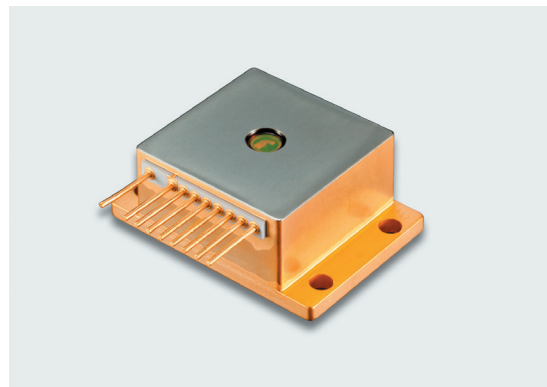


## ■ Features

- Emission wavelength: 4.57  $\mu\text{m}$  (Typ.)
- Output power: 20 mW (Min.)
- Threshold current: 1.0 A (Max.)

## ■ Applications

- Trace gas analysis ( $\text{N}_2\text{O}$ ,  $\text{CO}$ )



## ■ 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 <sup>*1)</sup>	$I_f$	This product has individual difference.	A
Forward voltage <sup>*1)</sup>	$V_f$	Confirm data sheet attached to a product <sup>*2)</sup>	V
Reverse voltage <sup>*1)</sup>	$V_r$	0.0	V
Change speed of forward current <sup>*3)</sup>	-	5	mA/s
TEC current (cooling mode) <sup>*4)</sup>	$I_c$	+3.7	A
TEC current (heating mode) <sup>*4)</sup>		-1.5	A
TEC voltage	$V_c$	$\pm 13.0$	V
Operating temperature (case) <sup>*5) *6)</sup>	$T_{\text{op(c)}}$	+10 to +60	$^\circ\text{C}$
Operating temperature (QCL) <sup>*7)</sup>	$T_{\text{op(qcl)}}$	0 to +55	$^\circ\text{C}$
Change speed of operating temperature <sup>*8)</sup>	-	10	$^\circ\text{C}/\text{min}$
Storage temperature <sup>*5)</sup>	$T_{\text{stg}}$	-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) <sup>(2)</sup>	$T_{\text{op(qcl)}}$	$K^{(1)}=2190\text{ cm}^{-1}$	+10	-	+50	$^\circ\text{C}$
Spectral linewidth <sup>(3)</sup>	$\Delta K_L$	$K^{(1)}=2190\text{ cm}^{-1}$	-	-	0.2 <sup>(4)</sup>	$\text{cm}^{-1}$
Wavenumber tuning range <sup>(5)</sup>	$\Delta K_T$	$K^{(1)}=2190\text{ cm}^{-1}$	$\pm 1.0$	-	-	$\text{cm}^{-1}$
Radiant power	$\Phi_e$	$K^{(1)}=2190\text{ cm}^{-1}$	20	-	-	mW
Threshold current	$I_{\text{th}}$	$T_{\text{op(qcl)}}=+20\text{ }^\circ\text{C}$	-	-	1.0	A
Side mode suppression ratio	SMSR	$T_{\text{op(qcl)}}=+20\text{ }^\circ\text{C}$	25 <sup>(4)</sup>	-	-	dB

(1) K: Emission wavenumber ( $\text{cm}^{-1}$ ).

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

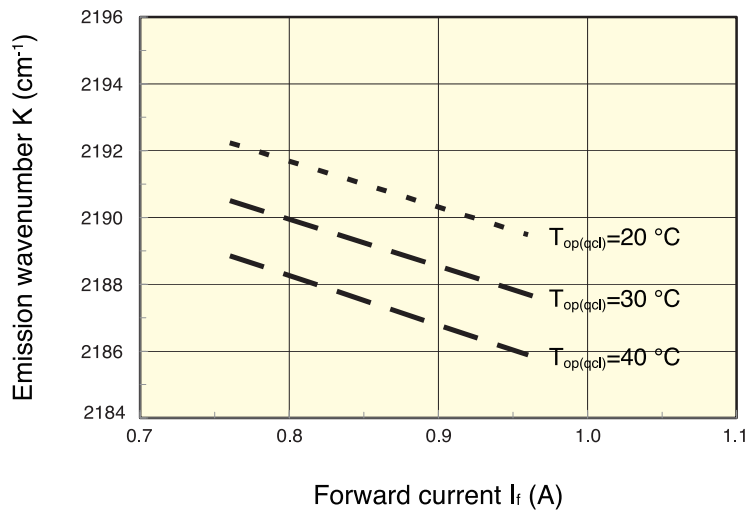
(3) FWHM.

(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).

# 4.57 μm DFB-CW type Quantum cascade lasers L12004-2190H-C

## Typical characteristics



Characteristics	Symbols	Conditions	Typical values
Temperature coefficient of wavenumber	$\delta K_T$	$I_f = \text{const.}$	$-0.18 \text{ cm}^{-1}/^\circ\text{C}$
Current coefficient of wavenumber	$\delta K_C$	$T_{\text{op(qcl)}} = \text{const.}$	$-0.015 \text{ cm}^{-1}/\text{mA}$

## TEC

Characteristics	Symbols	Test conditions	Specifications
Maximum temperature difference	$\Delta T_{\text{max}}$	$T_h = 27^\circ\text{C}$ , in $\text{N}_2$ , $Q_c = 0$ , $I_c = +3.7 \text{ A}$	$> 40^\circ\text{C}$
Maximum heat pumping capacity	$Q_{\text{cmax}}$	$T_h = 27^\circ\text{C}$ , in $\text{N}_2$ , $I_c = +3.7 \text{ A}$ , $\Delta T = 0$	$> 18 \text{ W}$
AC resistance	ACR	$T_h = 27^\circ\text{C}$ , $I_c = 0.1 \text{ mA}$ , $1 \text{ kHz}$	$2.0 \Omega \pm 0.4 \Omega$

