

NICHIA CORPORATION

SPECIFICATIONS FOR LASER DIODE BANK

Part No. NUGM06

- RoHS Compliant

This product has eight LD packages with a collimator lens. "LD Bank", "LD Banks", "this product", and "the product" as used herein refer to this product. "LD" and "LDs" as used herein refer to the LD package(s) that are used in the LD Bank.

SPECIFICATIONS

(1) Rated Conditions

Forward Current: 1.9A (CW), $T_m = 65^\circ\text{C}$

(2) Absolute Maximum Ratings of the LD Bank

Item	Symbol	Absolute Maximum Rating	Unit
Forward Current	I_F	2.3	A
Allowable Reverse Current	I_R	85	mA
Storage Temperature	T_{stg}	-40~85	$^\circ\text{C}$
Operating LD Plate Temperature ¹	T_m	0~65	$^\circ\text{C}$

¹ See Figure 1 for the measurement point of the operating LD plate temperature (T_m).

(3) Initial Electrical/Optical Characteristics of the LD Bank^{2, 3}

Item	Symbol	Condition	Min	Typ.	Max	Unit
Optical Output Power	P_o	$I_F = 1.9\text{A}$	12.0	(13.5)	15.0	W
Dominant Wavelength ⁴	λ_d	$I_F = 1.9\text{A}$	520	(525)	530	nm
Forward Voltage ⁵	V_F	$I_F = 1.9\text{A}$	31	(35)	40	V
Beam Pointing Tilt Angle ⁶	$\Delta\theta$	$I_F = 1.9\text{A}$	-	-	0.7	$^\circ$

² Characteristics values are values measured under Nichia's measurement conditions/environments; there may be variations for the measurement repeatability/reproducibility of these values. The values in parentheses are for reference purposes only.

³ Characteristics at $T_m = 22^\circ\text{C}$ (approx. $T_B = 26^\circ\text{C}$). See Figure 1 for the measurement points of T_m and T_B .

⁴ Average dominant wavelength value of the LDs used in the LD Bank.

⁵ Characteristics measured with the eight LDs connected in series.

⁶ $\Delta\theta = \sqrt{\Delta\theta_{//}^2 + \Delta\theta_{\perp}^2}$ (calculated per LD)

(4) Lifetime Characteristics of the LD Bank⁷

Item	Symbol	Condition	Min	Typ.	Max	Unit
Estimated lifetimes ^{8, 9}	Life	Cumulative Failure Rate = 50%	10000	(20000)	-	h
		Cumulative Failure Rate = 1%	1000	-	-	h

⁷ Values in parentheses are for reference purposes only.

⁸ Operating conditions: $T_m = 65^\circ\text{C}$, $I_F = 1.9\text{A}$ (CW) in ACC (automatic current control) mode

⁹ How the lifetime is determined: Linearly extrapolated from the reduction ratio of the optical output power calculated at 1000 hours of operation for each LD Bank.

Failure criteria: $\leq \text{Initial } P_o \times 0.5$

Sample size for the cumulative failure rate calculation: ≥ 500 LD Banks.

(5) Initial Electrical/Optical Characteristics of the LD^{10, 11}

Item	Symbol	Condition	Min	Typ.	Max	Unit	
Optical Output Power	P_o	$I_F = 1.9A$	1.1	(1.65)	2.2	W	
Dominant Wavelength ^{12, 13}	λ_d	$I_F = 1.9A$	518	(525)	532	nm	
Threshold Current	I_{th}	CW	100	-	380	mA	
Slope Efficiency	η	CW	-	(1.0)	-	W/A	
Forward Voltage	V_F	$I_F = 1.9A$	4.0	(4.4)	5.5	V	
Beam Divergence ¹⁴	Parallel	$\theta_{//}$	$I_F = 1.9A$	0.2	(0.4)	0.6	°
	Perpendicular	θ_{\perp}	$I_F = 1.9A$	-1.0	(0)	1.0	°

¹⁰ Characteristics values are values measured under Nichia's measurement conditions/environments; there may be variations for the measurement repeatability/reproducibility of these values. The values in parentheses are for reference purposes only.

¹¹ Characteristics at operating case temperature (T_C) = 25°C. See Figure 2 for the measurement point of T_C .

¹² The LD Bank has the LDs from three dominant wavelength (λ_d) ranks as follows:

Rank A: $518.0nm \leq \lambda_d < 523.0nm$, LD Location Numbers 1 and 3

Rank B: $523.0nm \leq \lambda_d < 527.0nm$, LD Location Numbers 2, 4, 5, and 7

Rank C: $527.0nm \leq \lambda_d \leq 532.0nm$, LD Location Numbers 6 and 8

See OUTLINE DIMENSIONS for LD Location Numbers.

¹³ λ_d is calculated from chromaticity coordinate (x , y) values on the chromaticity diagram calculated using the intensities in the region equal to or above $1/e^2$ of the peak intensity shown in Figure 3.

