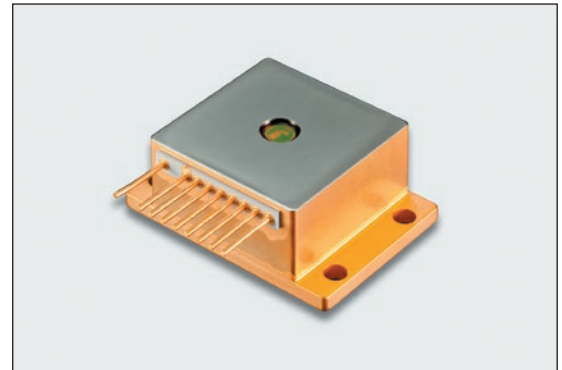


■ Features

- Emission wavelength: 4.53 μm (Typ.)
- Output power: 20 mW (Min.)
- Threshold current: 1.0 A (Max.)

■ Applications

- Trace gas analysis (N_2O)



■ Outline

Quantum Cascade Lasers, using structures of SPC (Single Phonon-Continuum) depopulation and DFB (Distributed Feedback), emit CW (Continuous Wave) mid-IR laser under room temperature.

By controlling the chip's operating temperature through the Peltier element installed in the HHL package, it is possible to tune the emission wavelength without mode hopping while keeping longitudinal single mode operation.

■ Absolute and characteristics

$T_{\text{op}(qcl)} = +20\text{ }^{\circ}\text{C}$, unless otherwise specified.

| Parameter | Symbol | Ratings | Unit |
|--|----------------------|--|-------------------------------|
| Forward current *1 | I_f | This product has individual difference. Confirm data sheet attached to a product *2 | A |
| Forward voltage *1 | V_f | | V |
| Reverse voltage *1 | V_r | 0.0 | V |
| Change speed of forward current *3 | — | 5 | mA/s |
| TEC current (cooling mode) *4 | I_c | +3.7 | A |
| TEC current (heating mode) *4 | | -1.5 | A |
| TEC voltage | V_c | ± 13.0 | V |
| Operating temperature (case) *5*6 | $T_{\text{op}(c)}$ | +10 to +60 | $^{\circ}\text{C}$ |
| Operating temperature (QCL) *7 | $T_{\text{op}(qcl)}$ | 0 to +55 | $^{\circ}\text{C}$ |
| Change speed of operating temperature *8 | — | 10 | $^{\circ}\text{C}/\text{min}$ |
| Storage temperature *5 | T_{stg} | -20 to +65 | $^{\circ}\text{C}$ |

*1 Confirm data sheet attached to a product. Sensitive to electrical surges and instability. Reverse current/voltage cause damage in laser specifications and out of warranty.

*2 Necessary specifications of power supply: $I_f \geq 1.3\text{ A}$, $V_f \geq 16\text{ V}$.

*3 Speed when changing the forward current (I_f).

*4 Even if TEC current (I_c) is below the absolute maximum, insufficient heat dissipation from this product may cause damage in laser and TEC specifications and out of warranty. Especially there are possibilities of damage, degradation and less reliability when TEC is operated in heating mode since heated-up side (laser chip) is thermally isolated from case of package and ambience. Refer to schematic configuration in 3-2-4.

*5 Avoid water condensation.

*6 Temperatures of case (body) of HHL-package.

*7 Temperatures of QC-laser when operated; should be monitored by the built-in thermistor for $T_{\text{op}(qcl)}$.

*8 Speed when changing the operation temperature ($T_{\text{op}(qcl)}$) controlled by the built-in TEC.

■ Specifications (laser)

| Parameter | Symbol | Condition | Min. | Typ. | Max. | Unit |
|--------------------------------|----------------------|--|-----------|------|--------|--------------------|
| Operating temperature (QCL) *2 | $T_{\text{op}(qcl)}$ | $K^{*1}=2209\text{ cm}^{-1}$ | +10 | — | +50 | $^{\circ}\text{C}$ |
| Spectral linewidth *3 | ΔK_L | $K^{*1}=2209\text{ cm}^{-1}$ | — | — | 0.2 *4 | cm^{-1} |
| Wavenumber tuning range *5 | ΔK_T | $K^{*1}=2209\text{ cm}^{-1}$ | ± 1.0 | — | — | cm^{-1} |
| Radiant power | Φ_e | $K^{*1}=2209\text{ cm}^{-1}$ | 20 | — | — | mW |
| Threshold current | I_{th} | $T_{\text{op}(qcl)}=+20\text{ }^{\circ}\text{C}$ | — | — | 1.0 | A |
| Side mode suppression ratio | SMSR | $T_{\text{op}(qcl)}=+20\text{ }^{\circ}\text{C}$ | 25 *4 | — | — | dB |

*1 K: Emission wavenumber (cm^{-1}).

