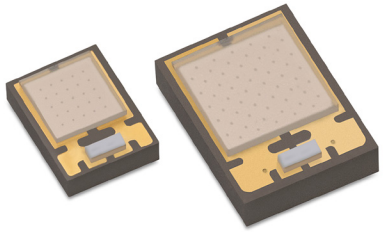
# LUXEON UV U Line

## Assembly and Handling Information



## Introduction

This application brief addresses the recommended assembly and handling procedures for LUXEON UV U Line emitters. Proper assembly, handling, and thermal management, as outlined in this application brief, ensure high optical light output and long light output maintenance for LUXEON UV U Line emitters.

## Scope

The assembly and handling guidelines in this application brief apply to the following products with the part number designations as described below:

| **LUXEON UV U1** | **L H U V – B B B B – A C C C** |
|---|---|
| Where: | |
| B B B B – | designates peak wavelength (0385=385nm ±5nm, 0395=395nm ±5nm, 0405=405nm ±5nm, 0415=415nm ±5nm) |
| C C C – | designates minimum radiometric power bin (025=250mW, 030=300mW, 035=350mW, 040=400mW, 045=450mW, 050=500mW, 055=550mW, 060=600mW, 065=650mW, 070=700mW, 075=750mW, 080=800mW) |
| **LUXEON UV U2** | **L 1 F 3 – U A A A B 0 0 0 C C C C 0** |
| Where: | |
| A A A – | designates peak wavelength 380=380nm, 390=390nm, 400=400nm and 410=410nm) |
| B – | designates product name and die size (2=LUXEON UV U2 with 2mm$^2$ die size) |
| C C C C – | designates minimum radiometric power bin (0400=400mW, 0600=600mW, 0800=800mW, 1000=1000mW, 1200=1200mW, 1400=1400mW) |

In the remainder of this document, the term LUXEON emitter refers to any product in the LUXEON UV U Line as listed above.

 ©2017 Lumileds Holding B.V. All rights reserved.

# Table of Contents


Introduction . . . . . 1

Scope. . . . . 1

1. Component . . . . . 3

1.1 Description . . . . . 3

1.2 Optical Center and Property . . . . . 3

1.3 Handling Precautions . . . . . 4

1.4 Cleaning . . . . . 4

1.5 Electrical Isolation . . . . . 4

1.6 Mechanical Files. . . . . 4

1.7 Soldering. . . . . 4

2. Printed Circuit Board (PCB) Design Guidelines. . . . . 5

2.1 PCB Footprint and Land Pattern . . . . . 5

2.2 Surface Finishing . . . . . 6

2.3 Solder Mask . . . . . 6

2.4 Minimum Spacing . . . . . 6

3. Assembly Process Guidelines . . . . . 6

3.1 Stencil Design. . . . . 6

3.2 Solder Paste . . . . . 6

3.3 Solder Paste Screen Printing. . . . . 6

3.4 Pick-and-Place . . . . . 7

3.5 Reflow Accuracy. . . . . 11

4. Packaging Considerations—Chemical Compatibility . . . . . 11

About Lumileds . . . . . 12


 ©2017 Lumileds Holding B.V. All rights reserved. 

# 1. Component

## 1.1 Description

The LUXEON UV U Line emitter is an ultra-compact, surface mount, high-power ultraviolet (UV) and violet LED with peak wavelength ranging from 380nm to 420nm. Each LUXEON UV U Line emitter consists of a high brightness InGaN chip on a ceramic substrate. The ceramic substrate provides mechanical support and provides a thermal path from the LED chip to the bottom of the emitter (Figure 1). An interconnect layer electrically connects the LED chip to cathode and anode pads of equal size on the bottom of the ceramic substrate.

All LUXEON UV U Line emitters contain a transient voltage suppressor (TVS) chip which protects the LED chip against electrostatic discharge (ESD) events.

As with any other UV light sources, proper safety precautions must be followed to protect eyes and skin from UV exposure when operating these light sources. A UV caution label is attached to each reel shipped.

