

CW quantum cascade laser

L12004/L12005/L12006 series (with lens)

DFB-CW drive type quantum cascade laser with lens

It is a DFB-CW drive type quantum cascade laser (QCL) with a collimation lens built into the airtight package (HHL package). Lens alignment of invisible mid-infrared laser light is no longer required, and ease of use has been improved. By controlling the temperature with the built-in TE-cooler in the HHL package, it is possible to sweep the emission wavelength without mode hopping while maintaining the single mode operation.

Features

- **Light output: 20 mW min.**
- **Threshold current: 1 A max.**
- **Emission wavelength**
L12004 series: 4 μm band
L12005 series: 5 μm band
L12006 series: 6 μm band

Applications

- **Extremely trace gas analysis**
L12004-2190H-E: N₂O, CO
L12004-2310H-E: CO₂, CO₂ isotope
L12005-1900H-E: NO
L12006-1631H-E: NO₂

Absolute maximum ratings (T_{QCL}=20 °C excluding temperature section)

Type no.	Forward current*1 I _F (A)	Forward voltage*1 V _F (V)	Reverse voltage*1 V _R (V)	Current rise time*2 t _r (μs)	Current fall time*3 t _f (μs)	TE-cooler current (cooling mode)*4 I _c (A)	TE-cooler current (heating mode)*4 I _c (A)	TE-cooler voltage V _c (V)	Operating temperature (case)*5 *6 T _{case} (°C)	Operating temperature (QCL)*7 T _{QCL} (°C)	Operating temperature (QCL) Lifting speed*8 (°C/min)	Storage temperature T _{stg} *5 (°C)
L12004-2190H-E L12004-2310H-E L12005-1900H-E L12006-1631H-E	Because there are individual differences, refer to the inspection report attached to a product*9		0.0	>400	>400	+3.7	-1.5	±13.0	+10 to +60	+5 to +55	10	-20 to +65

*1: There is a risk of damage to the characteristics due to surges or unstable currents. Do not apply reverse current or reverse voltage.

*2: The time it takes for the forward current to increase from 0% to 90% of the maximum value (I_F max). If the forward current is increased from 0% to 90% of the maximum value (I_F max) at 400 μs or less, there is a risk of characteristic damage.

*3: The time it takes for the forward current to decrease from 90% to 0% of the maximum value (I_F max). If the forward current is decreased from 90% to 0% of the maximum value (I_F max) at 400 μs or less, there is a risk of characteristic damage.

*4: The operation of this product in the state of insufficient heat dissipation may lead to overheating, deterioration, disconnection, etc. even at currents below the maximum rating value of the TE-cooler current (I_c). Especially when energizing the electronic cooling element in the heating mode, the heat dissipation on the laser side is insufficient, which may affect the failure or reliability, so please use it after sufficient verification.

*5: No dew condensation

When there is a temperature difference between a product and the surrounding area in high humidity environments, dew condensation may occur on the product surface. Dew condensation on the product may cause deterioration in characteristics and reliability.

*6: Package temperature monitored by a built-in thermistor

*7: Laser (QCL) element temperature monitored by a built-in thermistor

*8: The speed at which the operating temperature of the QCL is raised or lowered, controlled by the built-in electronic cooling element.

*9: The drive current capabilities must be I_F ≥ 1.3 A, V_F ≥ 16 V.

Note: Exceeding the absolute maximum ratings even momentarily may cause a drop in product quality. Always be sure to use the product within the absolute maximum ratings.

Use drive power supply with output current > 1.3 A, output voltage > 16 V, surge measure, constant current control function.