*2 This product is able to emit the target wavenumber at a certain $T_{\text{op}(qcl)}$ within the specified temperature range.

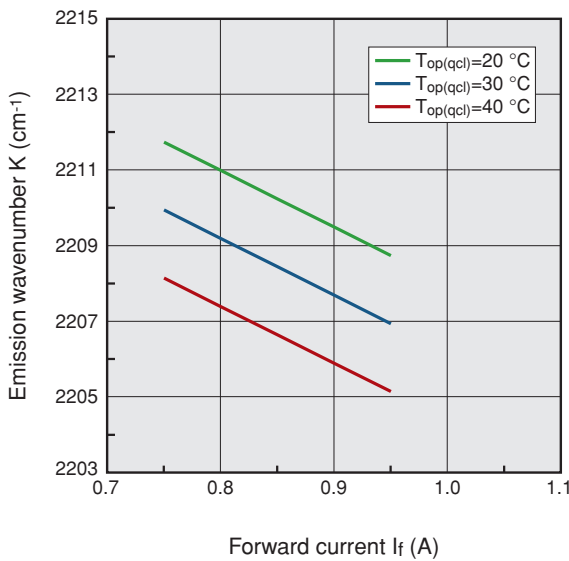
*3 WHM.

*4 These values are limited by resolution and signal-to-noise ratio of instrument when tested.

*5 Continuously wavenumber scan range; Center of the tunability range is the emission wavenumber (K).

CW Quantum Cascade Laser L12004-2209H-C

Figure 1: Typical characteristics



| Parameter | Symbol | Condition | Typical values | Unit |
|---------------------------------------|--------------|-------------------------------|----------------|----------------------|
| Temperature coefficient of wavenumber | δK_T | $I_f = \text{const.}$ | -0.18 | cm ⁻¹ /°C |
| Current coefficient of wavenumber | δK_C | $I_{op(qcl)} = \text{const.}$ | -0.015 | cm ⁻¹ /mA |

■ TEC

| Parameter | Symbol | Condition | Specification | Unit |
|--------------------------------|------------------|---|---------------|----------|
| Maximum temperature difference | ΔT_{max} | $T_h = 27\text{ °C}$, in N ₂ , $Q_c = 0$, $I_c = +3.7\text{ A}$ | >40 | °C |
| Maximum heat pumping capacity | Q_{cmax} | $T_h = 27\text{ °C}$, in N ₂ , $I_c = +3.7\text{ A}$, $\Delta T = 0$ | >18 | W |
| AC resistance | ACR | $T_h = 27\text{ °C}$, 1 kHz | 2.5 ± 0.3 | Ω |

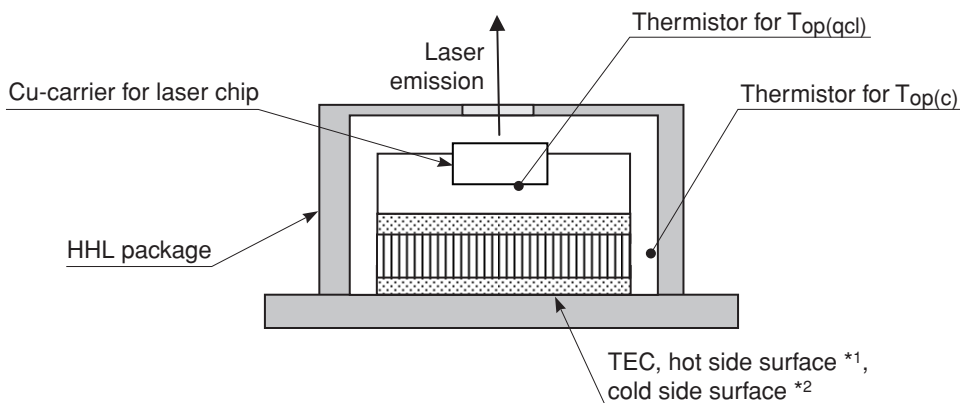
* ΔT : Temperature difference
 Q_c : Heat pumping capacity
 I_c : TEC current
 T_h : Temperature of TEC's hot side surface (TEC: cooling mode)