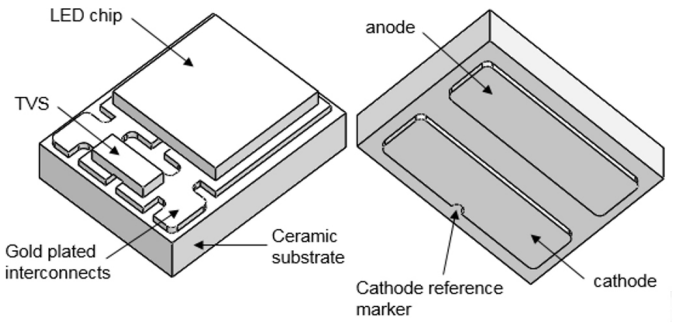



**Figure 1. 3D renditions of a representative of LUXEON UV U Line. Top view (left) and bottom view (right).**

## 1.2 Optical Center and Property

The theoretical optical centers of LUXEON UV U Line emitters are shown in Figure 2.

Note that when designing secondary optics for LUXEON UV U Line emitters, the lens material selected should be able to withstand UV exposure and minimize light absorption at the wavelength chosen. For example, a lens which is made of untreated standard grade polycarbonate (PC) absorbs UV light and turns yellowish over time, which, in turn, reduces the light output performance of the whole LED system while a quartz glass will not absorb less UV and last much longer than polymeric lens. Lumileds recommends that customers discuss the impact of prolonged exposure to UV light with lens suppliers when selecting appropriate lens materials.

The LED chip used in the LUXEON UV U Line is a five-sided emitter. Consequently, there is some minimal side light. The rayset files are provided on lumileds.com for optical simulation.

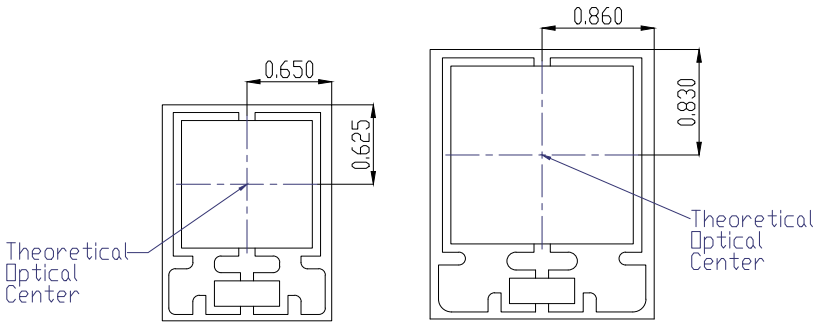



**Figure 2. The optical centers of the LUXEON UV U Line emitter (in mm).**

 ©2017 Lumileds Holding B.V. All rights reserved. 

## 1.3 Handling Precautions

The LUXEON UV U Line emitter is designed to maximize light output and reliability. There is no coating on top of the package surface. However, improper handling of the emitter may damage the LED chip or the TVS and affect the overall performance and reliability. In order to minimize the risk of damage during handling, LUXEON UV U Line emitters should only be picked up manually from the side of the ceramic substrate as shown in Figure 3.

When handling finished boards containing LUXEON UV U Line emitters, do not touch the top surface with any fingers (see Figure 4a). Also, do no turn over the board for probing, if the electrodes are at the back of the board, or stack multiple boards on top of each other (see Figure 4b).

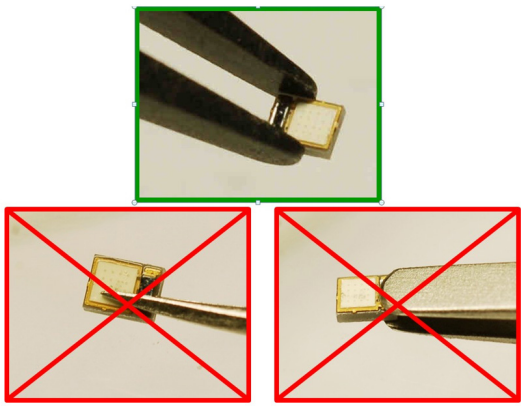


**Figure 3. Correct handling (top) and incorrect handling (bottom) of LUXEON UV U Line emitters.**

## 1.4 Cleaning

The LUXEON UV U Line emitter should not be exposed to dust/debris or any contaminants. Excessive dust/debris or contaminants may cause a drastic decrease in optical power output or perhaps being burnt off by the UV light leaving a mark on the top of the LED chip. In the event that the surface of a LUXEON UV U Line emitter requires cleaning, a compressed gas duster at a distance of 6" away will be sufficient to remove the dust and debris or an air gun with 20 psi (at nozzle) from a distance of 6". Make sure the parts are secured first.