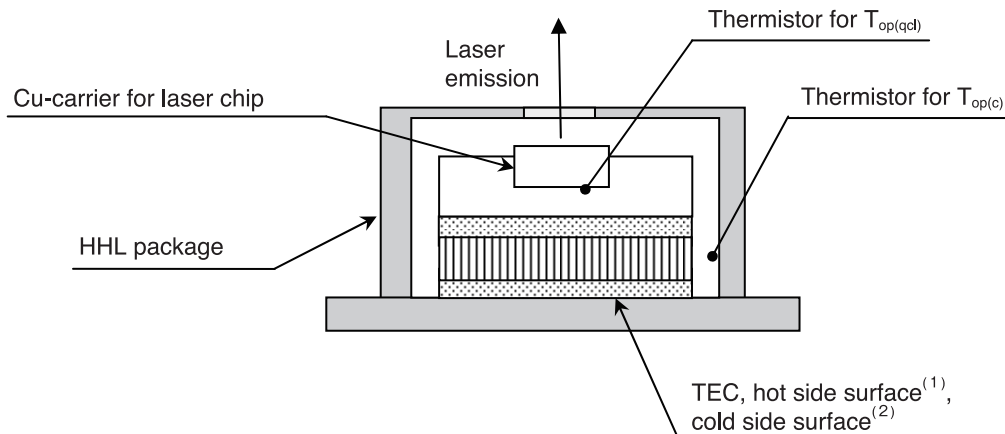
Note)  $\Delta T$ : Temperature difference  
 $Q_c$ : Heat pumping capacity  
 $I_c$ : TEC current  
 $T_h$ : Temperature of TEC's hot side surface (TEC: cooling mode)

## Thermistor

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

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.

## 4.57 $\mu\text{m}$ DFB-CW type Quantum cascade lasers L12004-2190H-C

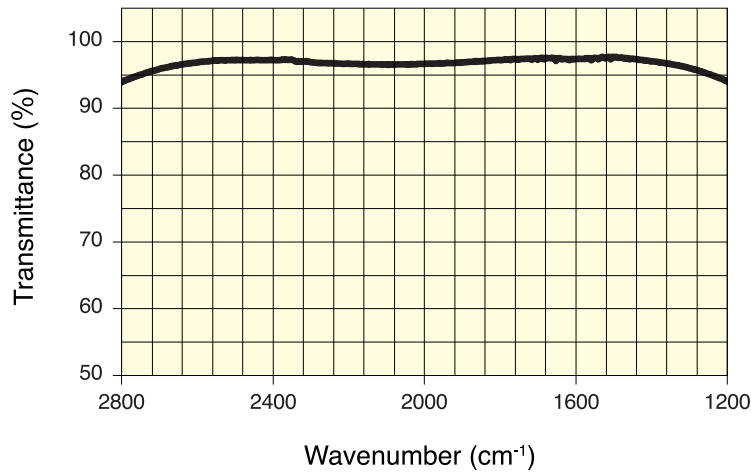
### ■ Window of HHL package

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

(1): Mechanical aperture of HHL package.

(2): Average in the bandwidth.

### ■ Typical transmittance curve of the window

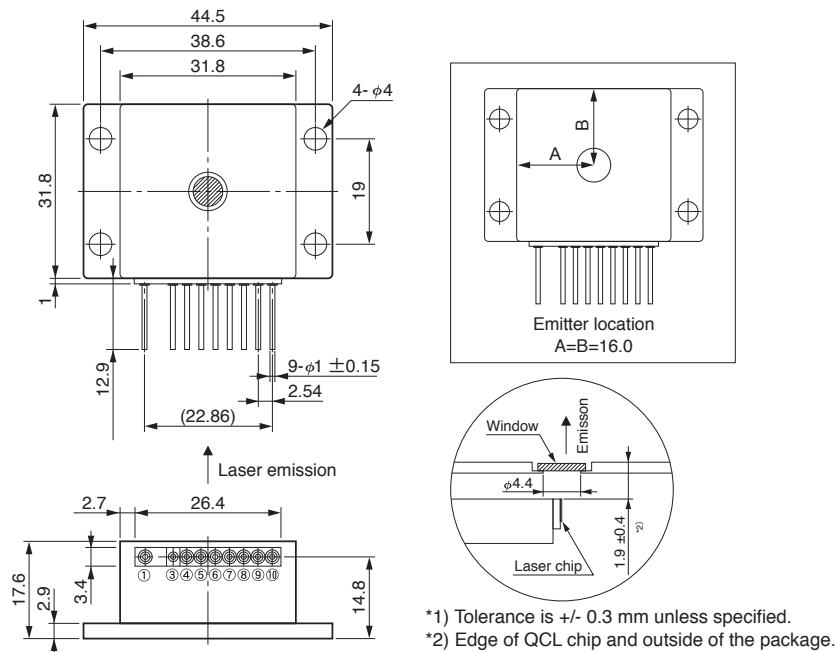


### ■ Necessary specifications of power supply for the laser (QCL)

Characteristics	Specifications
Output current	$\geq 1.3$ A
Output voltage	$\geq 16$ V
Function	Surge protect
	Constant current control

## 4.57 $\mu\text{m}$ DFB-CW type Quantum cascade lasers L12004-2190H-C

### 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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