Electrical and optical characteristics (laser)

Type no.	Emission wavenumber (emission wavelength) ^{*10} K	Spectral linewidth ^{*11} ΔK_L	Wavenumber sweep range current tuning ^{*12 *13} ΔK_c	Wavenumber sweep range temperature tuning ^{*12 *14} ΔK_T	Light output ϕ_e	Threshold current ^{*15} I_{th}	Side mode suppression ratio ^{*15} SMSR	Current tuning coefficient ^{*16} δK_c	Temperature tuning coefficient ^{*17} δK_T
	Typ. (cm^{-1})	Max. (cm^{-1})	Min. (cm^{-1})	Min. (cm^{-1})	Min. (mW)	Max. (A)	Min. (dB)	Typ. (cm^{-1}/mA)	Typ. ($\text{cm}^{-1}/^\circ\text{C}$)
L12004-2190H-E	2190 (4.57 μm)	0.2 ^{*18}	± 0.5	± 1.0	20	1.0	25 ^{*18}	-0.015	-0.18
L12004-2310H-E	2310 (4.33 μm)							-0.017	-0.18
L12005-1900H-E	1900 (5.26 μm)							-0.016	-0.14
L12006-1631H-E	1631 (6.13 μm)							-0.015	-0.15

*10: $T_{QCL} = +10$ to $+50$ °C

*11: FWHM The center wavenumber is the emission wavenumber (K)

*12: The wavelength sweep range indicates a range of wavenumber that can be continuously varied. The center wavenumber of the variable range is the emission wavenumber (K).

*13: Current tuning: When the forward current (I_F) is changed in the range of $I_{th} < I_F < I_{F \text{ max}}$ at the operating temperature range of $T_{QCL} = +10$ to $+50$ °C.

*14: Temperature tuning is when the forward current (I_F) is changed in the range of $I_{th} < I_F < I_{F \text{ max}}$ at the operating temperature $T_{QCL} = 10$ to 50 °C.

*15: $T_{QCL} = 20$ °C

*16: $T_{QCL} = \text{constant}$

*17: $I_F = \text{constant}$

*18: Limited by resolution and S/N of measurement and inspection equipment

Electrical characteristics (TE-cooler and thermistors)

Type no.	Thermoelectric cooler		Thermistor	
	Maximum temperature difference ^{*19} ΔT_{max} (°C)	Maximum heat absorption ^{*20} $Q_{c \text{ max}}$ (W)	R25 resistance R25 T=25 °C	Beta value B 0 °C/100 °C
L12004-2190H-E	>40	>18	10 k Ω $\pm$ 2.5 %	3450 K
L12004-2310H-E				
L12005-1900H-E				
L12006-1631H-E				

*19: $T_h = 27$ °C, in N_2 , $Q_c = 0$, $I_c = +3.7$ A

*20: $T_h = 27$ °C, in N_2 , $I_c = +3.7$ A, $\Delta T = 0$

Note: ΔT : Temperature difference between the high-temperature side surface and the low-temperature side surface of the TE-cooler

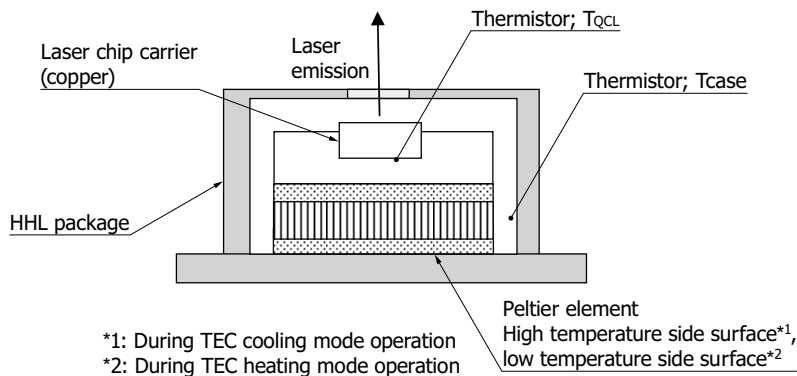
Q_c : Heat absorption

I_c : TE-cooler current

T_h : Temperature of the high-temperature side surface of the TE-cooler (TEC cooling mode)

