

SPECIFICATIONS FOR NICHIA **BLUE** LASER DIODE

Part No. NUBB24

NICHIA CORPORATION

0. Specifications

Blue laser diode: NUBB24

(In this specification, the blue laser diode is referred to as "LD", and the laser diode chip mounted on the LD is referred to as "LD chip".)

1. Specifications

(1) Rated

Forward Current: 3.0A(CW Operation), $T_m=70^\circ\text{C}$, ACC (Auto Current Control) Operation

(2) Absolute Maximum Ratings

| Item | Symbol | Absolute Maximum Ratings | Unit |
|---------------------------|-----------|--------------------------|------------------|
| Forward Current | I_F | 3.5 | A |
| Allowable Reverse Current | I_R | 85 | mA |
| Storage Temperature | T_{stg} | -40 ~ 85 | $^\circ\text{C}$ |
| Operating Temperature *1) | T_m | 0 ~ 70 | $^\circ\text{C}$ |

*1) Refer to Fig. 1

(3) Initial Electrical/Optical Characteristics

($T_m=25^\circ\text{C}$)

| Item | Symbol | Test Condition | Min. | Typ. | Max. | Unit |
|------------------------------|----------------|-------------------|------|--------|------|----------|
| Optical Output Power | P_o | $I_F=3.0\text{A}$ | 39.5 | (44) | - | W |
| Dominant Wavelength *2) | λ_d | $I_F=3.0\text{A}$ | 449 | (455) | 461 | nm |
| Threshold Current | I_{th} | CW Operation | 240 | - | 440 | mA |
| Slope Efficiency | η | CW Operation | - | (16.2) | - | W/A |
| Forward Voltage *3) | V_F | $I_F=3.0\text{A}$ | 28 | (32) | 36 | V |
| Beam Pointing Tilt Angle *4) | $\Delta\theta$ | $I_F=3.0\text{A}$ | - | - | 1.2 | $^\circ$ |
| Beam Divergence *5) | Parallel | $I_F=3.0\text{A}$ | 0 | (0.8) | 1.6 | $^\circ$ |
| | Perpendicular | $I_F=3.0\text{A}$ | -1.5 | (0) | 1.5 | $^\circ$ |

All figures in this specification are measured by Nichia's method and may contain measurement deviations. () are reference figures.

*2) λ_d is defined from trichromatic coordinate (x, y) values on chromaticity diagram calculated from the peak intensity higher than $1/e^2$ shown in Fig 2.

*3) When connected in series with the 8 LD chips.

*4) The beam pointing tilt angle measurement is performed for the total emission area once the LD initiates laser oscillation. To calculate the beam pointing tilt angle, the following equation is used: $\Delta\theta = \sqrt{\Delta\theta_{//}^2 + \Delta\theta_{\perp}^2}$

*5) Full angle at $1/e^2$ from peak intensity (Total Emission Area)

(4) Lifetime Characteristics

| Item | Symbol | Test Condition | Min. | Typ. | Max. | Unit |
|----------------------------|--------|-----------------------------|------|---------|------|------|
| Estimated Lifetime *6) *7) | Life | Cumulative Failure Rate 50% | 8000 | (20000) | - | h |
| | | Cumulative Failure Rate 1% | 1000 | - | - | h |

() are reference figures.

*6) Condition: $T_m=70^\circ\text{C}$, ACC, $I_F=3.0\text{A}$ (CW), $N=8\text{LD}$ chips (8 series connection)

*7) Calculation Method: Estimated in the linear extrapolation by degradation rate at tested duration 1000 hrs.

Criteria for Judging the Defect of Lifetime: $P_o \times 0.5$

Cumulative failure rate is calculated by the parameter greater than 500pcs.