¹⁴ Full angle at $1/e^2$ of peak intensity

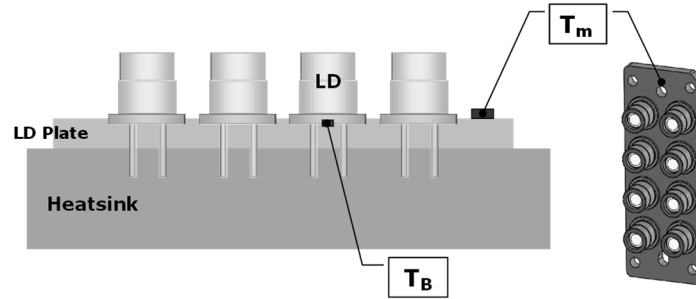


Figure 1. Temperature measurement points of the LD Bank

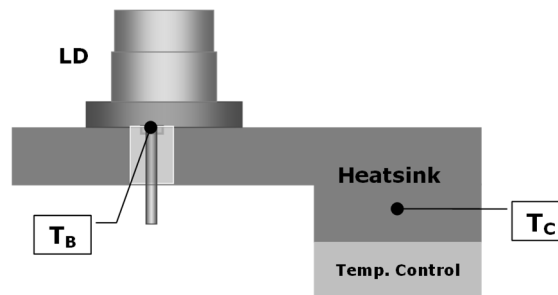


Figure 2. Temperature measurement points of the LD

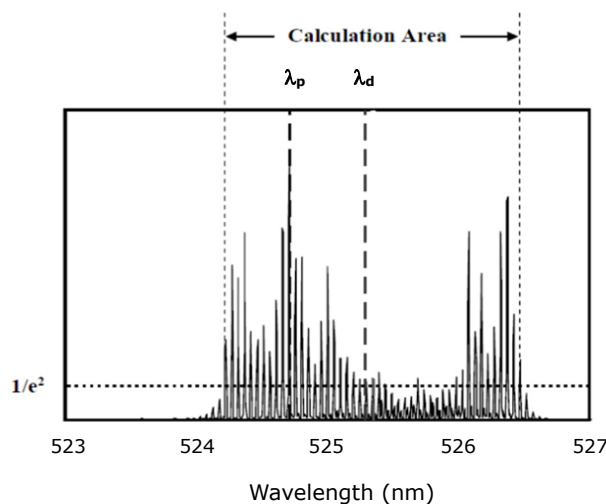
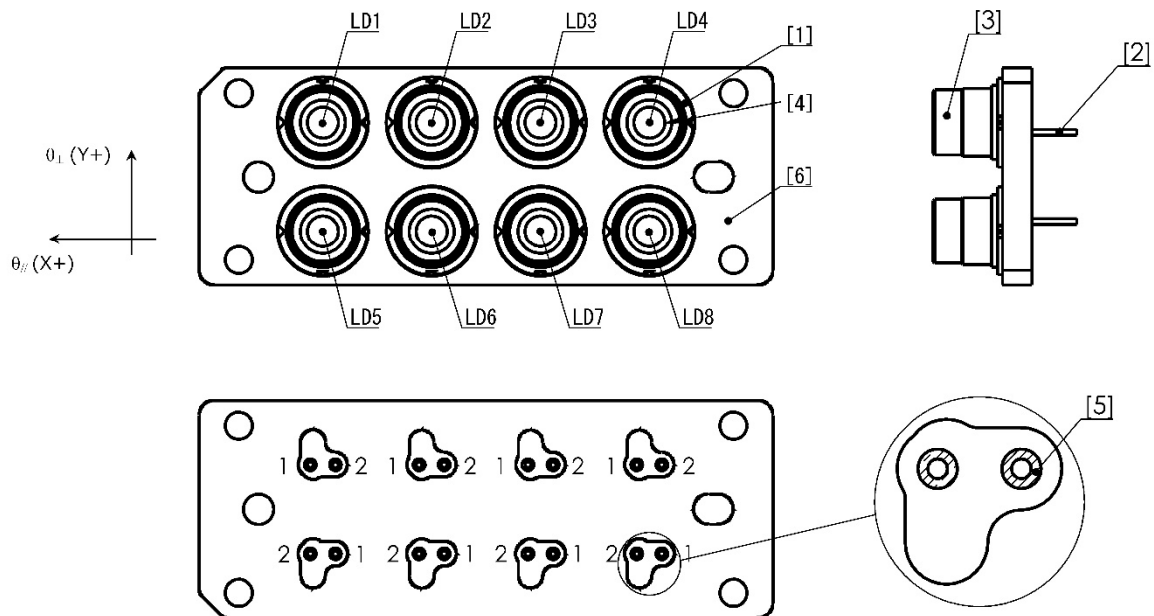


Figure 3. Definition of the Dominant Wavelength

OUTLINE DIMENSIONS (CONT.)