The thermistor built-in is the same specification

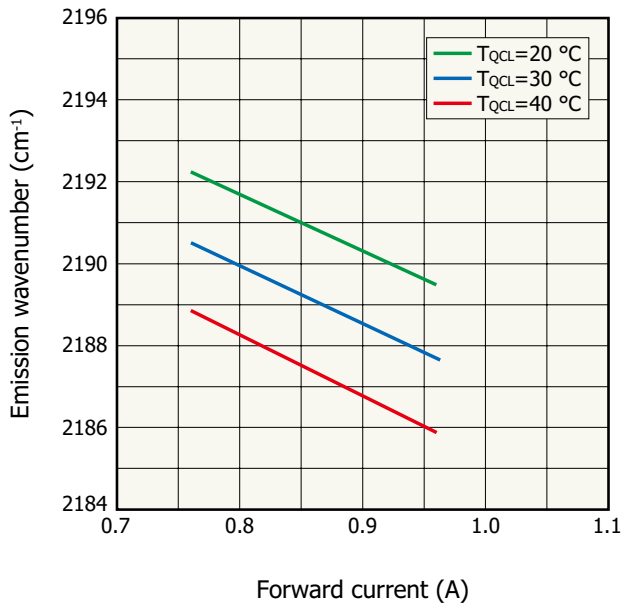
Thermistor placement (schematic diagram)



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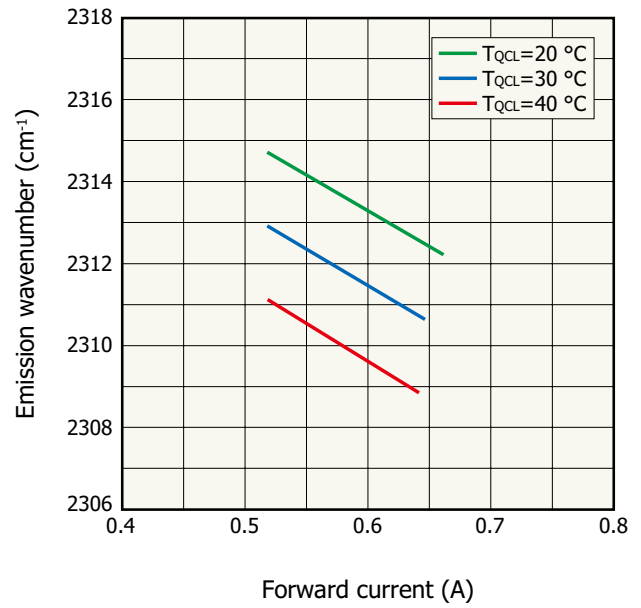
❑ Emission wavenumber vs. forward current (typical example)

L12004-2190H-E



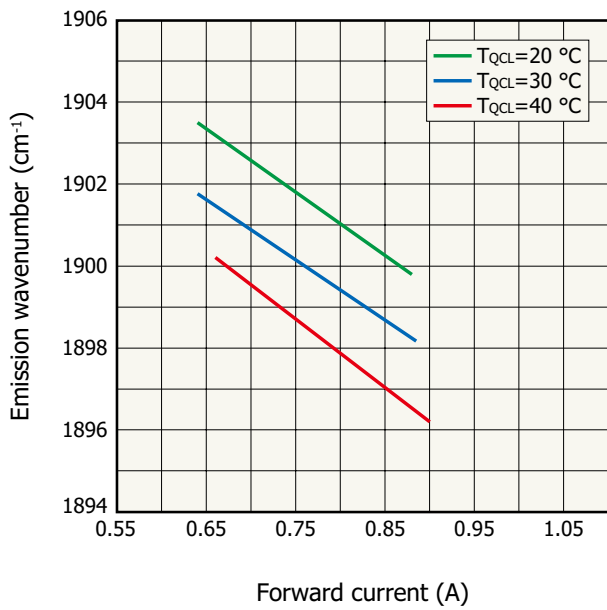
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L12004-2310H-E