If there is any solder flux residue on the top of the package, it may turn brown during LED operation. In general, any foreign (organic) contamination which is not transparent to violet or UV light should be removed to prevent possible photo-chemical degradation of the foreign material.

## 1.5 Electrical Isolation

LUXEON UV U Line emitters contain only two electrical pads on the bottom of the ceramic substrate with a spacing of 0.25mm and 0.60mm for LUXEON UV U1 and LUXEON UV U2 respectively. The gold plated interconnects (Figure 1) of LUXEON UV U Line emitters are not coated with any protective layer. Consequently any conductive debris or residue may cause emitter shorting or reduce creepage distance over time.

## 1.6 Mechanical Files

Mechanical 3-D STEP files for LUXEON UV U Line are available on the Lumileds website at lumileds.com.

## 1.7 Soldering

LUXEON UV U Line emitters are designed to be soldered onto a Printed Circuit Board (PCB). For detailed assembly instructions, see Section 4.

 ©2017 Lumileds Holding B.V. All rights reserved. 

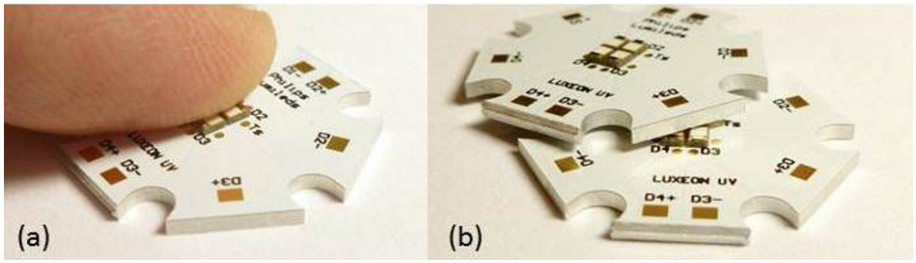



**Figure 4. Do not touch the top of surface of the LUXEON UV U Line emitter when handling a finished board (a) or stack boards with one or more LUXEON UV U Line emitters on top of each other (b).**

# 2. Printed Circuit Board (PCB) Design Guidelines

The LUXEON UV U Line emitter is designed to be soldered onto a Metal Core PCB (MCPCB) or a ceramic PCB such as aluminum nitride (AlN). Table 1 shows the differences between these two PCB substrates.

**Table 1. MCPCB versus Ceramic PCB Comparison.**

| | MCPCB | ALN CERAMIC PCB |
|---|---|---|
| Cost | Low | High |
| Coefficient of thermal expansion (CTE) | Low CTE matching to LUXEON UV U Line | High CTE matching to LUXEON UV U Line |
| LED assembly packing density (thermal resistance consideration) | Suitable for low density with larger LED to LED spacing | Good for high density where LED to LED spacing may be as low as 200µm |
| Mechanical assembly and handling | Generally easy as board does not easily break | Extra precaution to prevent ceramic breakage |
| Solder mask and land pattern | Need to use solder mask to define land pattern | Land pattern can be defined by top copper layer, hence no solder mask degradation over time due to UV light |

To ensure optimal operation of the LUXEON UV U Line emitter, the PCB should be designed to minimize the overall thermal resistance between the LED package and the heat sink.

## 2.1 PCB Footprint and Land Pattern

The LUXEON UV U Line emitter has two pads that need to be soldered onto corresponding pads on a PCB to ensure proper electrical operation. Figure 5 shows the recommended footprint designs for LUXEON UV U Line emitters.