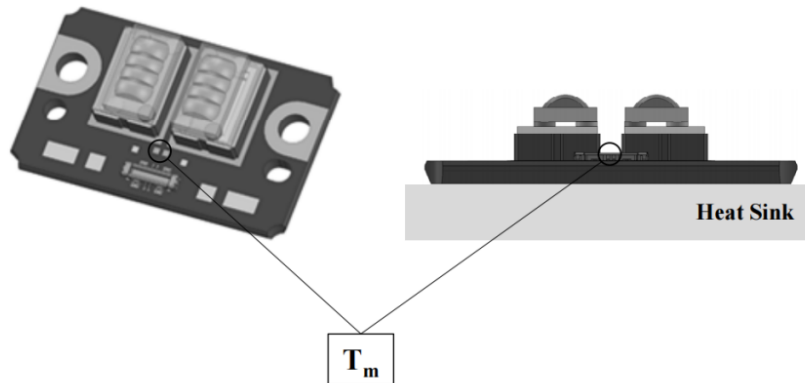


Fig.1 Schematic diagram of the measurement system

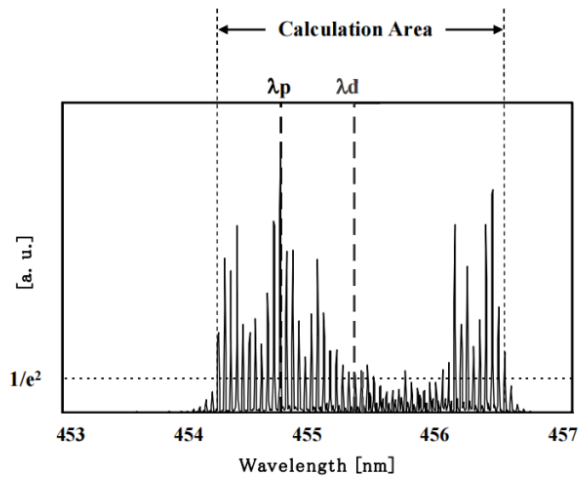


Fig.2 Definition of the Dominant Wavelength

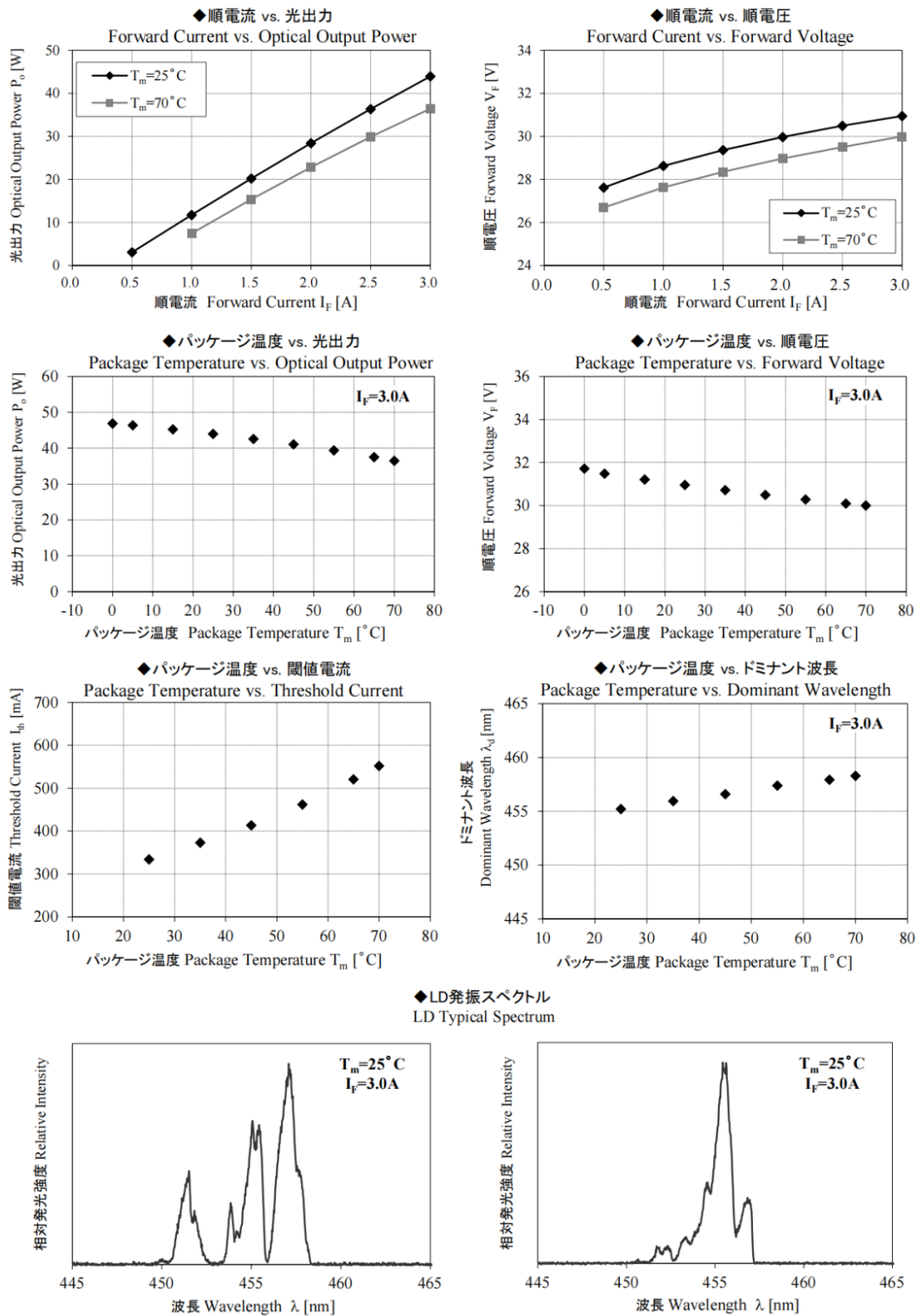
2. **Outline Dimensions and Materials**

Refer to the outline dimension pages within this specification.

3. **Packaging**

Refer to the packaging page within this specification.

4. Typical Initial Optical/Electrical Characteristics



5. Reliability

(1) Test Items and Test Conditions

| Test Item | Test Conditions | Note | Compliant Standard | Criteria for Judging |
|------------------------------|---|------------|--------------------|----------------------|
| Temperature Cycle | -40°C (15min.) ~ 85°C (15min.) | 100 cycles | JEITA ED-4701 105A | A |
| Vibration | 200 m/s ² , 20 ~ 2000 ~ 20Hz (4min.) 4 cycles of each X, Y, Z | 48 min. | JEITA ED-4701 403A | A |
| Shock | 15000 m/s ² , 0.5ms X, Y, Z | 5 times | JEITA ED-4701 404A | A |
| High Temperature Storage | T _A = 85 °C | 1000hrs. | JEITA ED-4701 201A | A |
| Temperature Humidity Storage | T _A = 85 °C, RH = 85 % | 1000hrs. | JEITA ED-4701 103A | A |
| Low Temperature Storage | T _A = -40 °C | 1000hrs. | JEITA ED-4701 202A | A |
| Life Test | T _m =70°C, I _F =3.0A(CW), ACC Operation | 1000hrs. | | B |

(2) Criteria for Judging the Failure

| | Item | Symbol | Test Conditions | Criteria for Judging the Failure |
|---|----------------------|----------------|-------------------------------|--|
| A | Forward Voltage | V _F | I _F =3.0A (series) | >Initial value×1.1 <Initial value×0.9 |
| | Optical Output Power | P _o | I _F =3.0A | >Initial value×1.1 <Initial value×0.9 |
| | Beam Tilt Angle | Δθ | I _F =3.0A | >Initial value +0.5deg. <Initial value -0.5deg. |
| B | Optical Output Power | P _o | Life Test Condition | >Initial value×1.1 <Initial value×0.9 |

6. Cautions

- Semiconductor devices, including Nichia laser diodes (the LD), can be damaged or fail in certain probability. The probability can be largely affected by the circuit used and/or environmental conditions. The following precautions should be carefully reviewed and followed to avoid the risk of any damage or failure.
- When incorporating the modules, equipment, systems, etc., the customer must acknowledge that any LD can fail statistically and must design its equipment fail safe designs to avoid consequential bodily and/or property damage.
- This LD uses a resin to secure the lens. The securing strength will be sufficient under normal use; however, depending on how the LDs are used, the lens may be removed. To ensure the safety and reliability of the LDs, ensure that the following precautions are followed when using the LDs.