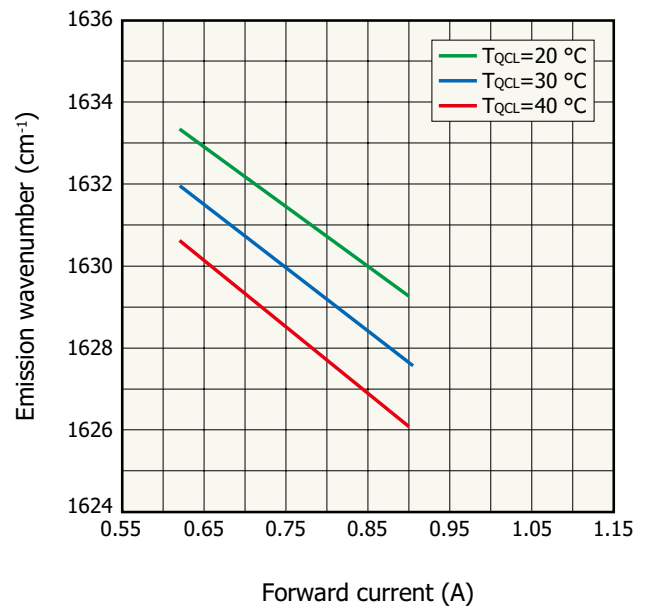
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L12005-1900H-E



KLDB0031EA

L12006-1631H-E



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Window material

Type no.	Material	Dimensions		Anti-reflection film	Coating	
		Aperture diameter*21 (mm)	thickness (mm)		Bandwidth (cm ⁻¹)	Transmittance*22 (%)
L12004-2190H-E	ZnSe, parallel plate	φ4.4	0.7	Double-sided AR coating	2200 to 2180	>99
L12004-2310H-E					2320 to 2300	
L12005-1900H-E					1910 to 1890	
L12006-1631H-E					1641 to 1621	

*21: Aperture diameter of the laser emission part of the package

*22: Average transmittance in band

Beam characteristics (T_{QCL}=20 °C)

Type no.	Beam spread angle*23 θ			Beam waist position*24 Z _{wo}		Beam waist diameter*25 W _o		
	Min. (mrad)	Typ. (mrad)	Max. (mrad)	Min. (mm)	Max. (mm)	Min. (mm)	Typ. (mm)	Max. (mm)
L12004-2190H-E	0	3	5	50	1000	0.5	1.5	3.0
L12004-2310H-E								
L12005-1900H-E								
L12006-1631H-E								

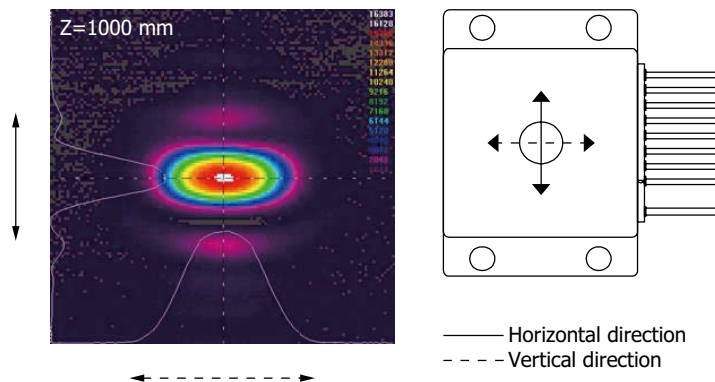
*23: The half-angle of the beam either vertically (perpendicular to the pin) or horizontally (horizontal to the pin), whichever is wider. See P6 beam profile.

*24: From the top of the package.

*25: 1/e² diameter

Note: This value varies from product to product, so check the inspection report attached to the product.