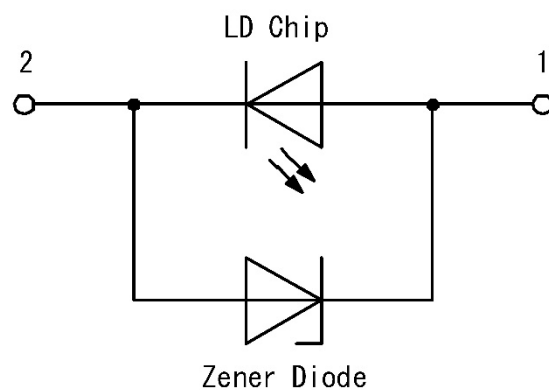
No. UTZ-ZA08020

LDの位置番号
LD Location Number



番号 No.	部品名	Component Name	材質	Material
[1]	ステム	Stem	鉄+金めっき	Fe + Au plating
[2]	リード	Lead	鉄合金+金めっき	Fe alloys + Au plating
[3]	キャップ	Cap	鉄合金+ニッケルめっき	Fe alloys + Ni plating
[4]	レンズ	Lens	光学ガラス	Optical Glass
[5]	シールガラス	Sealing Glass	ガラス	Glass
[6]	LDプレート	LD Plate	銅+ニッケルめっき	Cu + Ni plating

駆動回路
Drive Circuit

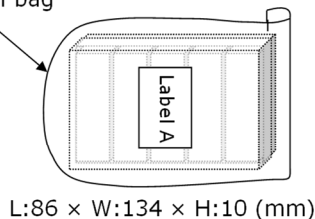


1. LD Anode
2. LD Cathode

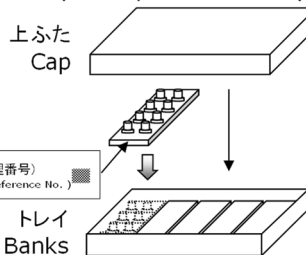
PACKAGING

● Inner Packaging

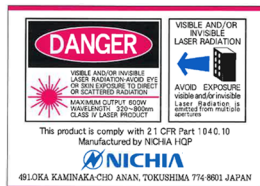
帯電防止防湿袋
(真空パック)
Antistatic, moisture-proof bag
(Vacuum Packing)



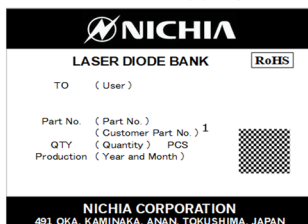
トレイにつきLDバンク最大5台
Number of LD Bank per tray: 5 LD Banks (max.)
No. UTZ-ZA08060