1. LASER BEAM CAN DAMAGE EYES:

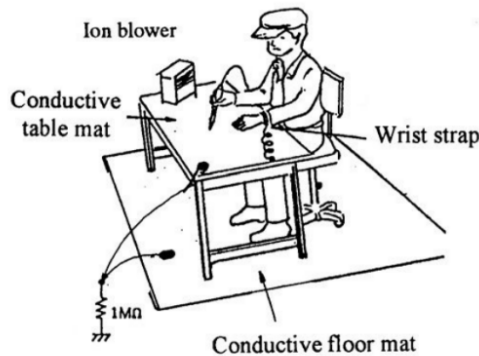
- Laser Light can damage the human eyes and skin. Do not expose the eye or skin to laser light directly. This Laser product has an optical lens and emits a collimated laser beam. The light from this product, both direct and reflected, is very harmful as it can propagate a long distance while maintaining high optical density. When handling the product, wear appropriate safety glasses to protect eyes from laser light including reflected and stray light. The reflected and stray light spilling into an unintended area should be attenuated and/or absorbed.
- When handling the LD, wear appropriate safety glasses to prevent laser light, even any reflections, from being exposed to the eyes.
- Use of the LD should conform to **Class 4 of the IEC60825-1 and 21 CFR Part 1040.10 Safety Standards.**



2. Static Electricity and Electrical Surges:

Static electricity or electrical surges will reduce and degrade the reliability of the LD. When working with the LDs take countermeasures to avoid the generation of static electricity, including the following:

- Use or wear appropriate work clothes, gloves, shoes, grounded wrist straps and other tools to avoid static electricity.
- Wrist band must be grounded by high resistance (1M Ohm) wire.
- Use anti-static case for transport and storage of the LD.
- Use fully grounded workbenches, soldering tools, equipment and circuits. Especially, the soldering iron must be a leak-free type. Ground the equipment and the circuit to be connected, and surge current must be blocked at the power supply.
- Insulating materials will not release static electricity. Use an ion blower to neutralize the electrostatic.
- To prevent electrostatic generation, maintain an environmental humidity of more than 40%.
- Do not connect or disconnect oscilloscope probes or voltage meter cables when the LD is operated. That may cause a surge.
- Do not use the LD near a Glow Electric Discharge Tube or similar equipment, due to the chance of inducing an electrical surge by high frequency noise.



3. Absolute Maximum Ratings:

The active layer of the mounted LD chips has a high current density and generates a high electric field during its operation. In order to prevent excessive damage, the LD must be operated strictly below the Absolute Max Rating.

The LD will have shorter lifetime if used at higher temperature. In order to elongate the lifetime, design the equipment to use the LD at lower temperature and lower output power.

During operation, if the forward current and/or optical output power are increased the lifetime of the LDs will decrease. Ensure that the LDs are operated within the recommended conditions.

4. Operating Power Supply:

When adjusting the operation current, make sure to simultaneously monitor the optical output power by using a power meter.

The LD will change its forward voltage requirement and optical output power according to the temperature change. Also, the LD will require a higher operation current to maintain the same output power as it degrades. In order to maintain the output power, use of an APC (Automatic Power Control) is recommended, which uses feedback of the optical output power to adjust the operation current.

Confirm that the electrical spike current generated by switching on and off does not exceed the maximum operating current as specified within this document as the absolute max rating. Additionally, ensure that there are appropriate countermeasures to reduce chattering and/or overshooting in the circuit.

ACC (Auto Current Control) mode is recommended for the operation of this product. Additionally, be careful for the overshooting in order to avoid excessive optical output power as the laser operation is started.

5. Design Consideration:

LDs may fail as either a short circuit or an open circuit. If an LD shorts during operation, the forward voltage of the LD may fluctuate greatly. When designing a circuit, ensure that both short and open circuits are considered and that there will be no issues if a short or open circuit occurs.

Since this LD uses a resin to secure the lens, if the lens becomes removed during operation, it may cause unintentional laser exposure to occur (e.g. random radiation) leading to accidents/injuries (e.g. causing an object to smoke, fire, and the laser light to escape). Ensure that the chosen system includes a safeguard (e.g. containing the laser light, emergency shutdown, etc.).