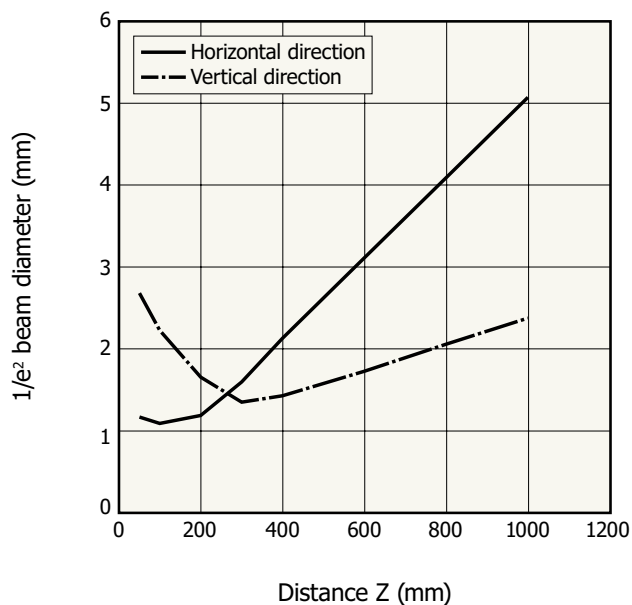
Beam profile (typical example)



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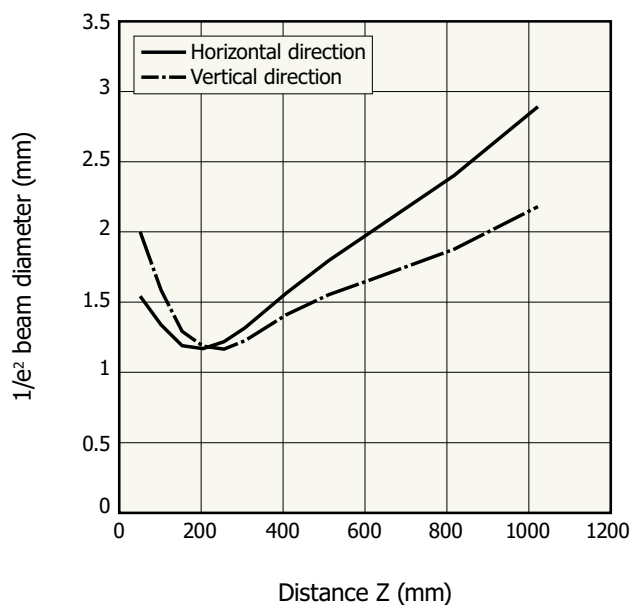
Beam diameter characteristics (typical example)

L12004-2190H-E



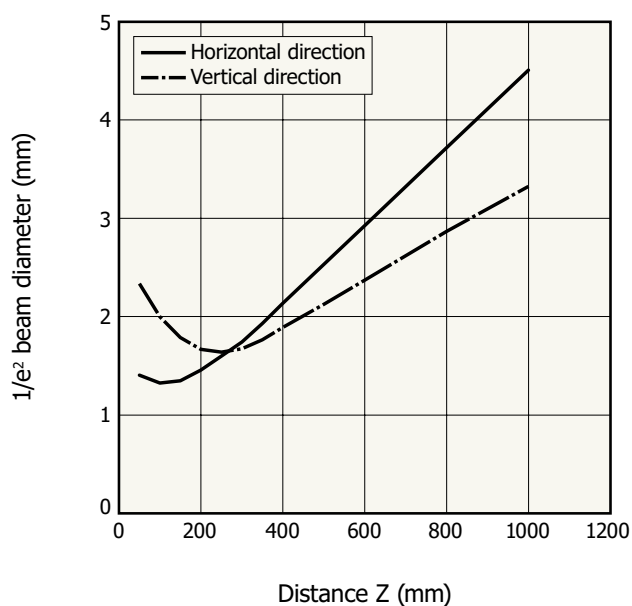
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L12004-2310H-E