Label A: Laser warning label

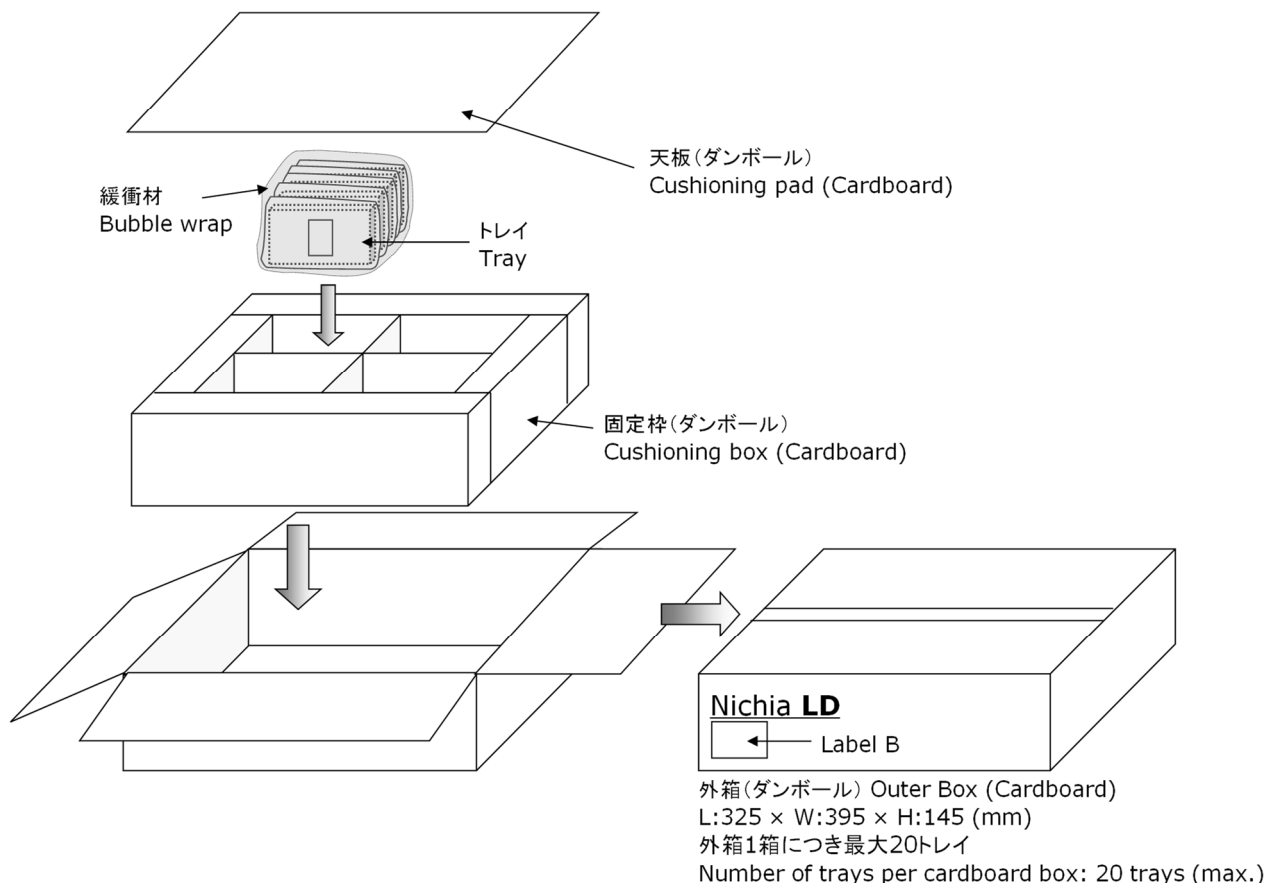


Label B: Box shipping label



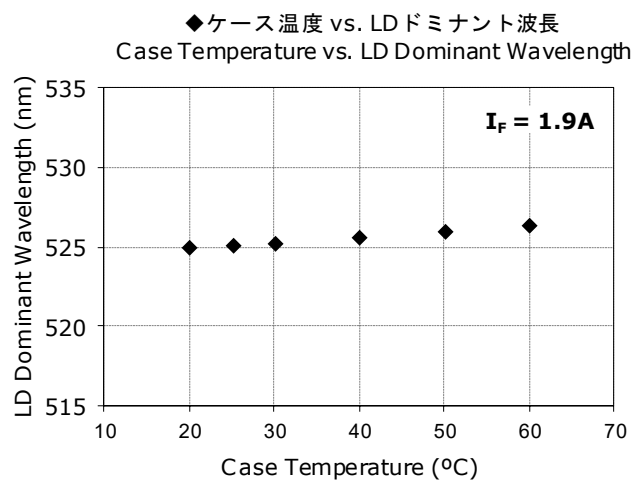
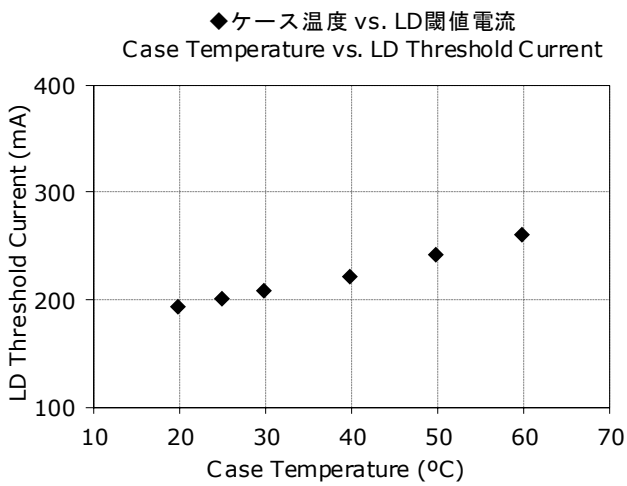
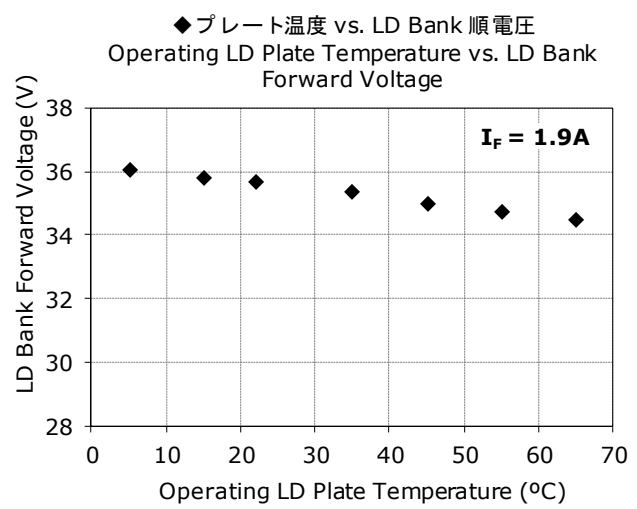
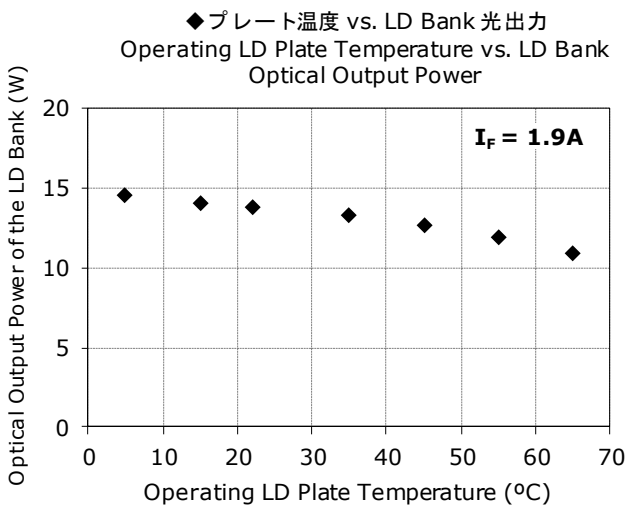
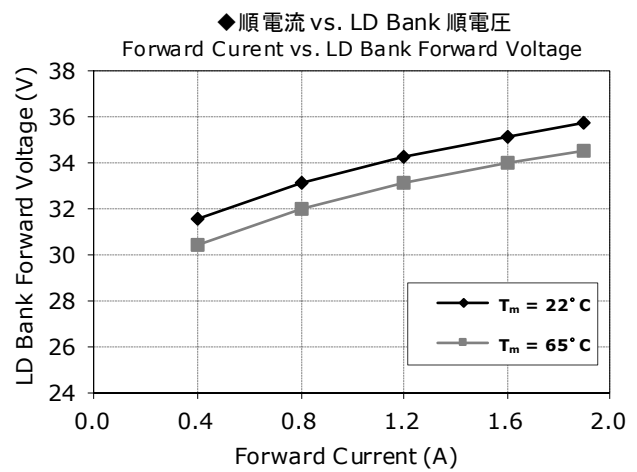
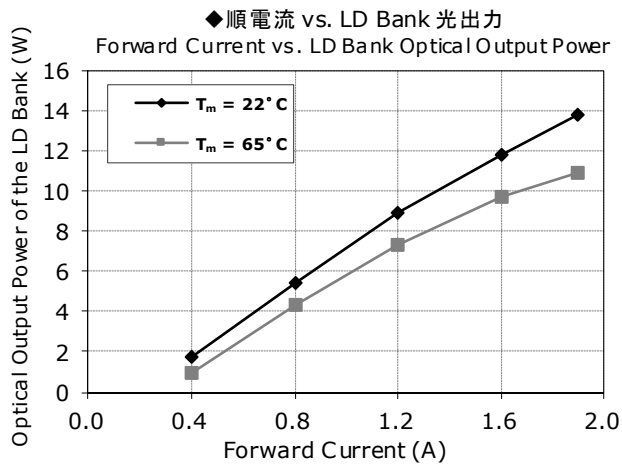
※ 要望なき場合、ユーザ型番は印刷されないことがあります。
The Customer Part No. will only be included on the labels when specifically requested.