■ Thermistor

| Parameter | Symbol | Condition | Specification | Unit |
|------------|----------|---------------|-------------------------------|------|
| Resistance | R_{25} | 25 °C | $10\text{ k}\Omega \pm 2.5\%$ | — |
| Beta value | B | 0 °C / 100 °C | 3450 K | — |

* Same specifications for both thermistors of $T_{op(qcl)}$ and $T_{op(c)}$.

Figure 2: Thermistor configurations (schematic)



*1 when TEC is operated in cooling mode.
 *2 when TEC is operated in heating mode.

CW Quantum Cascade Laser L12004-2209H-C

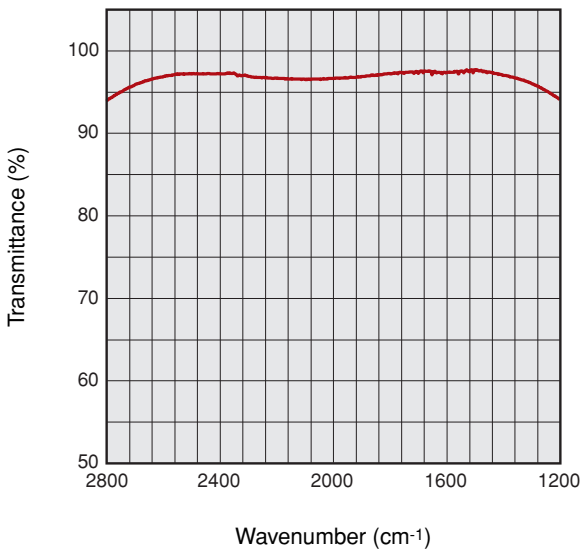
■ Window of HHL package

| Parameter | | Specification | Unit |
|-----------|-------------------|--------------------|------------------|
| Material | | ZnSe, Plano-Plano | — |
| Dimension | Clear aperture *1 | $\phi 4.4$ | mm |
| | Thickness | 0.7 | mm |
| Coating | Coating | BBAR, both surface | — |
| | Bandwidth | 2500 to 1250 | cm ⁻¹ |
| | Transmittance *2 | >96 | % |

*1 Mechanical aperture of HHL package.

*2 Average in the bandwidth.

Figure 3: Typical transmittance curve of the window

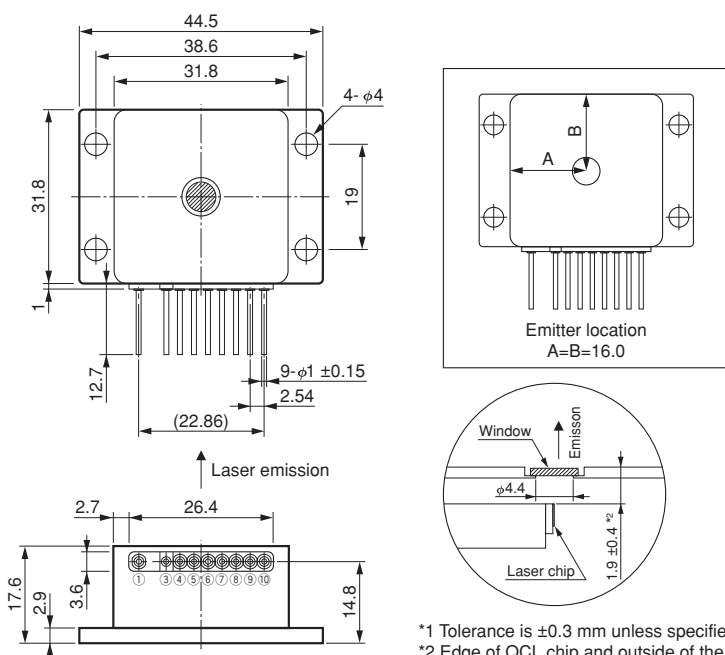


■ Necessary specifications of power supply for the laser (QCL)

| Parameter | Specification | Unit |
|----------------|--------------------------|------|
| Output current | ≥ 1.3 | A |
| Output voltage | ≥ 16 | V |
| Function | Surge protect | — |
| | Constant current control | — |

