HAMAMATSU
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CW quantum cascade laser

L12004/L12005/L12006/L12007 series

DFB-CW drive type quantum cascade laser

A quantum cascade laser (QCL) employing SPC (single photon-continuum) and DFB (distributed feedback) structures, enables single-mode emission with continuous operation at room temperature. By controlling the temperature with the built-in TE-cooler in the HHL package, the QCL 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
  L12007 series: 7 µm band

Applications

- **Extremely trace gas analysis**
  L12004-2190H-C: N_2O, CO
  L12004-2290H-C: N_2O
  L12004-2310H-C: CO_2, CO_2 isotope
  L12005-1900H-C: NO
  L12006-1631H-C: NO_2
  L12007-1294H-C: CH_4
  L12007-1354H-C: SO_2
  L12007-1392H-C: SO_3

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 tr (µs)	Current fall time*3 tf (µs)	TE-cooler current (cooling mode)*4 Ic (A)	TE-cooler current (heating mode)*4 Ic (A)	TE-cooler voltage Vc (V)	Operating temperature (case)*5 *6 Tcase (°C)	Operating temperature (QCL)*7 T_{QCL} (°C)	Operating temperature (QCL) Lifting speed*8 (°C/min)	Storage temperature Tstg*5 (°C)
L12004-2190H-C	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
L12004-2209H-C												
L12004-2310H-C												
L12005-1900H-C												
L12006-1631H-C												
L12007-1294H-C												
L12007-1354H-C												
L12007-1392H-C												

*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 (IF 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 (Ic). Especially when energizing the TE-cooler 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 TE-cooler.
*9: The drive current capabilities must be $I_F \geq 1.3$ A, $V_F \geq 16$ 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 ΔKL	Wavenumber sweep range*12 ΔK	Light output ϕe	Threshold current*13 Ith	Side mode suppression ratio *13 SMSR	Current tuning coefficient*14 δKc	Temperature tuning coefficient*15 δKT
	Typ. (cm^{-1})	Max. (cm^{-1})	Min. (cm^{-1})	Min. (mW)	Max. (A)	Min. (dB)	Typ. (cm^{-1}/mA)	Typ. (cm^{-1}/°C)
L12004-2190H-C	2190 (4.57 μm)	0.2*16	±1.0	20	1.0	25*16	-0.015	-0.18
L12004-2209H-C	2209 (4.53 μm)						-0.015	-0.18
L12004-2310H-C	2310 (4.33 μm)						-0.017	-0.18
L12005-1900H-C	1900 (5.26 μm)						-0.016	-0.14
L12006-1631H-C	1631 (6.13 μm)						-0.015	-0.15
L12007-1294H-C	1294 (7.73 μm)						-0.01	-0.1
L12007-1354H-C	1354 (7.39 μm)						-0.01	-0.13
L12007-1392H-C	1392 (7.18 μm)						-0.01	-0.13

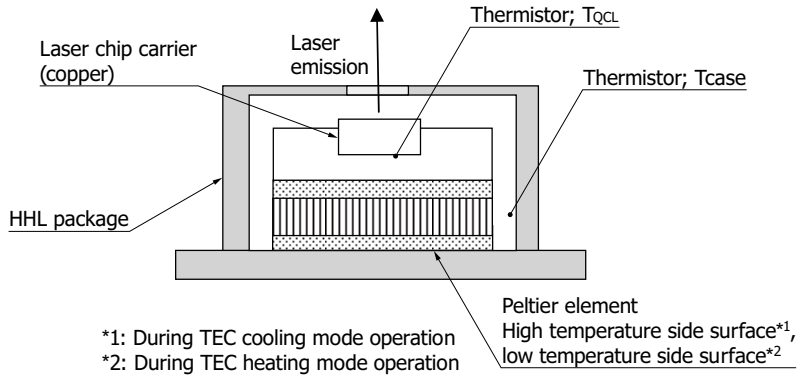
*10: T_{QCL}=+10 to +50 °C
*11: FWHM The center wavenumber is the emission wavenumber (K)
*12: The wavelength sweep range indicates a range of wavenumber that can be continuously varied. The center wavenumber of the variable range is the emission wavenumber (K).
*13: T_{QCL}=20 °C
*14: T_{QCL}=constant
*15: I_F=constant
*16: 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*17 ΔTmax (°C)	Maximum heat absorption*18 Qcmax (W)	R25 resistance R25 T=25 °C	Beta value B 0 °C/100 °C
L12004-2190H-C	>40	>18	10 kΩ ± 2.5 %	3450 K
L12004-2209H-C				
L12004-2310H-C				
L12005-1900H-C				
L12006-1631H-C				
L12007-1294H-C				
L12007-1354H-C				
L12007-1392H-C				

