C

\( T_A \): Ambient temperature: °C

\( T_S \): Soldering temperature (anode side): °C

\( R_{JA} \): Thermal resistance from junction to ambient: °C/W

\( R_{JS} \): Thermal resistance from junction to \( T_S \) measurement point: °C/W

\( W \): Input power (\( I_F \times V_F \)): W

(7) Cleaning

- The LEDs should not be cleaned with water, benzine, and/or thinner.
- If required, isopropyl alcohol (IPA) should be used. Other solvents may cause premature failure to the LEDs due to the damage to the resin portion. The effects of such solvents should be verified prior to use.
  
  In addition, the use of CFCs such as Freon is heavily regulated.
- When dust and/or dirt adheres to the LEDs, soak a cloth with Isopropyl alcohol (IPA), then squeeze it before wiping the LEDs.
- Ultrasonic cleaning is not recommended since it may have adverse effects on the LEDs depending on the ultrasonic power and how LED is assembled.

If ultrasonic cleaning must be used, the customer is advised to make sure the LEDs will not be damaged prior to cleaning.
(8) Eye Safety

- In 2006, the International Electrical Commission (IEC) published IEC 62471:2006 Photobiological safety of lamps and lamp systems, which added LEDs in its scope.
- On the other hand, the IEC 60825-1:2007 laser safety standard removed LEDs from its scope.
- However, please be advised that some countries and regions have adopted standards based on the IEC laser safety standard IEC 60825-1:20112001, which still includes LEDs in its scope.
- Most of Nichia’s LEDs can be classified as belonging into either the Exempt Group or Risk Group 1.
- High-power LEDs, that emit light containing blue wavelengths, may be classified as Risk Group 2.
- Please proceed with caution when viewing directly any LEDs driven at high current, or viewing LEDs with optical instruments which may greatly increase the damages to your eyes.
- Viewing a flashing light may cause eye discomfort. When incorporating the LED into your product, please be careful to avoid adverse effects on the human body caused by light stimulation.
- The products are UV light LEDs, and radiate intense UV light during operation. Since UV light can be harmful to eyes, do NOT look directly into the UV light, even through an optical instrument. In case of the light reflection, UV protective glasses are required to use in order to avoid damage by the light.
- Ensure that appropriate warning signs/labels are provided both on each of the systems/applications using the UV LEDs, in all necessary documents (e.g. specification, manual, catalogs, etc.), and on the packaging materials.

(9) Miscellaneous

- Nichia warrants that the discrete LEDs will meet the requirements/criteria as detailed in the Reliability section within this specification. If the LEDs are used under conditions/environments deviating from or inconsistent with those described in this specification, the resulting damage and/or injuries will not be covered by this warranty.
- Nichia warrants that the discrete LEDs manufactured and/or supplied by Nichia will meet the requirements/criteria as detailed in the Reliability section within this specification; it is the customer’s responsibility to perform sufficient verification prior to use to ensure that the lifetime and other quality characteristics required for the intended use are met.
- The applicable warranty period is one year from the date that the LED is delivered. In the case of any incident that appears to be in breach of this warranty, the local Nichia sales representative should be notified to discuss instructions on how to proceed while ensuring that the LED in question is not disassembled or removed from the PCB if it has been attached to the PCB. If a breach of this warranty is proved, Nichia will provide the replacement for the non-conforming LED or an equivalent item at Nichia’s discretion. FOREGOING ARE THE EXCLUSIVE REMEDIES AVAILABLE TO THE CUSTOMER IN RESPECT OF THE BREACH OF THE WARRANTY CONTAINED HEREIN, AND IN NO EVENT SHALL NICHIA BE RESPONSIBLE FOR ANY INDIRECT, INCIDENTAL OR CONSEQUENTIAL LOSSES AND/OR EXPENSES (INCLUDING LOSS OF PROFIT) THAT MAY BE SUFFERED BY THE CUSTOMER ARISING OUT OF A BREACH OF THE WARRANTY.
- NICHIA DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.
- This LED is intended to be used for general lighting, household appliances, electronic devices (e.g. mobile communication devices); it is not designed or manufactured for use in applications that require safety critical functions (e.g. aircraft, automobiles, combustion equipment, life support systems, nuclear reactor control system, safety devices, spacecraft, submarine repeaters, traffic control equipment, trains, vessels, etc.). If the LEDs are planned to be used for these applications, unless otherwise detailed in the specification, Nichia will neither guarantee that the LED is fit for that purpose nor be responsible for any resulting property damage, injuries and/or loss of life/health.
- This LED does not comply with ISO/TS 16949 and is not intended for automotive applications.
- The customer will not reverse engineer, disassemble or otherwise attempt to extract knowledge/design information from the LED.
- All copyrights and other intellectual property rights in this specification in any form are reserved by Nichia or the right holders who have granted Nichia permission to use the content. Without prior written permission from Nichia, no part of this specification may be reproduced in any form or by any means.
- Both the customer and Nichia will agree on the official specifications for the supplied LEDs before any programs are officially launched. Without this agreement in writing (i.e. Customer Specific Specification), changes to the content of this specification may occur without notice (e.g. changes to the foregoing specifications and appearance, discontinuation of the LEDs, etc.).
Mounting Techniques for LEDs with a Lens

