

6.13 μm DFB-CW type Quantum cascade lasers L12006-1631H-C

■ Features

- Emission wavelength: 6.13 μm (Typ.)
- Output power: 20 mW (Min.)
- Threshold current: 1.0 A (Max.)

■ Applications

- Trace gas analysis (NO_2)



■ 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.

| Characteristics | Symbols | Ratings | Units |
|--|----------------------|---|-----------------------------|
| Forward current ^{*1)} | I_f | This product has individual difference. | A |
| Forward voltage ^{*1)} | V_f | Confirm data sheet attached to a product ^{*2)} | 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)

| Characteristics | Symbols | Test conditions | Min. | Typ. | Max. | Units |
|--|----------------------|--|-------------------|------|--------------------|------------------|
| Operating temperature (QCL) ⁽²⁾ | $T_{\text{op(QCL)}}$ | $K^{(1)}=1631\text{ cm}^{-1}$ | +10 | - | +50 | $^\circ\text{C}$ |
| Spectral linewidth ⁽³⁾ | ΔK_L | $K^{(1)}=1631\text{ cm}^{-1}$ | - | - | 0.2 ⁽⁴⁾ | cm^{-1} |
| Wavenumber tuning range ⁽⁵⁾ | ΔK_T | $K^{(1)}=1631\text{ cm}^{-1}$ | ± 1.0 | - | - | cm^{-1} |
| Radiant power | ϕ_e | $K^{(1)}=1631\text{ cm}^{-1}$ | 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.

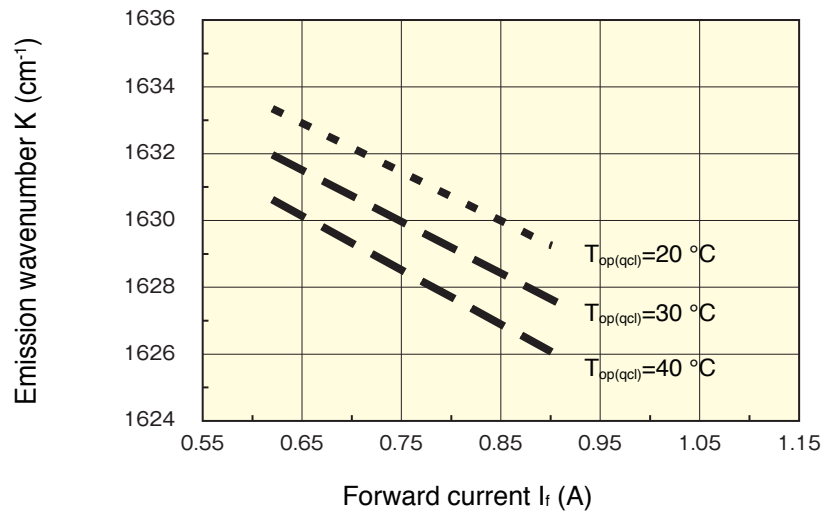
(3) FWHM.

(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).

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Typical characteristics



| Characteristics | Symbols | Conditions | Typical values |
|---------------------------------------|--------------|--------------------------------------|---------------------------------------|
| Temperature coefficient of wavenumber | δK_T | $I_f = \text{const.}$ | $-0.15\text{ cm}^{-1}/^\circ\text{C}$ |
| Current coefficient of wavenumber | δK_C | $T_{\text{op}(qcl)} = \text{const.}$ | $-0.015\text{ cm}^{-1}/\text{mA}$ |

TEC

| Characteristics | Symbols | Test conditions | Specifications |
|--------------------------------|-------------------------|---|-------------------------------|
| Maximum temperature difference | ΔT_{max} | $T_h = 27\text{ }^\circ\text{C}$, in N_2 , $Q_c = 0$, $I_c = +3.7\text{ A}$ | $>40\text{ }^\circ\text{C}$ |
| Maximum heat pumping capacity | $Q_{c\text{max}}$ | $T_h = 27\text{ }^\circ\text{C}$, in N_2 , $I_c = +3.7\text{ A}$, $\Delta T = 0$ | $>18\text{ W}$ |
| AC resistance | ACR | $T_h = 27\text{ }^\circ\text{C}$, $I_c = 0.1\text{ mA}$, 1 kHz | $2.0\ \Omega \pm 0.4\ \Omega$ |

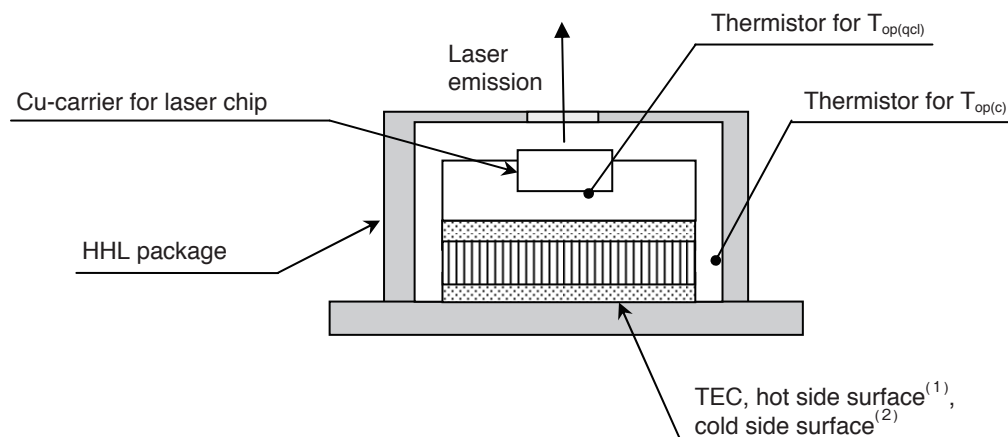
Note) ΔT : Temperature difference
 Q_c : Heat pumping capacity
 I_c : TEC current
 T_h : Temperature of TEC's hot side surface (TEC: cooling mode)