CW Quantum Cascade Laser L12004-2209H-C

Figure 4: Dimensional outline and pin connection (unit: mm)




*1 Tolerance is ± 0.3 mm unless specified.
*2 Edge of QCL chip and outside of the package.

| Pin No. *3 | Function | Pin No. *3 | Function |
|------------|------------------------|------------|----------------------|
| ① | TEC cathode (-) | ⑦ | QCL cathode (-) |
| ③ | N.C. | ⑧ | Thermistor, (Top(c)) |
| ④ | QCL anode (+) | ⑨ | Thermistor, (Top(c)) |
| ⑤ | Thermistor, (Top(qcl)) | ⑩ | TEC anode (+) |
| ⑥ | Thermistor, (Top(qcl)) | — | — |

*3 Pin of ③ is electrically connected to the case; package body. Other all pins are floating to the case.

Warning (Class 3B Laser)
Invisible laser radiation: Avoid exposure to beam

●The laser radiation emitted from this product is an invisible laser beam that cannot be seen by the human eye. This product falls within "Class 3B Laser" according to IEC 60825-1 laser product classification. Always comply with IEC 60825-1 safety standards when using this product.



DANGER - LASER RADIATION
AVOID EXPOSURE TO BEAM

MAXIMUM PULSE WAVELENGTH
POWER RESTRICTION FREQUENCY MTR

Class 3B Laser product IEC 60825-1:2014

Class 3B Laser
Warning label Explanatory label

LGGP070203CS

●Information described in this material current as of October 2023. Specifications are subject to change without notice.

HAMAMATSU PHOTONICS K.K. www.hamamatsu.com

HAMAMATSU PHOTONICS K.K., Solid State Division

1126-1 Ichino-cho, Higashi-ku, Hamamatsu City, 435-8558 Japan, Telephone: (81)53-434-3311, Fax: (81)53-434-5184

U.S.A.: HAMAMATSU CORPORATION: 360 Foothill Road, Bridgewater, NJ 08807, U.S.A., Telephone: (1)908-231-0960, Fax: (1)908-231-1218 E-mail: usa@hamamatsu.com

Germany: HAMAMATSU PHOTONICS DEUTSCHLAND GMBH.: Arzbergerstr. 10, 82211 Herrsching am Ammersee, Germany, Telephone: (49)8152-375-0, Fax: (49)8152-265-8 E-mail: info@hamamatsu.de

France: HAMAMATSU PHOTONICS FRANCE S.A.R.L.: 19 Rue du Saule Trapu, Parc du Moulin de Massy, 91882 Massy Cedex, France, Telephone: (33)1 69 53 71 00, Fax: (33)1 69 53 71 10 E-mail: infos@hamamatsu.fr

United Kingdom: HAMAMATSU PHOTONICS UK LIMITED: 2 Howard Court, 10 Tewin Road, Welwyn Garden City, Hertfordshire, AL7 1BW, UK, Telephone: (44)1707-294888, Fax: (44)1707-325777 E-mail: info@hamamatsu.co.uk

North Europe: HAMAMATSU PHOTONICS NORDEN AB: Torshamnsgatan 35, 16440 Kista, Sweden, Telephone: (46)8-509-031-00, Fax: (46)8-509-031-01 E-mail: info@hamamatsu.se

Italy: HAMAMATSU PHOTONICS ITALIA S.R.L.: Strada della Moia, 1 int. 6 20044 Arese (Milano), Italy, Telephone: (39)02-93 58 17 33, Fax: (39)02-93 58 17 41 E-mail: info@hamamatsu.it

China: HAMAMATSU PHOTONICS (CHINA) CO., LTD.: 1201, Tower B, Jianning Center, 27 Dongsanhuan Bellu, Chaoyang District, 100020 Beijing, P.R. China, Telephone: (86)10-6586-6006, Fax: (86)10-6586-2866 E-mail: hpc@hamamatsu.com.cn

Taiwan: HAMAMATSU PHOTONICS TAIWAN CO., LTD.: 13F-1, No.101, Section 2, Gongdao 5th Road, East Dist., Hsinchu City, 300046, Taiwan(R.O.C) Telephone: (886)3-659-0080, Fax: (886)3-659-0081 E-mail: info@hamamatsu.com.tw