● Outer Packaging



- 本製品はトレイを帯電防止防湿袋でパックしたのち、輸送の衝撃から保護するためダンボールで梱包します。
The LD Banks shipped in trays are packed in an antistatic, moisture-proof bag.
They are shipped in the cardboard box to protect them from external forces during transportation.
- 取り扱いに際して、落下させたり、強い衝撃を与えたりしますと、製品を損傷させる原因になりますので注意してください。
Do not drop or expose the box to external forces as it may damage the LD Banks.
- ダンボールには防水加工がされていないので、梱包箱が水に濡れないように注意してください。
Do not expose the cardboard box to water as it is not water-resistant.
- 輸送、運送に際して弊社梱包状態あるいは同等の梱包を行ってください。
Using the original packaging materials or equivalent in transit is recommended.

ELECTRICAL/OPTICAL CHARACTERISTICS



RELIABILITY

(1) Test Items and Conditions

Test	Test Conditions	Test Duration	Reference Standard	Failure Criteria #
Resistance to Soldering Heat (Hand Soldering)	$T_{\text{slid}} = 350 \pm 10^{\circ}\text{C}$, 5sec (2mm from the base of the lead)	2 times		1
Solderability	$T_{\text{slid}} = 245 \pm 5^{\circ}\text{C}$, 5sec Lead-free Solder (Sn-3.0Ag-0.5Cu)	1 time	JEITA ED-4701/301 303A	2
Temperature Cycle	-40°C (30min) \sim 85°C (30min)	100 Cycles	JEITA ED-4701/100 105	1
Vibration	200m/s^2 , 100~2000~100Hz, 4 cycles, 4min, each X, Y, Z	48 minutes	JEITA ED-4701/400 403	1
Shock	15000m/s^2 , 0.5ms, each X, Y, Z	3 times	JEITA ED-4701/400 404	1
High Temperature Storage	$T_A = 85^{\circ}\text{C}$	1000 hours	JEITA ED-4701/200 201	1
Temperature Humidity Storage	$T_A = 85^{\circ}\text{C}$, RH = 85%	1000 hours	JEITA ED-4701/100 103	1
Low Temperature Storage	$T_A = -40^{\circ}\text{C}$	1000 hours	JEITA ED-4701/200 202	1
Operating Life	$T_m = 65^{\circ}\text{C}$, $I_F = 1.9\text{A}$ (CW) in ACC mode	1000 hours		3