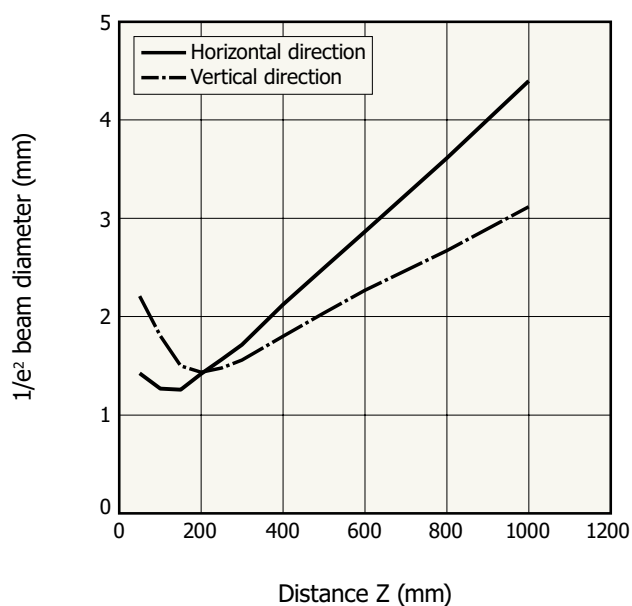
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L12005-1900H-E



KLD80047EA

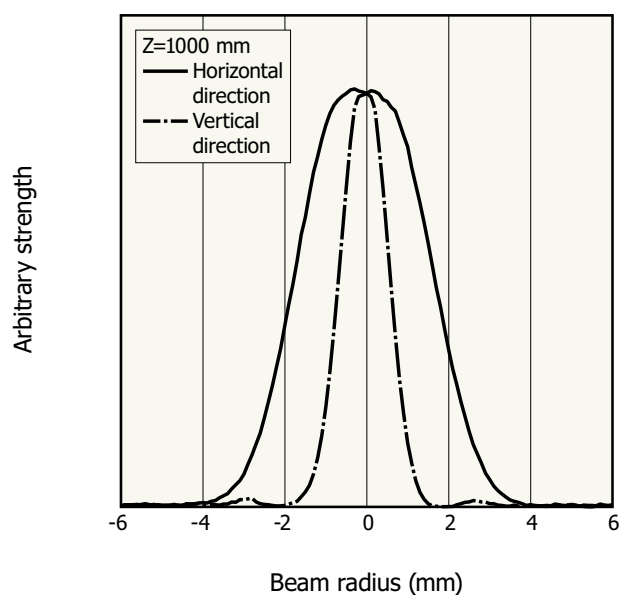
L12006-1631H-E



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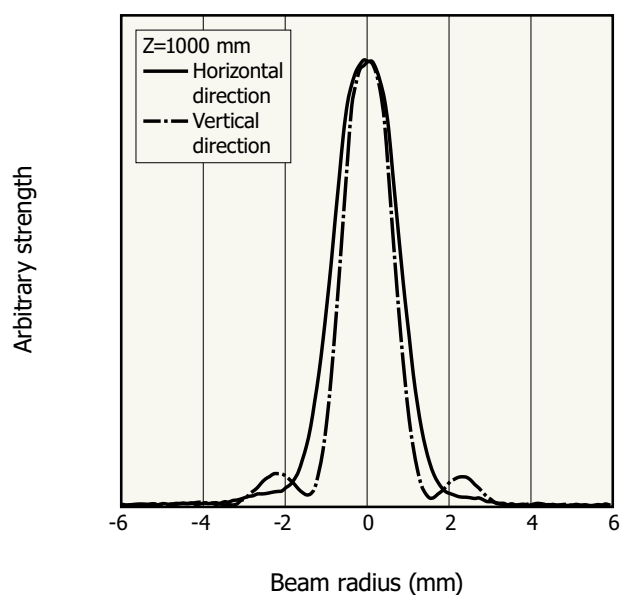
Beam intensity distribution (typical example)