1. Introduction
As LEDs have recently been miniaturized and highly-functional, higher mounting technologies are necessary for them. It has been difficult to mount such advanced LEDs because of the lenses and the smaller absorption area. Improper mounting will affect the function and the reliability of the performance from the end product. To manufacture high-performance lighting fixtures with high functional LEDs, it is critical to develop the mounting technology.

We have seen many mounting problems in highly-functional LEDs with a lens. This document provides the mounting techniques for such LEDs, exhibiting some mounting failures. Please note that this document recommends a modular mounter to be used.

2. Mounting Failures in LEDs with a Lens
Many LEDs with a lens have been developed for higher performance. Such lenses are mostly made of resin; when external stress is applied to the lens, some are susceptible to damage, leading to abnormal optical characteristics, and others are susceptible to wire breakage, leading to abnormal electrical characteristics. Therefore, applying external stress to the lens has to be avoided as much as possible.
Moreover, the contact area of a pick-and-place nozzle and the lens is limited by the presence of the lens, which sometimes causes air leak, resulting in absorption error.

Problem 1: Damage to the lens during the mounting process
Problem 2: Absorption error due to air leak

An LED lens sometimes sticks to the top cover tape due to the resin’s adhesive property, resulting in LED tilting within the cavity.
Also, the center of gravity of an LED with a lens is located higher. When the emboss carrier tape is exposed to an excessive vibration, the LED may be tilted within the cavity.

Problem 3: LED tilting within the cavity due to its adhesion to the top cover tape
Problem 4: LED tilting within the cavity due to vibration of the emboss carrier tape

Please refer to the following sheets for the countermeasures against Problems 1 to 4.
3. Mounting Techniques

3-1. Problem 1: Damage to the lens during the mounting process

Nichia establishes the optimal absorption method and the optimal cavity shape/size for each LED with a lens.

In general, there are two absorption methods; one is the “nozzle insertion system” and the other is the “non-insertion nozzle system.”

3-1-1. Nozzle Insertion System

The nozzle insertion system is optimal for the 383/385 series, considering the LED shape/tolerance and the cavity shape/size. The LEDs can be absorbed in a stable condition, when the nozzle is inserted into the cavity and brought close to the lens. Please take care not to insert the nozzle too close to the lens. Therefore, please refer to Nichia’s specifications for the insertion depth.

The pick-and-place nozzle is chamfered so as to form a “C Surface” (a sloped surface) and an “R Surface” (a curved surface), enabling a smooth mounting of the LEDs. Such design of the nozzle can prevent the LEDs from tilting in the cavities.

3-1-2. Non-Insertion Nozzle System

When the nozzle insertion system is used for the x19 series, the nozzle may touch the lens and apply excessive stress to it, considering the LED’s shape/tolerance and the dimensional tolerance of the nozzle. If the clearance is left between the nozzle and the lens to avoid the contact with each other, it may be impossible to insert the nozzle into the cavity due to the oversized nozzle.

Then, Nichia recommends that the “Non-Insertion Nozzle system” be used for the x19 series. With this system, the nozzle reaches at the top surface of the cavity and absorbs the LEDs.

With the nozzle insertion system, the lens can get damaged due to the insertion pressure of the nozzle. On the other hand, with the non-insertion nozzle system, the nozzle is less likely to apply stress to the lens; only a slight absorption stress is applied to the lens.

Also, superior durability of the nozzle is achieved because of its sufficient thickness, since it does not have to be inserted into the cavities.
Correction of the Absorption Point

Please adjust the mounter to ensure that the nozzle should absorb the correct point on the LEDs. The absorption point can be corrected with the image recognition unit by aiming at the center of the hole on the bottom surface of the cavity. Please refer to the following pictures for the image recognition unit.