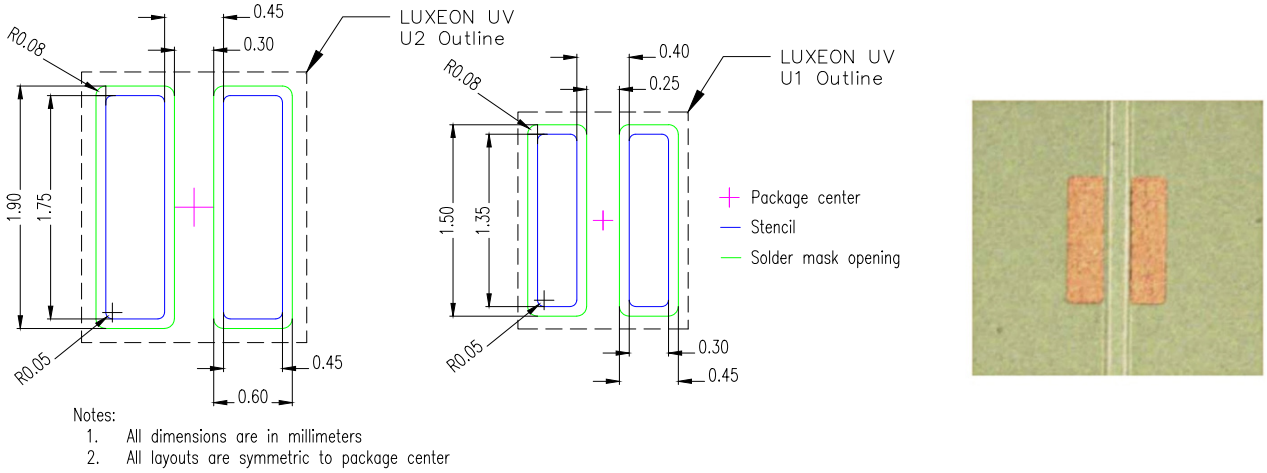



**Figure 5. Recommended PCB Footprint for LUXEON UV U Line.**
**NOTE: Solder mask degradation needs to be considered in the end product application requirement.**

 ©2017 Lumileds Holding B.V. All rights reserved. 

The electrical pads of the LUXEON UV U Line emitter also serve as thermal pads between the LED and the PCB. To enhance heat dissipation from the LUXEON UV U Line emitter onto the metal core PCB (MCPCB), it is best to extend the copper area around each electrode approximately 4mm from the center of the LUXEON UV U Line emitter, where possible. Furthermore, it is desirable to keep the thermal resistance values of the two copper pads on the MCPCB underneath each LUXEON UV U Line emitter approximately equal to ensure a balanced heat transfer from the LUXEON UV U Line emitter through both electrodes for optimum thermal performance.

For ceramic based PCB substrate such as aluminum nitride ceramic with excellent thermal conductivity, the top copper area around the electrode can be reduced further and typically can be made slightly larger than the LUXEON UV U Line emitter pads to define the land pattern.

## 2.2 Surface Finishing

Lumileds recommends using either a high temperature organic solderability preservative (OSP) or electroless nickel immersion gold (ENIG) on the copper layer of the PCB.

## 2.3 Solder Mask

Since solder mask material contains organic compounds, the solder mask susceptibility to UV degradation varies from each supplier.

## 2.4 Minimum Spacing

A minimum edge to edge spacing between LUXEON UV U Line emitters of 200µm to account for manufacturing tolerances such as package size and pick-and-place placement tolerance can be achieved with a standard pick and place equipment such as the one described in section 3.4. Placing multiple LUXEON UV U Line emitters too close to each other and using Al-MCPCB as opposed to ceraminc PCB may adversely impact the ability of the PCB to dissipate the heat from the emitters.

# 3. Assembly Process Guidelines

## 3.1 Stencil Design

The appropriate stencil design for the LUXEON UV U Line emitter is included in the PCB footprint design (see Figure 5). The recommended stencil thickness is 100µm.

## 3.2 Solder Paste

Lumileds recommends a lead-free no clean solder paste to mount LUXEON UV U Line emitters onto a PCB. A suitable starting choice of solder paste is from Alpha® SAC305-CVP390-M20 type 3. However, since application environments vary widely, Lumileds recommends that customers perform their own solder paste evaluation in order to ensure it is suitable for the targeted application.

## 3.3 Solder Paste Screen Printing

In general, there are three methods to align the stencil to the PCB during solder paste screen printing:

1. The stencil is manually aligned to the PCB prior to printing. No adjustments are made during printing.
2. The stencil is manually aligned to the PCB prior to printing. During printing, the machine keeps track of the PCB fiducial mark(s) and makes any necessary adjustments to maintain proper alignment with the PCB.
3. A technician performs a crude alignment of the stencil to the PCB. During printing, the machine keeps track of the PCB fiducial mark(s) and the stencil fiducial mark(s) and maintains proper alignment between the fiducials throughout the process.

Method 1 has the worst accuracy and repeatability of the three methods discussed. Method 2 offers the same accuracy as method 1 but ensures better repeatability. Method 3 has the best accuracy and best repeatability of the 3 methods discussed.

Depending on what screen printing method is used, the size of the anode and cathode solder mask openings on the PCB may have to be enlarged to compensate for any misalignments between the stencil and the PCB panel. Note, though, that any enlargement in the solder mask opening for anode and cathode pads may reduce the solder reflow placement accuracy.