(2) Failure Criteria

Criteria #	Items	Conditions	Failure Criteria
1	Forward Voltage (V_F)	$T_m = 22^{\circ}\text{C}$, $I_F = 1.9\text{A}$ (CW)	<Initial Value \times 0.9 >Initial Value \times 1.1
	Optical Output Power (P_o)		<Initial Value \times 0.9 >Initial Value \times 1.1
	Beam Pointing Tilt Angle ($\Delta\theta$)		<Initial Value - 0.5° >Initial Value + 0.5°
2	Solderability	-	Less than 95% solder coverage (The calculation of the 95% does not include the area of 0.5mm from the tip of the lead.)
3	Optical Output Power (P_o)	$T_m = 65^{\circ}\text{C}$, $I_F = 1.9\text{A}$ (CW)	<Initial Value \times 0.9 >Initial Value \times 1.1

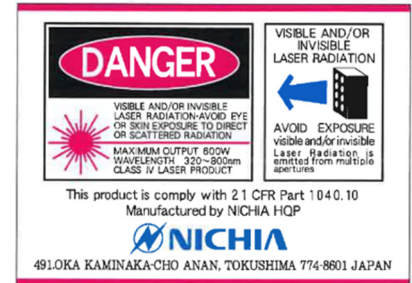
Cautions

When using the LD Bank for the chosen application (e.g. equipment, devices, etc.), design for safety must be considered to ensure that any LD Bank failure does not cause any injuries to the human body and/or damage to property.

The LD Bank can fail at a certain rate. The failure rate and/or failure mode of the LD can vary depending on several factors (e.g. circuit, environmental conditions, etc.). In order to maintain the reliability of the LD Bank, the following issues must be considered when using it.

(1) Laser Hazard

- This LD Bank is a laser diode classified as Class 4 per JIS C 6802, IEC 60825-1, and FDA/CDRH 21 CFR Part 1040.10; this is the most hazardous class. Ensure that the latest editions of IEC 60825-1 and/or applicable standards for general safety requirements and guidance for laser products are complied with.
- There is a risk of serious injury to the skin/eyes if they are exposed to the LD light. Even diffused/reflected light is harmful. It must be ensured that the maximum permissible exposure is not exceeded; use proper safety glasses for the wavelength and optical output power of the LD.
- The LD Bank emits collimated light. Collimated light propagates over a long distance while maintaining a high energy density; the skin/eyes must not be exposed to the light.



(2) Storage

- To avoid condensation, the LD Banks must not be stored in areas where temperature and humidity fluctuate greatly both before and after opening the antistatic, moisture-proof bag. The LD Banks must be stored under an environment of 5-35°C, 40-75% RH.
- The LD Bank has plated parts. If the LD Banks are exposed to a corrosive environment, it may cause the plated surface to tarnish causing issues (e.g. electric connection failures). Once the antistatic, moisture-proof bag is opened, ensure that the LD Banks are assembled into the chosen application/heatsink immediately; if they are not used immediately, they must be stored in a hermetically sealed container (e.g. the original antistatic, moisture-proof bag).
- Do not store the LD Banks in a dusty environment.
- Do not expose the LD Banks to direct sunlight and/or an environment over a long period of time where the temperature is higher than normal room temperature.
- Ensure that the LD Banks are stored under conditions/environments detailed above and assembled into the chosen application/heatsink within a year of the receipt of the LD Bank.