*17: Th=27 °C, in N_2, Qc=0, Ic=+3.7 A
*18: Th=27 °C, in N_2, Ic=+3.7 A, ΔT=0
Note: ΔT: Temperature difference between the high-temperature side surface and the low-temperature side surface of the TE-cooler
Qc: Heat absorption
Ic : TE-cooler current
Th: Temperature of the high-temperature side surface of the TE-cooler (TEC cooling mode)
The thermistor built-in is the same specification

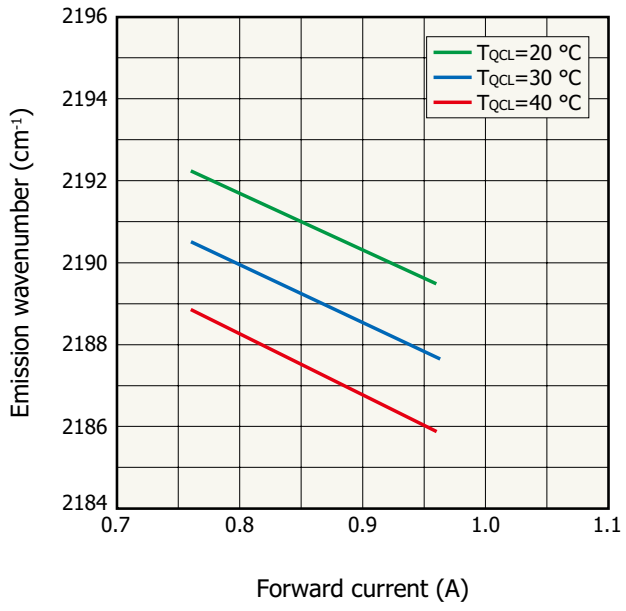
Thermistor placement (schematic diagram)



*1: During TEC cooling mode operation
*2: During TEC heating mode operation

Emission wavenumber vs. forward current (typical example)

L12004-2190H-C



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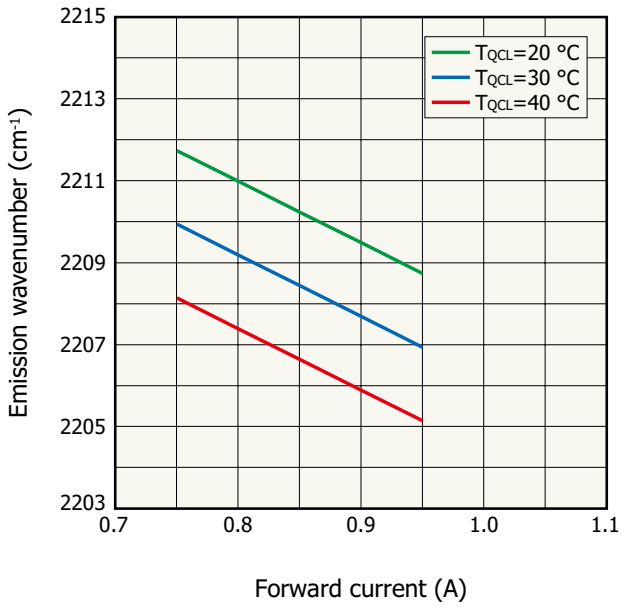
L12004-2209H-C