In order to ensure proper alignment between the stencil and the PCB as well as reliable transfer of solder paste onto the PCB, all PCB panels should be rigidly supported during solder paste printing. Instead of placing the PCB panel on multiple support pins, it is best to place the PCB panel on a single solid plate. This is particularly important for PCB panels which contain v-scores or perforated holes for de-panel purposes.

Figure 6 shows the outcome of a well-controlled stencil printing process according to method 3 above. In this example, the recommended stencil pattern of Figure 5 was used in combination with a stencil thickness of 100um and a solder paste from Alpha® (SAC305-CVP390-M20 type 3).

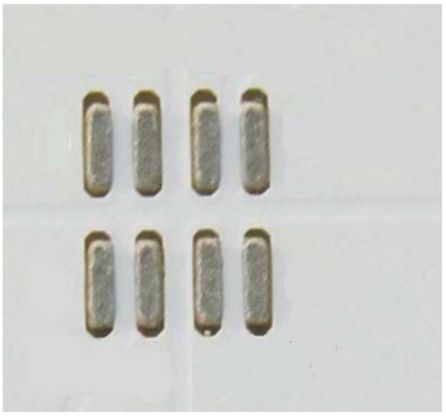


**Figure 6. An example of good stencil printing on 4-up MCPCB star board.**

## 3.4 Pick-and-Place

Automated pick and place equipment provides the best handling and placement accuracy for LUXEON UV U Line emitters. Figure 8 and Figure 9 show two pick and place nozzle designs and corresponding machine settings for Samsung SM421 and Panasonic CM402 respectively which were successfully used to pick and place LUXEON UV U Line emitters. Based on these pick and place experiments, Lumileds advises customers to take the following general pick and place guidelines into account:

1. The nozzle tip should be clean and free of any particles since this may interact with the silicone coating of the LUXEON UV U Line package during pick and place.
2. During setup and any initial production runs, it is a good practice to inspect the top surface of the LUXEON UV U Line emitters under a microscope to ensure the emitters are not accidentally damaged by the pick and place nozzle.

Note that pick and place nozzles are customer specific and are typically machined to fit specific pick and place tools.

The recommended pick-up area which corresponds to the LED chip area is shown in the shaded region of Figure 7. The top of the LED chip is composed of an optically transparent ceramic material, so a nozzle tip material such as metal or ceramic can be evaluated.

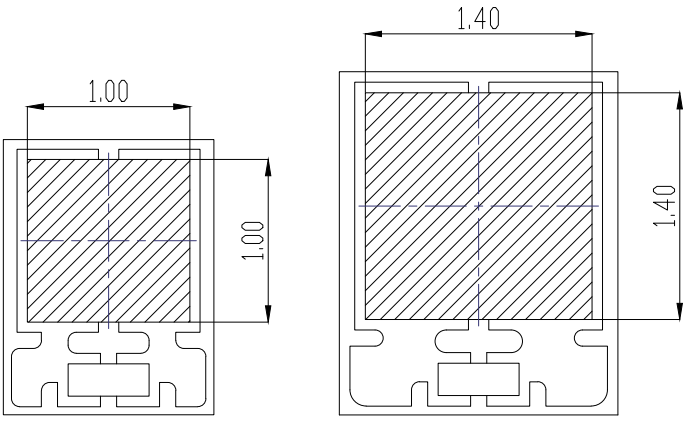


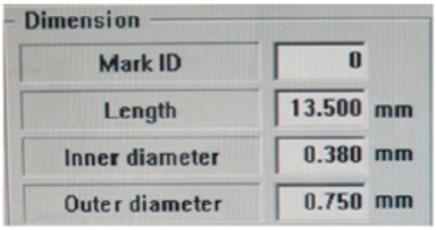

**Figure 7. Pick-up area (shaded) for LUXEON UV U1(left) and LUXEON UV U2 (right). Dimensions in mm.**

Standard off-the-shelf nozzle "CN040"