(3) Design Consideration

- Since the lifetime of the LD will become shorter as the operating current and/or the optical output power becomes larger, the LD Banks should be operated within the conditions as detailed in (1) Rated Conditions in the SPECIFICATION section.
- The LD Bank is a semiconductor device that has a high current density during operation in the emission layer. Exceeding the Absolute Maximum Ratings may damage the LD. The circuit must be designed to ensure that the Absolute Maximum Ratings are not exceeded even if the LD Banks are operated only for a short period of time.
- The LD Banks should be operated in an automatic current control (ACC) circuit. Additionally, the circuit to operate the LD Banks should be designed taking into consideration the current rise time. If no measures are incorporated into the circuit and the current rise time is too short, even though there seems to be no issues (e.g. inrush current, etc.) with the waveform of the current when observed with an oscilloscope, it may cause the LDs to emit excessive light resulting in it being damaged.
- When the LD Bank is operated in ACC mode, if it is operated at a higher operating LD plate temperature (T_m), the optical output power of the LD Bank will become lower and the lifetime of the LD Bank will become shorter; ensure that the thermal design of the chosen application is appropriate for the required heat dissipation performance.
- The forward voltage (V_F) and the optical output power vary depending on the operating LD plate temperature (T_m). Additionally, the optical output power will gradually decrease over time as the operating time increases. To stabilize the optical output power, an automatic power control (APC) system could be used; in this system, the operating current is automatically adjusted by monitoring the feedback from the photo diode incorporated in the chosen application. If the LD Bank is operated in APC mode, it will be the customer's responsibility to perform sufficient verification prior to use to ensure that there are no issues.
- When the power supply is turned on or off, the circuit may have issues (e.g. chattering, current spikes, inrush current, etc.) resulting in the Absolute Maximum Rating Current being exceeded. The circuit must be designed to prevent this from occurring.
- The failure modes for the LD Banks can be either a short circuit or an open circuit and this is very important to understand when designing the circuit. If the LDs become short-circuited during operation, the forward voltage (V_F) may fluctuate resulting in damage to the circuit. To ensure that there are no issues with the designed circuit when these failure modes occur in the LD Banks, perform a sufficient verification prior to use. This verification should be performed taking into consideration the conditions/environments in which the end-product containing the LD Banks will actually be used.
- Depending on the environment where the LD Banks are operated, dust/particles may be attracted by the light of the LD Banks (i.e. optical dust collection effect) and adhere to the surfaces of the collimator lenses, resulting in an adverse effect on the optical characteristics.

(4) Handling Precautions

- The LD Bank is hermetically sealed; ensure that excessive force is not applied to the lead, the cap, and/or the collimator lens of the LD when handling the LD Banks. If the collimator lens and/or the sealing glass at the base of the lead is damaged, the hermetic seal for the LD bank may fail causing reduction in the optical output power and/or change in the shape of the beam to be accelerated and eventually the LD Bank not to illuminate. Note that if the LD Bank is dropped, it may also break the hermetic seal for the LD Bank.
- Ensure that excessive force is not applied to the LD plate. Otherwise, it may cause the LD plate to be deformed and/or damaged resulting in the characteristics of the LD Bank not to meet the specification.
- Do not solder the LD plate directly to a heatsink.
- The pull and push force applied to the lead of the LD must be $\leq 5N$.
- When bending the lead, securely hold the lead on the side closer to the bottom of the stem from where the bending occurs in order to reduce the load that is applied to the base of the lead. Bending must be done only once.
Maximum Bending Angle: 90°
Bending location: No closer than 2mm from the base of the lead.

(5) Soldering

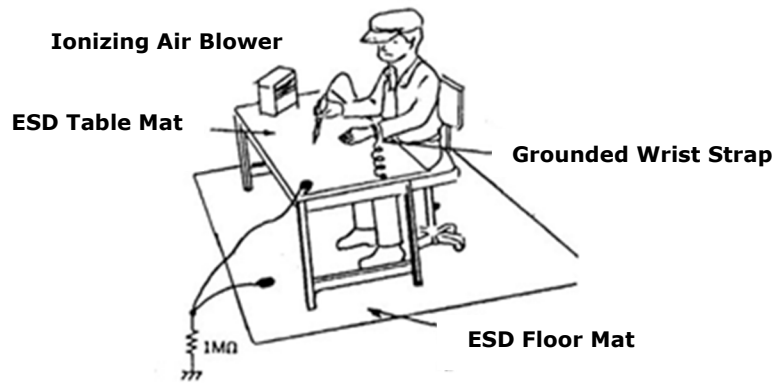
- The LD Bank is designed to be hand soldered. If reflow soldered, Nichia will not guarantee the reliability of the LD Banks.
- Ensure that the hand soldering is done under the conditions below:
Soldering temperature: $\leq 350^\circ C$, ≤ 3 sec
Soldering location: 2mm from the base of the lead
- Ensure that the tip of the soldering iron does not touch the sealing glass at the base of the lead.
- Ensure that solder does not attach to the sealing glass at the base of the lead.

(6) Shape of the Beam

- This LD emits elliptical-shaped parallel light through a collimator lens. Adjust the shape of the beam emitted from the LD with a lens that is suitable for the chosen application when using the LD Bank.
- Ensure that the collimator lens of the LD is not damaged/contaminated when handling the LD Bank. Otherwise, this may reduce the optical output power of the LD and/or change the shape of the beam emitted from the LD.