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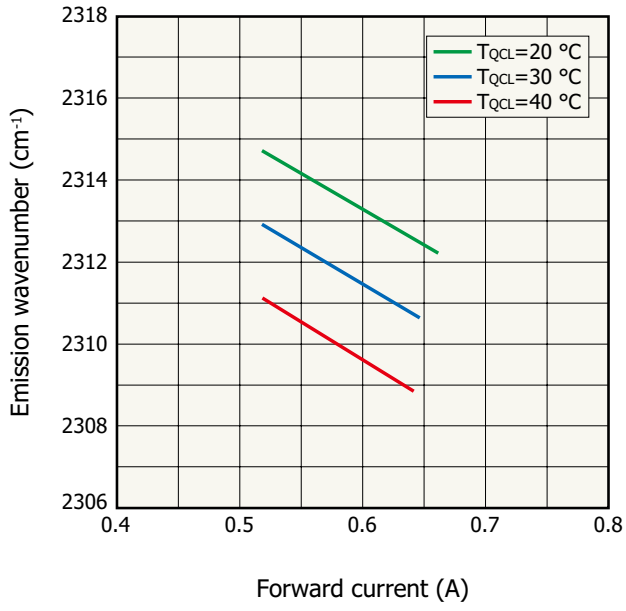
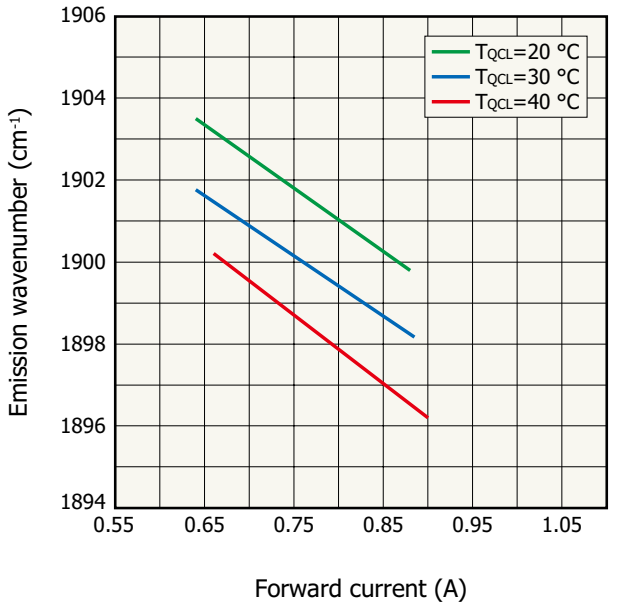
L12004-2310H-C



KLDB0030EA

L12005-1900H-C



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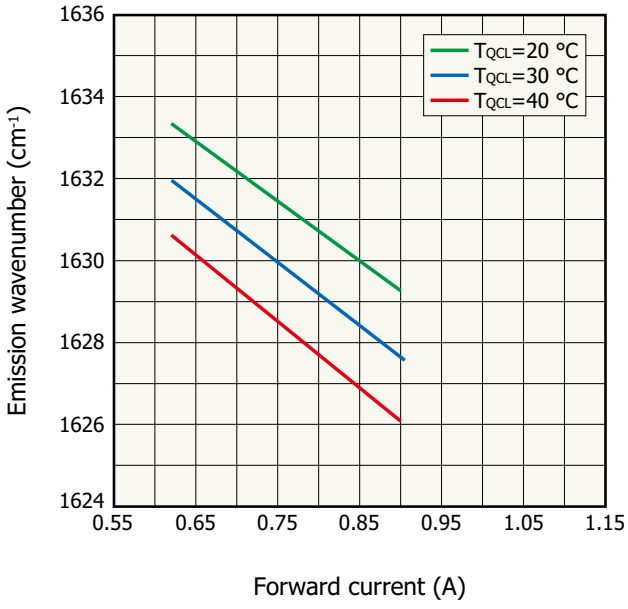
L12006-1631H-C