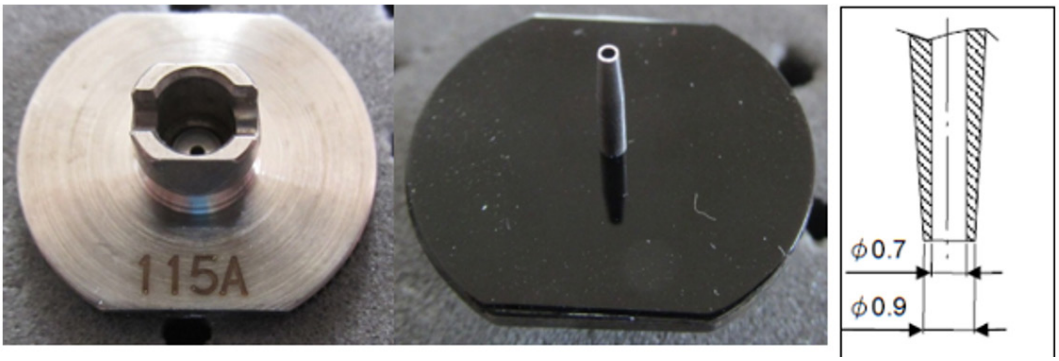


| PICK AND MOUNT INFORMATION | |
|---|---|
| Pick Height | -0.2mm |
| Mount Height | 0.0mm |
| Delay – Pick Up | 30ms |
| Delay – Place | 40ms |
| Delay – Vac Off | 0 |
| Delay – Blow On | 0 |
| | |
| | |

| PICK AND MOUNT INFORMATION | |
|---|---|
| Speed – XY | 1 |
| Speed – Z Pick Down | 1 |
| Speed – Z Pick Up | 1 |
| Speed – R | 1 |
| Speed – Z Place Down | 1 |
| Speed – Z Place Up | 1 |
| Z Align Speed | 1 |
| Soft Touch | Pick and Mount |

| VISION INFORMATION | |
|---|---|
| Camera No | Fly6 Cam |
| Side | 15 |
| Outer | 6 |

**Figure 8. Pick and place nozzle design based on off-the-shelf nozzles from Samsung and corresponding machine settings for Samsung S421. Nozzle "CN040" with outer diameter of 0.75mm and "CN065" with outer diameter of 1.20mm are suitable for LUXEON UV U1 and LUXEON UV U2 respectively.**




| PICK AND MOUNT INFORMATION | |
|---|---|
| Gap – Mount | 0.0mm |
| Gap – Pick | 0.2mm |
| Pickup position – Z | 0.0mm |
| Fdr drive time | Std |
| Pickup keep time | Std |
| Mount keep time | Std |
| Pickup speed | 100 |
| Mount speed | 100 |
| | |
| | |
| | |

| VISION INFORMATION | |
|---|---|
| Ref | 80 |
| Recognition speed | Auto (Fast) |
| Recognition height | 0.0mm |
| Lamp 1 | 0 |
| Lamp 2 | 0 |
| Lamp 3 | 0 |
| Lamp 4 | 140 |
| Lamp 5 | 0 |
| Lamp 6 | 0 |
| Lamp 7 | 0 |
| Lamp 8 | 0 |

**Figure 9. Pick and place nozzle design based on off-the-shelf nozzle from Panasonic (115A) and corresponding machine settings for Panasonic CM402. This nozzle is suitable for both LUXEON UV U1 and LUXEON UV U2.**

Some pick and place trouble shooting guide for poor pick-up yields and/or damaged LEDs.

a. LEDs not sitting correctly in the pocket tape during pick and place process. Evaluate a feeder equipped with a magnet strip. See Figure 10.

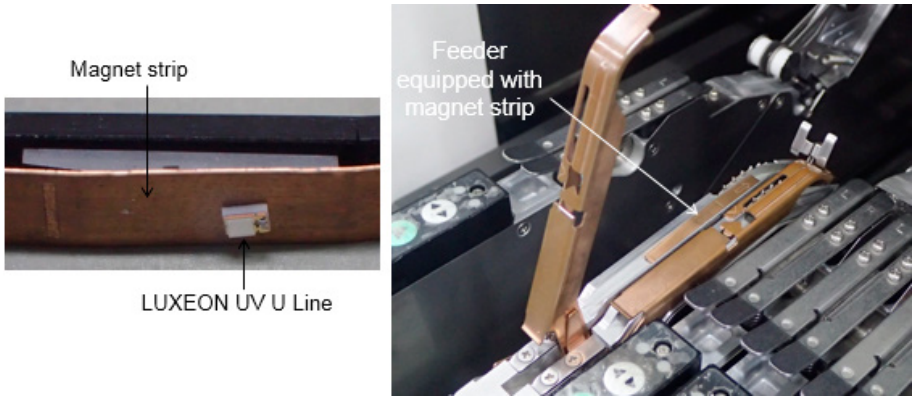



**Figure 10. LUXEON UV U Line is held by the magnet strip (left). Feeder (e.g. Panasonic CM402) equipped with magnet strip (right).**