6. Heat Sink:

The use of heat sinks is strongly recommended to reduce increases in temperature and in the operating current of the LD. If the heat dissipation capability is not sufficient, the temperature of the LD will increase, light output power will decrease, and the LD could be damaged or destroyed due to escalating increases in temperature and in the operating current.

The heat dissipation of the LDs will vary depending on the heatsink (e.g. heatsink material, size/volume, fin shape/configuration, etc.). To effectively dissipate the heat, the LDs should be attached to a heatsink in a manner that ensures the back of the copper substrate properly and adequately touches the heatsink. Ensure that the chosen system and its manufacturing process are designed considering the thermal resistance from junction to ambient through the heatsink.

7. Storage:

Rapid fluctuations in the storage temperature and/or humidity should be avoided both before and after opening the antistatic bag. After opening the antistatic bag, the storage conditions should be a temperature within the range of 5°C to 35°C and a relative humidity within the range of 40% to 75%. Before opening the antistatic bag, any storage temperatures and humidity levels which are outside of those parameters should be avoided.

If the metals/plated surfaces of the LDs are exposed to a corrosive environment, it may cause those surfaces to tarnish causing issues (e.g. solderability, reduction in the characteristics, reliability, etc.). Ensure that LDs are stored under proper conditions/environment and assembled into systems (i.e. soldering of lead wires) immediately.

The LD shall be used within one year after the receipt. Shelf life is one year.

8. Installation:

This LD is designed to be secured to a system/heatsink with screws. If the LDs are soldered to a system/heatsink, Nichia will not guarantee its reliability.

This LD has a hermetic sealing cover for the LD chips. Ensure that neither excessive prolonged pressure nor impact is applied to the LDs; this may cause the LDs (e.g. copper substrate, ceramic package, hermetic sealing cover, etc.) to be damaged, chipped, cracked and/or deformed, resulting in hermetic seal failures. If the LD chips become exposed, it may cause the characteristics to change.

Do not apply an external force of $\geq 40\text{N}$ to the connecting device or the cable connected to it.

Ensure that excessive force is not applied to the connecting device, especially during/after inserting a receptacle connecting device into the plug connecting device. If this occurs, it may damage the connecting device.

9. Beam Shape; Lens Care:

- The beam from the LD forms a collimated oval shape that has been corrected by the lens array.
- The shape of the beam must be converged by the appropriate lens to conform to the utility of the circuit.
- Handle the LD carefully to avoid damage to or staining of its lens surface because those may cause to decrease light output power and change the beam shape.
- Due to its short wavelength and high optical output power, optical depositions on optical path may occur depending on surrounding conditions. Appropriate design or countermeasures should be used to avoid optical depositions.
- This LD uses a resin to secure the lens to the ceramic package. If the LDs are operated in environments that have high temperatures and/or high humidity or if the reflected laser beams return to the LD and become focused around the lens, it may damage the adhesive resin. If the adhesive resin is damaged, it may cause the lens to move or be removed, and the optical characteristics (i.e. beam pointing tilt angle, beam divergence, and polarization angle) to change.

7. Limited Warranty

Limited Warranty

- (1) Nichia warrants that the LD itself, not incorporated into any module, equipment and/or system designed and/or manufactured by any party other than Nichia, shall perform in accordance with its specifications. This warranty shall become immediately null and void if any of Nichia's instructions set forth above are not followed.
- (2) The customer must acknowledge that any LD can statistically fail and must design its equipment in a fail safe design. It is customer's responsibility to confirm that the LD, as described in Nichia's specifications, meets the life expectancy needs of, and provides the features required by the Circuit and any related modules, equipment and/or systems.
- (3) This LD is intended to be used for 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 LDs are planned to be used for these applications, unless otherwise detailed in the specification, Nichia will neither guarantee that the LD is fit for that purpose nor be responsible for any resulting property damage, injuries and/or loss of life/health.
This LD does not comply with IATF 16949 and is not intended for automotive applications.