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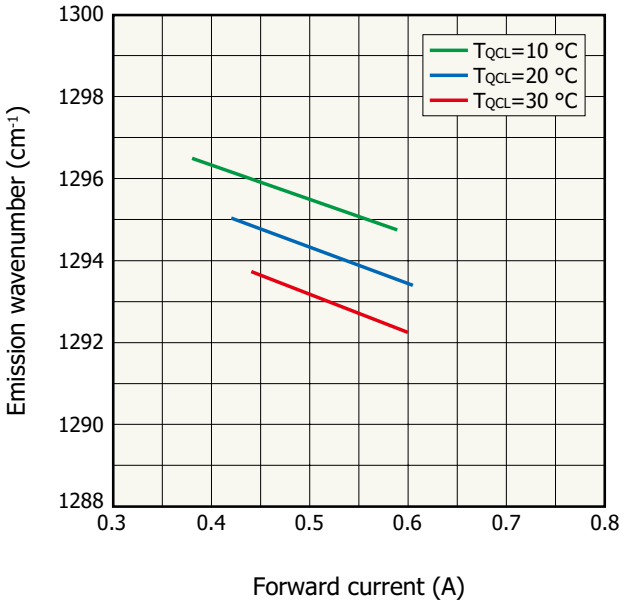
L12007-1294H-C



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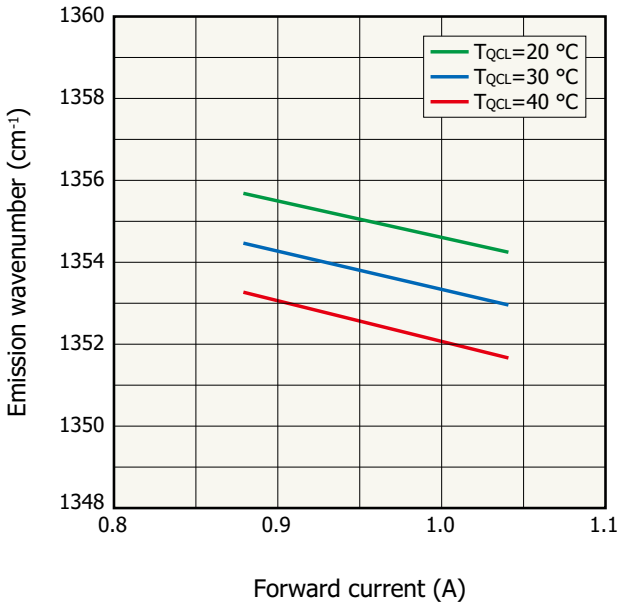
L12007-1354H-C



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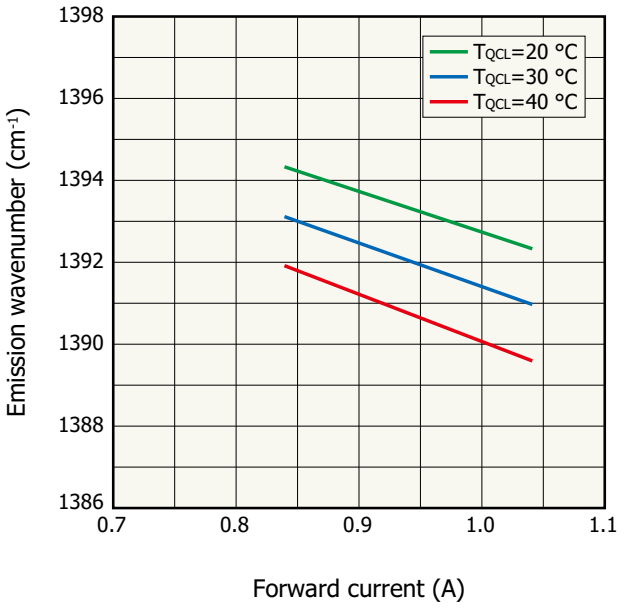
L12007-1392H-C