L12004-2190H-E



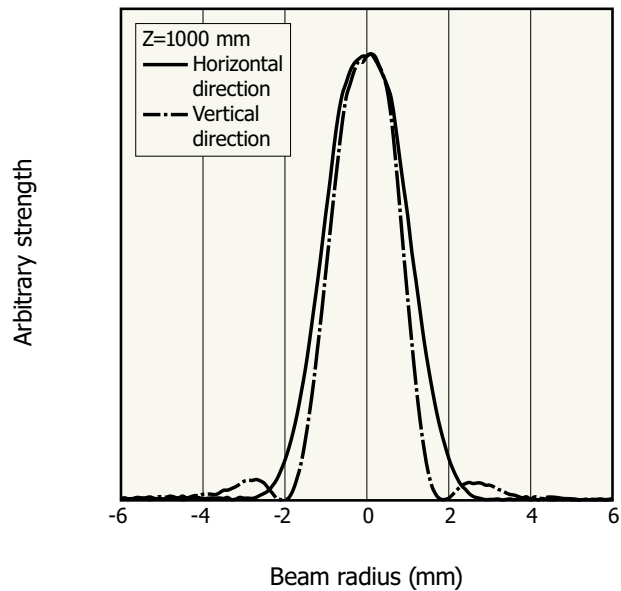
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L12004-2310H-E



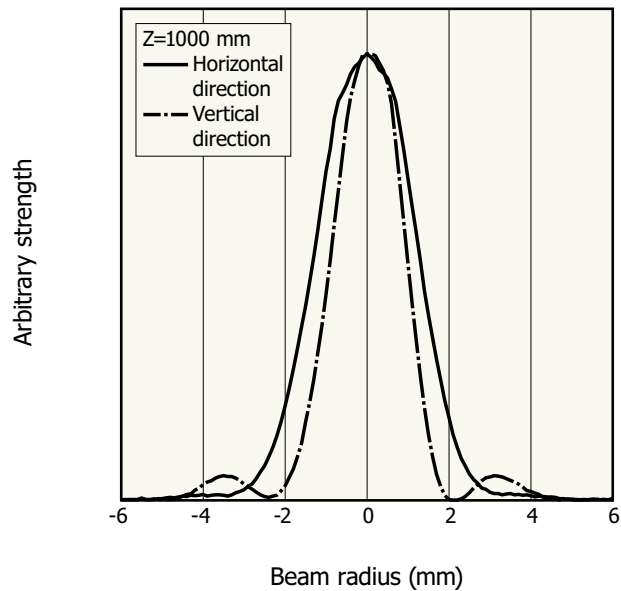
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L12005-1900H-E



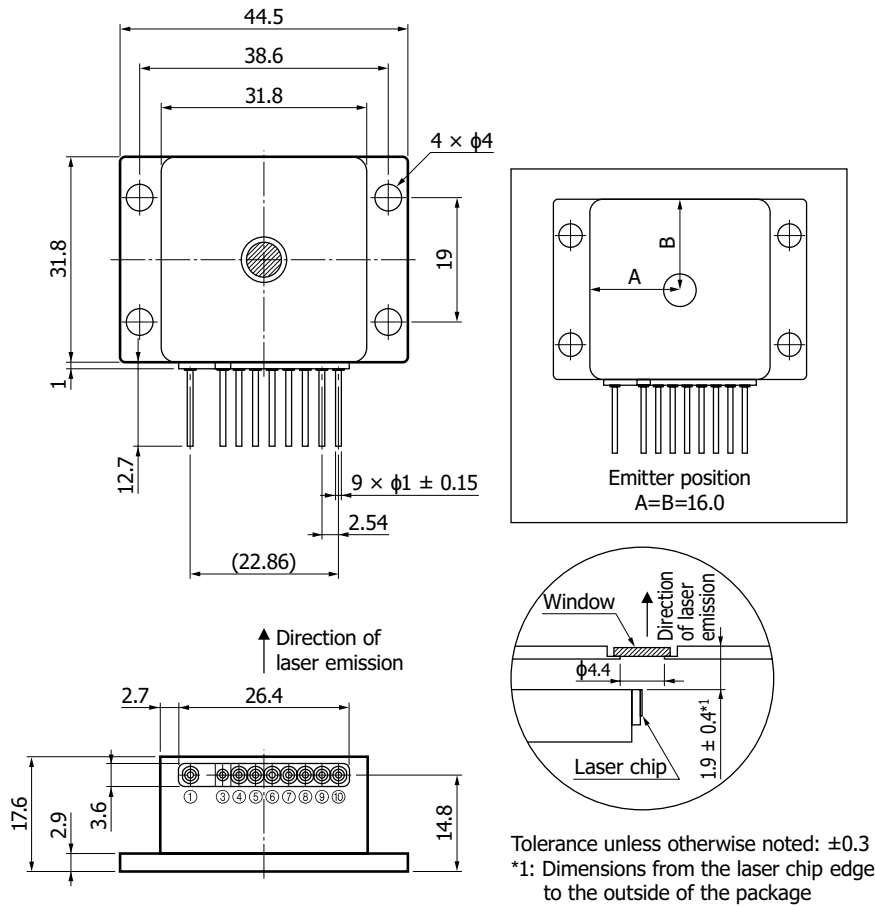
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L12006-1631H-E