Thermistor

| Characteristics | Symbols | Test conditions | Specifications |
|-----------------|----------|---|-------------------------------|
| Resistance | R_{25} | $25\text{ }^\circ\text{C}$ | $10\text{ k}\Omega \pm 2.5\%$ |
| Beta value | B | $0\text{ }^\circ\text{C} / 100\text{ }^\circ\text{C}$ | 3450 K |

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

Thermistor configurations (schematic)



(1) : when TEC is operated in cooling mode.
(2) : when TEC is operated in heating mode.

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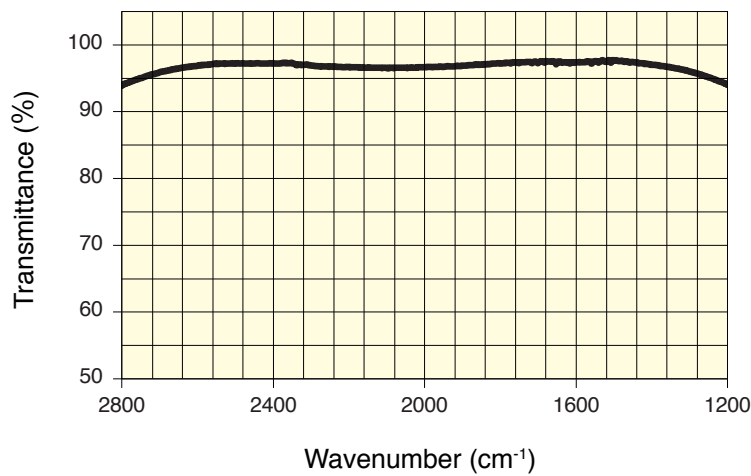
Window of HHL package

| Characteristics | | Specifications |
|-----------------|-------------------------------|--|
| Material | | ZnSe, Plano-Plano |
| Dimension | Clear aperture ⁽¹⁾ | $\phi 4,4$ mm |
| | Thickness | 0.7 mm |
| Coating | Coating | BBAR, both surface |
| | Bandwidth | 2500 cm^{-1} to 1250 cm^{-1} |
| | Transmittance ⁽²⁾ | > 96 % |

(1): Mechanical aperture of HHL package.

(2): Average in the bandwidth.

Typical transmittance curve of the window

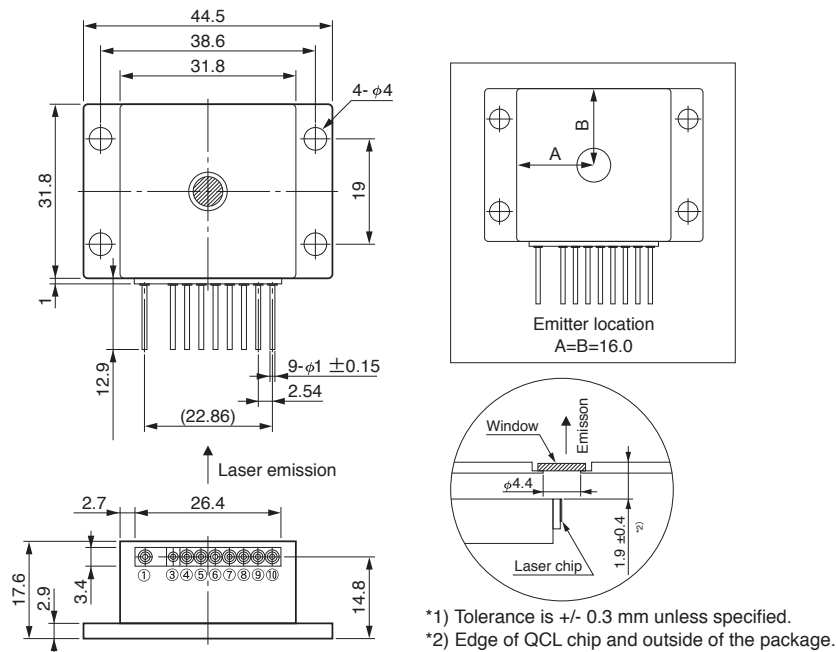


Necessary specifications of power supply for the laser (QCL)

| Characteristics | Specifications |
|-----------------|--------------------------|
| Output current | ≥ 1.3 A |
| Output voltage | ≥ 16 V |
| Function | Surge protect |
| | Constant current control |

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Dimensional outline and pin connection (unit:mm)



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

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

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Cat. No. LQCL2015E01
JAN. 2015