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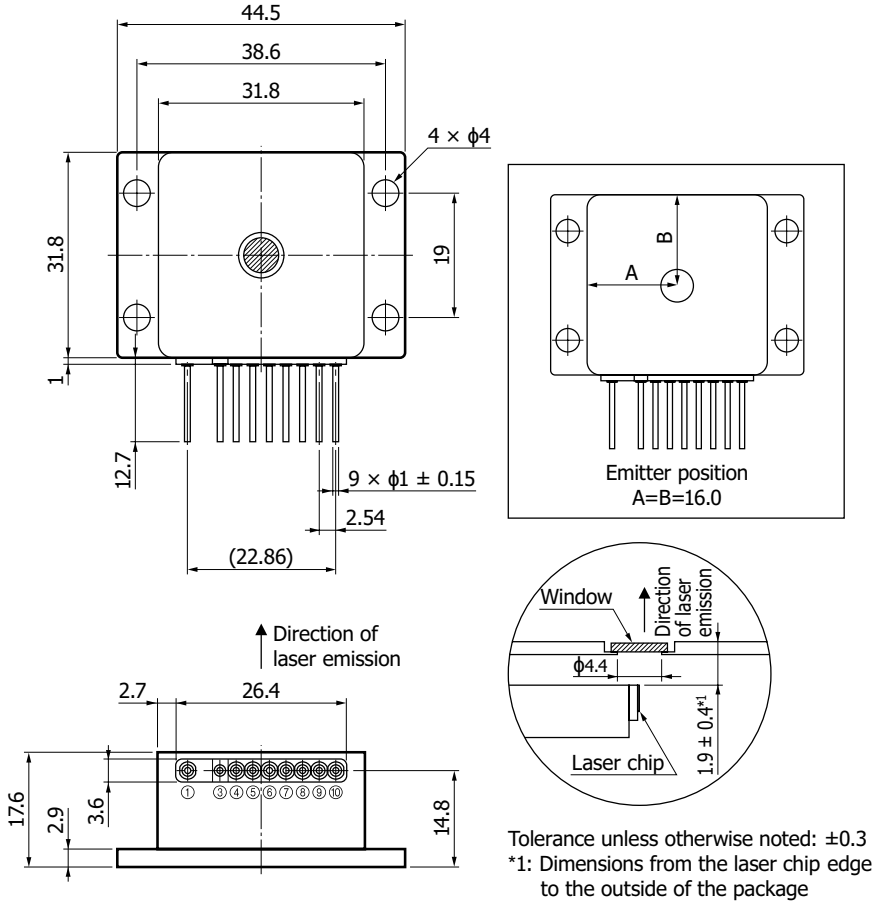
Window material

Type no.	Material	Dimensions		Coating		
		Apertureg diameter*19 (mm)	thickness (mm)	Anti-reflection film	Bandwidth (cm^{-1})	Transmittance*20 (%)
L12004-2190H-C	ZnSe, parallel plate	ϕ4.4	0.7	Double-sided AR coating	2500 to 1250	>96
L12004-2209H-C						
L12004-2310H-C						
L12005-1900H-C						
L12006-1631H-C						
L12007-1294H-C						
L12007-1354H-C						
L12007-1392H-C						

*19: Aperture diameter of the laser emission part of the package
*20: Average transmittance in band

Dimensional outline (unit: mm)



Tolerance unless otherwise noted: ±0.3
*1: Dimensions from the laser chip edge to the outside of the package

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].

Class 3B Laser

Warning label　Explanatory label

KLDC0003EA

Label for wearing protective goggles

KLDC0005EA

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)

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