KLD80052EA

Dimensional outline (unit: mm)



Pin No.*2	Function	Pin No.*2	Function
①	TEC cathode (-)	⑦	QCL cathode (-)
③	N.C. (case)	⑧	Thermistor (Tcase)
④	QCL anode (+)	⑨	Thermistor (Tcase)
⑤	Thermistor (TQCL)	⑩	TEC anode (+)
⑥	Thermistor (TQCL)	—	—

*2: ③ pin is electrically connected to the case of the package.
Other pins are electrically isolated from the case of the package.

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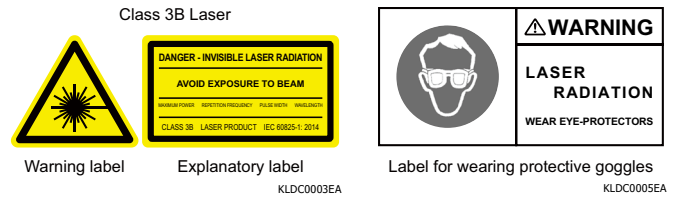
Note: Do not solder to the electrode terminal, connect it with a socket. Refer to [A11134-07](#) for socket details.

Warning (Class 3B laser)
Invisible laser emission: Avoid exposure to the beam

This product falls under the "Class 3B laser" in the classification of laser products according to IEC 60825-01. The laser light emitted by this product is an invisible laser light that cannot be seen by the naked eye. Observing the laser light directly is dangerous, and you should also avoid direct exposure to the skin. In addition, some conditions may cause skin damage or flammable substances to ignite.

When using equipment incorporating this product, please classify it according to IEC 60825-01.

Note: For more detailed information, please see [IEC 60825-1:2014].



Precautions

(1) Electrostatic countermeasures

To prevent damage due to static electricity, take electrostatic countermeasures such as grounding of workers, work benches, and work tools. For details, please refer to the related information "Precautions / Compound opto-semiconductors (photosensors, light emitters)". Also protect this device from surge voltages which might be caused by peripheral equipment.

(2) Reflected light

The product will be destroyed if it is irradiated with laser light, such as by regular reflection. When using this product, use extra caution to avoid irradiation of reflected light.

Related information

www.hamamatsu.com/sp/ssd/doc_en.html

■ Precautions

- Disclaimer
- Safety consideration / Opto-semiconductor products
- Precautions / Compound opto-semiconductors (photosensors, light emitters)

■ Catalog

- [Accessories for quantum cascade laser \(QCL\)](#)

The content of this document is current as of April 2025.

Product specifications are subject to change without prior notice due to improvements or other reasons. This document has been carefully prepared and the information contained is believed to be accurate. In rare cases, however, there may be inaccuracies such as text errors. Before using these products, always contact us for the delivery specification sheet to check the latest specifications.

The product warranty is valid for one year after delivery and is limited to product repair or replacement for defects discovered and reported to us within that one year period. However, even if within the warranty period we accept absolutely no liability for any loss caused by natural disasters or improper product use. Copying or reprinting the contents described in this material in whole or in part is prohibited without our prior permission.

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