(7) Electrostatic Discharges (ESD) and Electrical Surges

- The LD Bank is sensitive to transient excessive voltages (e.g. ESD, lightning surge). If this excessive voltage occurs in the circuit, it may cause the LD to be damaged causing issues (e.g. the LD to become dimmer or not to illuminate). Ensure that when handling the LD Banks, necessary measures are taken to protect them from ESD. The following examples are recommended measures to eliminate the charge:
 - Wearing antistatic clothes, gloves, shoes, etc.
 - Grounded wrist straps with a $1M\Omega$ resistor
 - Grounded workstation equipment and tools
 - Using the original antistatic shipping tray for transport/storage
- Ensure that all necessary measures are taken to prevent the LD Banks from being exposed to transient excessive voltages (e.g. ESD, lightning surge):
 - tools, jigs, and machines that are used are properly grounded
 - appropriate antistatic materials/equipment are used in the work area
 - the system/assembly is designed to provide ESD protection for the LDs against transient excessive voltages
- Grounding insulators neither removes nor prevents surface charges. If the tool/equipment used is an insulator (e.g. glass cover, plastic, etc.), ensure that necessary measures have been taken to protect the LD Bank from transient excessive voltages (e.g. ESD). The following examples are recommended measures to eliminate the charge:
 - Dissipating static charge with conductive materials
 - Preventing charge generation with moisture
 - Neutralizing the charge with ionizers
- In work environments with a RH of $\leq 40\%$, ESD events are more likely to occur. When handling/assembling the LD Banks, it should be performed in an environment with the proper humidity level.
- Do not connect/disconnect any devices (e.g. oscilloscope probes, voltage meter cables, etc.) while the LD Banks are energized. Otherwise, this may cause an electrical surge resulting in the LD Banks being damaged.
- High-frequency noises could induce a surge into the circuit, causing an excessive current to flow. Do not use the LD Banks near devices that produce high-frequency noises (e.g. glow discharge tube, etc.).



(8) Thermal Management

- The temperature of the LD Banks while in operation may vary depending on the thermal resistance of the heatsink and other materials (e.g. thermal interface materials, etc.), the condition of the contact surface of the heatsink (e.g. holes/opening, cavities/recesses, foreign materials, etc.), and how the LD Banks are attached to the heatsink (e.g. with/without grease, etc.). Once the heatsink and other materials are selected, sufficient verification should be performed to ensure that adequate adhesion is achieved and that the Absolute Maximum Operating LD Plate Temperature (T_m) is not exceeded.
- When thermal grease is used, ensure that it does not adversely affect the electrical characteristics of the LD Bank and that the volatile compounds from the grease do not have an effect on the optical characteristics.

LIMITED WARRANTY

- Nichia warrants that the LD Banks will meet the requirements/criteria as detailed in the RELIABILITY section within this specification. If the LD Banks 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 quality of the LD Banks that are manufactured and/or supplied by Nichia will be as detailed within this specification; it is the customer's responsibility to perform a sufficient verification prior to use to ensure that the lifetime and other quality characteristics required for the intended use are met.]
- This LD Bank is intended to be used for household appliances and electronic devices (e.g. mobile communication devices) laser diodes have been used in; it is not designed or manufactured for use in applications that require safety critical functions (e.g. automobiles, trains, vessels, aircraft, spacecraft, submarine repeaters, nuclear reactor control systems, traffic control equipment, combustion equipment, life support systems, safety devices, etc.). If the LD Banks are planned to be used for these applications, unless otherwise detailed in the specification, Nichia will neither guarantee that the LD Bank is fit for that purpose nor be responsible for any resulting property damage, injuries and/or loss of life/health. This LD Bank does not comply with IATF 16949 and is not intended for automotive applications.
- The applicable warranty period is one year from the date that the LD Bank is delivered.

RETURN POLICY FOR NON-CONFORMING LD BANKS

In the event that the LD Bank is found not to conform to the foregoing specifications within a year of the receipt of the LD Bank, Nichia will be subject to the procedure set forth below:

- Nichia will provide the replacement for the non-conforming LD Bank or an equivalent item, or refund at Nichia's discretion, provided that the customer
 - (1) promptly notifies Nichia in writing of the details of the non-conformity,
 - (2) ships the non-conforming LD Bank at the customer's expense to Nichia for examination, and
 - (3) the non-conformity is specifically attributable to Nichia and not due to mishandling or misuse by the customer.
- Once Nichia has received both information and the non-conforming LD pursuant to item (2) of the foregoing clause, Nichia will conduct a thorough investigation to provide the customer with feedback.
- THE REMEDIES PROVIDED IN CLAUSE 1 OF THIS SECTION 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.

MISCELLANEOUS

- The Customer must perform a receiving inspection within two weeks of the receipt of the LD Bank.
- Without prior written permission from Nichia, the customer will not reverse engineer, disassemble or otherwise attempt to extract knowledge/design information from the LD Bank. In the case of any incident that appears not to conform to the foregoing specifications, the local Nichia sales representative should be notified to discuss instructions on how to proceed while ensuring that the LD Bank in question are not disassembled.
- 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 LD Banks 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 LD Banks, etc.).