Warranty Service

Warranty service is available during the one (1) year period commencing on the date of shipment from Nichia. During the Warranty Period, if the customer finds failure or defect, following process shall be taken:

- (1) Fill in and send "Questions for Laser Damage Analysis" to Nichia and obtain Return Authorization Number (RA number)
- (2) Return to QA Manager Nichia Corp. 491 Oka, Kaminaka-Cho Anan-Shi, Tokushima 774-8601, JAPAN. The customer must bear all packaging, handling, insurance and shipping costs that incurred related to returning the LD to Nichia.
- (3) Nichia shall conduct full analysis of the returned LD. If Nichia determines that the LD fails to meet the Limited Warranty above, Nichia will send the customer equivalent quantity of replacement LDs. If Nichia determines that the LD was damaged after the shipment from Nichia, Nichia shall contact the customer, at which time the customer may request either service of the LD by Nichia (at its standard fees therefore) or return of the LD to customer.

Disclaimer of Warranties

NICHIA HEREBY DISCLAIMS ALL OTHER WARRANTIES INCLUDING, BUT NOT LIMITED TO, IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

Limitation of Liability

THE PURCHASER'S SOLE REMEDY IN THE EVENT OF A BREACH OF THE ABOVE WARRANTY SHALL BE, AT NICHIA'S OPTION AND IN ITS SOLE DISCRETION, REPAIR OR REPLACEMENT OF THE LD. NICHIA SHALL HAVE NO OTHER LIABILITY WITH REGARD TO ANY OTHER DAMAGES INCURRED BY PURCHASER WITH REGARD TO ANY DEFECTIVE LD, INCLUDING, BUT NOT LIMITED TO, LIABILITY RESULTING FROM ANY ACCIDENT, DAMAGE OR INJURY RELATED TO THE LD CAUSED BY ACCIDENT, MISUSE, ABUSE, NEGLIGENCE, MISAPPLICATION, INCORRECT USE OF ELECTRICAL VOLTAGE, ELECTRICAL FLUCTUATIONS OR SURGES CAUSED BY IMPROPER OR FAULTY INSTALLATION, IMPROPER CONNECTIONS WITH ANY OTHER CIRCUITS, SYSTEMS, PERIPHERALS OR LDS, LD ALTERATION OR MODIFICATION, UNAUTHORIZED REPAIR, COSMETIC DAMAGE OR CUSTOMER ADJUSTMENTS, USE OF UNAUTHORIZED PARTS OR EQUIPMENT WHICH DAMAGE OR CAUSE FAILURE OF THE LD, PROBLEMS DUE TO INCOMPATIBILITY WITH ANY OTHER MODULE, EQUIPMENT OR SYSTEM, OR ANY ACTS OF NATURE.

Reverse Engineering

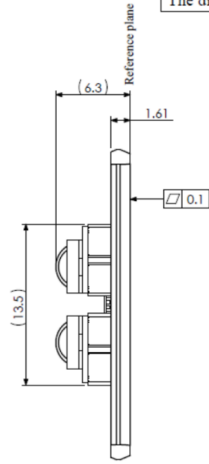
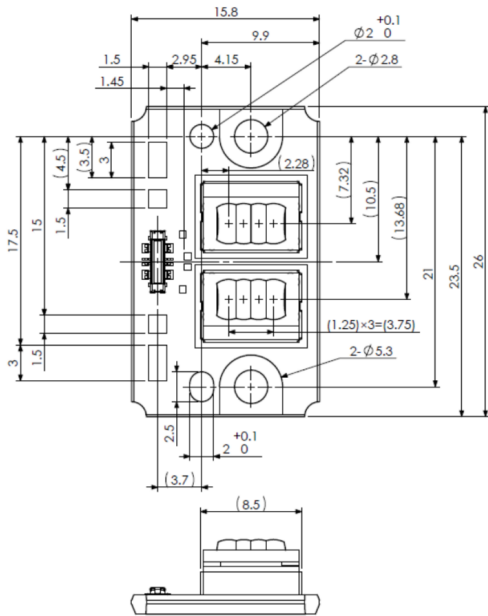
Nichia prohibit Purchaser from reverse engineering, disassembling, or taking any other steps to derive the structure or design of the LD. Any attempt to derive the structure or design of the LD shall be deemed breach of this Agreement, and shall make the limited warranty set forth above null and void.