3-2. Problem 2: Absorption error due to air leak

By the presence of the lens, the contact area of a pick-and-place nozzle and the lens is limited, which sometimes causes air leak, resulting in absorption error. In such cases, please change the absorption power into a more appropriate value. Judging from Nichia’s evaluation results, the LEDs can be properly mounted by adjusting the absorption power from -40 to -90 kpa.

3-3. Problem 3: LED tilting within the cavity due to its adhesion to the top cover tape

LED lenses are made of resin. Therefore, the lenses sometimes adhere to the top cover tape due to the resin’s stickiness. When the cover tape is peeled from the carrier tape, the LEDs tilt within their cavities, resulting in mounting failure.

It is impossible to eliminate the stickiness of the lens. Please refer to the following pages for the countermeasures against the LED tilting.
3-3-1. **Slow down the feeding speed.**

When the feeding speed is fast, the pick-and-place nozzle absorbs the LED before the lens is detached from the top cover tape, resulting in mounting failure.

Even when the LED is in contact with the top cover tape; however, by lowering the feeding speed, it can be detached from the tape before absorbed by the nozzle.

For example, the feeding speed can be changed by the screen as follows:

<table>
<thead>
<tr>
<th>Machine Type</th>
<th>CM20x Series</th>
<th>CM301 Series</th>
<th>Other Machine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feeding Speed</td>
<td>100</td>
<td>80</td>
<td>60</td>
</tr>
<tr>
<td>Suction Speed</td>
<td>100</td>
<td>80</td>
<td>60</td>
</tr>
</tbody>
</table>

For ref. Panasonic CM Mounter

For ref. Yamaha YS Mounter
3-3-2. Change the peeling angle.

As the following figures show, when the top cover tape is peeled off from the emboss carrier tape in an acute angle, the LED can be easily detached from the top cover tape, preventing it from tilting within the cavity.

* It is impossible to change the feeding speed of Panasonic BM Mounter. Instead, the operation speed of the head can be lowered, lengthening the absorption pitch.

The peeling angle can be adjusted to its optimal value by some of the mounters as follows:

Peeling Angle: Obtuse

Peeling Angle: Acute

for ref. Panasonic BM Mounter

for ref. Panasonic CM Mounter
3-4. Problem 4: LED tilting within the cavity due to vibration of the emboss carrier tape
When an excessive vibration is applied to the emboss carrier tape, LEDs may tilt within the cavities.
LEDs with a lens are susceptible to vibration, resulting in tilting, since its center of gravity is located higher.

3-4-1. Slow down the feeding speed.
The higher the feeding speed is, the more the vibration affects the LEDs within the cavities. When LEDs tilt within the cavities, please lower the feeding speed to decrease the vibration.
(For ref. Nichia recommends that the feeding speed should be a little slower than high speed.)
The carrier tape may be vibrated by an air feeder much more than an electric feeder. Please select the feeder depending on the LEDs to ensure that they are properly mounted.

3-4-2. Change the peeling point.
When the top cover tape is peeled off from the emboss carrier tape long before the nozzle comes down to absorb an LED, some of the LEDs move around within the space between the feeder cover and the carrier tape, leading to LED tilting.
Please peel off the cover tape just before the nozzle comes down to absorb an LED. Then, LED’s up-and-down movement can be restricted, preventing from LED tilting.
Comparison of the Peeling Positions

* Please note that some of the mounters are equipped with a shutter. In such cases, it is impossible to change the peeling position of the top cover tape.
4. Caution

**Please refrain from splicing the tape together.**

"Splicing" stands for the tape joint process while the mounter is operated. When there are a few LEDs left on the reel which is loaded on the mounter, some customers cut off and joint the edge of the tape to the next tape without detaching the feeder from the device. The splicing is to raise the machine utilization without bringing the device to a halt.

The splicing, however, may lead to the LED mounting failure; the LEDs may be tilted within the cavities due to the external stress applied to the carrier tape.

![Diagram showing splicing process](image)

There are a few LEDs left on a reel.

The edge of the tape is cut off and jointed to the next tape.

**Splicing**

5. Notice

Some mounting techniques for LEDs with a lens are described herein; however, they don’t fit in with all the mounters. Please select the optimal mounting techniques depending on the LED model and the mounter.

Nichia will aim to continue collecting data concerning the mounting techniques and offering beneficial information to our customers.

When you are concerned about any mounting technique, please contact us.

We would appreciate your cooperation.