 ©2017 Lumileds Holding B.V. All rights reserved. 

b. Evaluate pick and place machine with electric controlled feeder rather than pneumatic controlled feeder for better controllability.

c. Evaluate indexing with smaller pitch (for e.g. 2mm versus 4mm pitch) in pneumatic based feeder to minimize poor pick-up process, as shown in Figure 11.

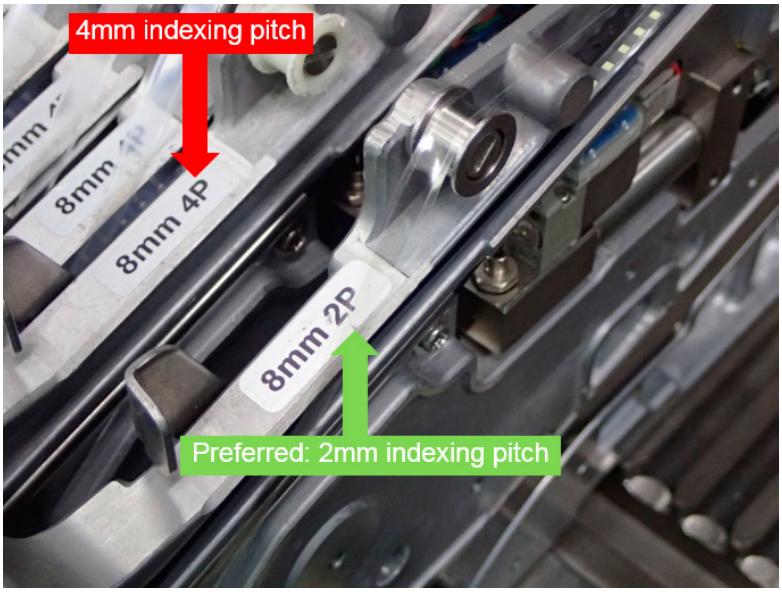



**Figure 11. An example of Samsung SM421 feeder with 2mm (preferred) and 4mm indexing pitches.**

## 3.5 Reflow Accuracy

Using the solder resist and stencil pattern layout as shown in Figure 5, LUXEON UV U Line's compact and lightweight construction can self-align during reflow as long as the two pads are in contact with their respective solder paste.

# 4. Packaging Considerations—Chemical Compatibility

The LUXEON UV U Line package does not have any silicone overcoat or overmold unlike most other LED packages. However due to the nature of the short wavelength emission spectrum (violet and UV), it emits high-energy light which can cause photo-thermal chemical degradation of polymeric materials. It is a good practice to keep the LED chip surface clean of any foreign contaminants. For example, if there is a solder flux residue on top of the LED chip, it may leave a burnt (brown/black) mark on the chip which can affect the total light output of the LUXEON UV U Line emitter and increase the LED chip temperature.

# About Lumileds

Lumileds is the global leader in light engine technology. The company develops, manufactures and distributes groundbreaking LEDs and automotive lighting products that shatter the status quo and help customers gain and maintain a competitive edge.

With a rich history of industry "firsts," Lumileds is uniquely positioned to deliver lighting advancements well into the future by maintaining an unwavering focus on quality, innovation and reliability.

To learn more about our portfolio of light engines, visit lumileds.com.

LUMILEDS

©2017 Lumileds Holding B.V. All rights reserved.
LUXEON is a registered trademark of the Lumileds Holding B.V. in the United States and other countries.

lumileds.com

Neither Lumileds Holding B.V. nor its affiliates shall be liable for any kind of loss of data or any other damages, direct, indirect or consequential, resulting from the use of the provided information and data. Although Lumileds Holding B.V. and/or its affiliates have attempted to provide the most accurate information and data, the materials and services information and data are provided "as is," and neither Lumileds Holding B.V. nor its affiliates warrants or guarantees the contents and correctness of the provided information and data. Lumileds Holding B.V. and its affiliates reserve the right to make changes without notice. You as user agree to this disclaimer and user agreement with the download or use of the provided materials, information and data..

AB178 LUXEON UV U Line
Application Brief 20170620