Miscellaneous

- (1) Acceptance Test: The Purchaser shall perform an acceptance test on the LD within fourteen (14) days of the date of shipment by Nichia of the LD.
- (2) The formal specifications must be exchanged and signed by both parties before large volume purchase begins.
- (3) The appearance and specifications of the LD may be modified for improvement without notice.
- (4) The content of this specification may be revised without notice.

■外形寸法図 / Outline Dimension(1)

本図面 () 内の数値は参考値
The dimension(s) in parentheses are for reference purposes.



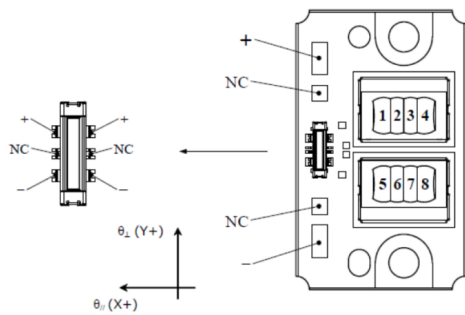
※Note
TOLERANCES based on JIS B 0405-m(table). UNLESS NOTED
Table. Limits for Linear measures(mm)

| Range | 0.5 to 3 | above 3 to 6 | above 6 to 30 |
|-----------|----------|--------------|---------------|
| Tolerance | ±0.1 | ±0.1 | ±0.2 |

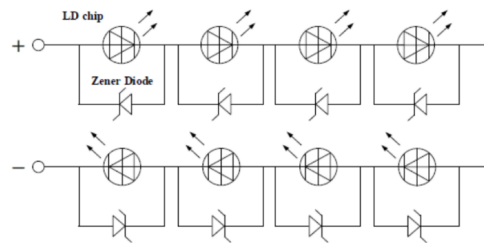
| | | | |
|--------------------|----------------------------|--|-------|
| Part Number | NUBB24 | | Unit |
| Title | 外形寸法図 OUTLINE DIMENSION | | mm |
| NICHIA CORPORATION | No. | | Scale |

■外形寸法図 / Outline Dimension(2)

LD chips Position No.



Pad Connection



| 部品 | Component Name | 材質 | Material |
|-----------|------------------------------|--------------|-----------------------|
| パッケージ | Package | セラミックス+硬質ガラス | Ceramics + Hard glass |
| チップ | Chip | 窒化ガリウム | Gallium nitride |
| サブマウント | Submount | 窒化アルミニウム | Aluminium nitride |
| ツェナーダイオード | Zener Diode | シリコン | Silicon |
| レンズアレイ | Lens Array | 光学ガラス | Optical glass |
| レンズ固定接着剤 | Adhesive for fixing the lens | 樹脂 | Resin |
| 基板 | Copper Substrate | 銅 | Copper |
| 電極 | Electrode | Auメッキ | Au plating |
| コネクタ | Connector | 樹脂 + Cu合金 | Resin + Cu alloys |

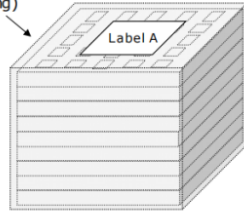
| 部品 | 供給元 | 型名 |
|-------|---|----------------------|
| Parts | Supplier | Part No. |
| コネクタ | 日本航空電子工業株式会社 Japan Aviation Electronics Industry, Ltd. | WP10-P004VA10-R15000 |

| Section | Approve | Check | Draw | Unit |
|---------|---------|-------|-----------|------|
| LDT | Ochiai | Iwasa | Yoshihara | mm |

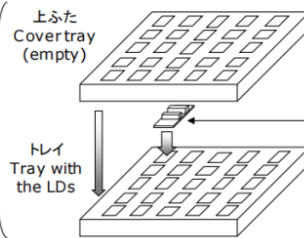
| Part Number | Date | Title | Scale |
|--------------------|--------------------|----------------------------|-------|
| NUBB24 | September 28, 2021 | 外形寸法図 OUTLINE DIMENSION | Allow |
| NICHIA CORPORATION | No. | | |

● Inner Packaging

帯電防止防湿袋 (真空パック)^{1,2}
Antistatic, moisture-proof bag
(Vacuum packing)



9 Trays max. (including 1 cover tray)
L:260mm x W:220mm x H:92mm

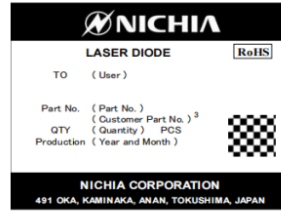


(日産型番)
(Nichia Part No.)
☒ (日産管理番号)
(Nichia Reference No.)

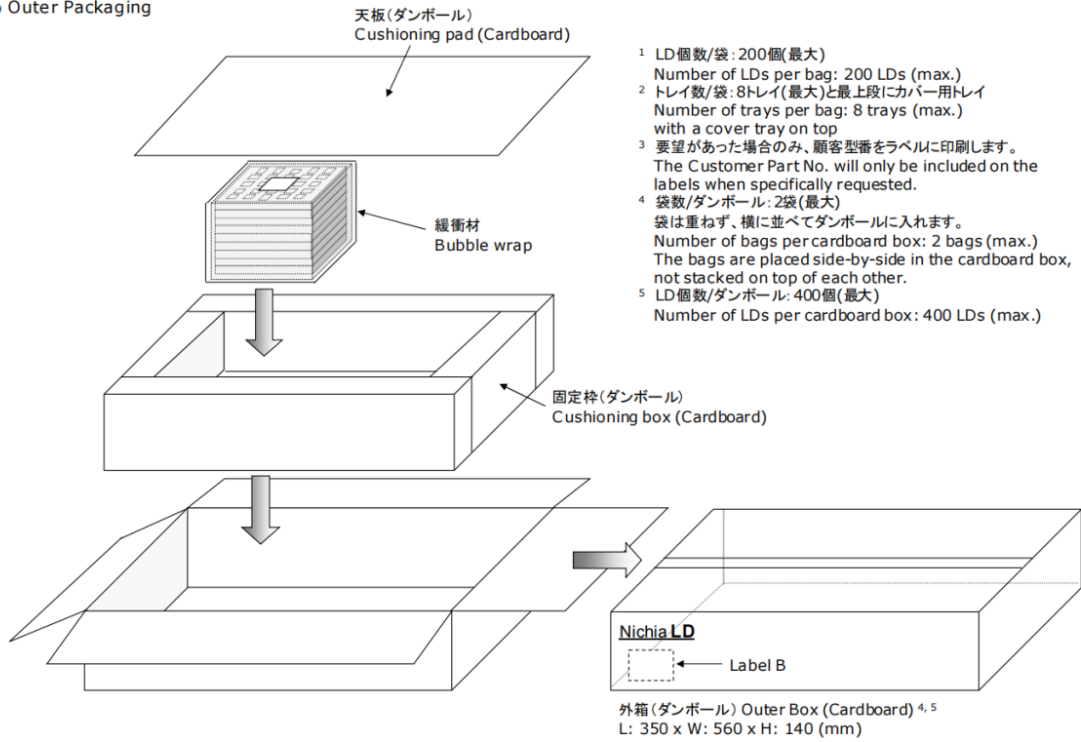
Label A: Laser warning label



Label B: Box Shipping label



● Outer Packaging



- 1 LD個数/袋: 200個(最大)
Number of LDs per bag: 200 LDs (max.)
- 2 トレイ数/袋: 8トレイ(最大)と最上段にカバー用トレイ
Number of trays per bag: 8 trays (max.)
with a cover tray on top
- 3 要望があった場合のみ、顧客型番をラベルに印刷します。
The Customer Part No. will only be included on the labels when specifically requested.
- 4 袋数/ダンボール: 2袋(最大)
袋は重ねず、横に並べてダンボールに入れます。
Number of bags per cardboard box: 2 bags (max.)
The bags are placed side-by-side in the cardboard box, not stacked on top of each other.
- 5 LD個数/ダンボール: 400個(最大)
Number of LDs per cardboard box: 400 LDs (max.)

| | | | | | |
|--------------------|---------|---------------|----------|-----------|-------|
| | Section | Approve | Check | Draw | Scale |
| | LDT | Ochiai | Hosokawa | Yoshihara | |
| | Date | Jan. 21, 2022 | | | |
| | Title | 梱包仕様図 | | | Allow |
| NICHIA CORPORATION | No. | | | | |