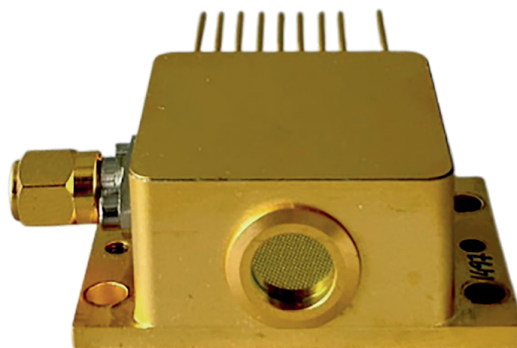


## RF-HHL Laser Module

Compact Mid-IR Laser with High-Frequency Amplitude Modulation

The RF-HHL Laser Module is a compact mid-infrared laser module offering fast amplitude modulation (AM) via a standard SMA input, providing precise control over the laser's output power and amplitude modulation. The module is packaged in a High Heat Load (HHL) enclosure, making it ideal for demanding environments requiring efficient thermal management, and includes a thermoelectric cooler (TEC), thermistor, and collimating optics.



### Key Features

- High-frequency amplitude modulation via SMA connector
- Single-mode QCL operation
- 300MHz cutoff at -3dB
- Wavelength range from 3 to 12  $\mu\text{m}$
- Compact and robust HHL housing

### Key Applications

- Gas sensing and environmental monitoring
- Infrared spectroscopy
- Optical signal processing
- OEM integration
- Molecular Dispersion Spectroscopy



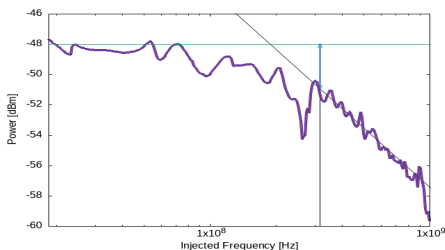
This laser module is highly versatile and can be configured with different laser types, including DFB lasers, high-power lasers, and comb lasers, depending on the specific needs of the application.

The RF-HHL offers an exceptional cutoff frequency at 3 dB of greater than 0.3 GHz, making it suitable for high-speed applications that require rapid modulation. The laser's output can be modulated at frequencies far beyond traditional systems, making it ideal for real-time signal processing, gas sensing, and other high-frequency applications.

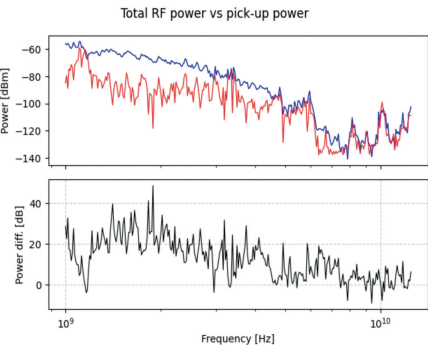
Specifications

PARAMETER NAME	MINIMUM VALUE	TYPICAL VALUE	MAXIMUM VALUE	UNIT	NOTE
Size		44.5 × 31.7 × 19		mm <sup>3</sup>	
Max. Temperature Differential		30	45	°C	Max. Differential attainable at zero heat load.
Max. Heat Load		6	15	W	Max. heat load to keep chip at room temperature.
Temperature Sensor				NTC, 10 kOhm	
Beam Divergence (Free Space, X axis, < 4500 nm)	2	2,8	5	mrاد	Divergence, measured at 1/e <sup>2</sup> from the peak of the distribution. Uncollimated option also available.
Beam Divergence (Free Space, Y axis, < 4500 nm)	2	2,5	4	mrاد	Divergence, measured at 1/e <sup>2</sup> from the peak of the distribution. Uncollimated option also available.
Beam Divergence (Free Space, X axis, < 11000 nm)	4	5,5	10	mrاد	Divergence, measured at 1/e <sup>2</sup> from the peak of the distribution. Uncollimated option also available.
Beam Divergence (Free Space, Y axis, < 11000 nm)	3	4,5	7	mrاد	Divergence, measured at 1/e <sup>2</sup> from the peak of the distribution. Uncollimated option also available.
Pointing error			+/- 3	mrاد	Is defined as the FWHM along the fast axis. With respect to the package base reference plane given by pin openings.
ZnSe Window Coating		3-12		μm	The ZnSe window is tilted to avoid back-reflections
Beam Diameter (Free space)			4	mm	Diameter at window exit.
Package Sealing		< 10 <sup>-6</sup>		cc He/sec	The QCL HHL package is hermetically sealed, the atmosphere inside the package is dry to prevent internal condensation, with < 10 ppm H <sub>2</sub> O.
Output Power		20	100	mW	Higher power can be available for multimode devices
Modulation Input	SMA, analog RF				
Modulation Bandwidth (3dB cut-off)	300 MHz				
Storage Temperature	-10		63	°C	

Pigtailed version is also available.



Bode diagram  
of RF-HHL



High frequency  
response of the laser:  
Measured signal  
(blue) and background  
pick-up signal (red),  
and difference (black).

The frequency response of the RF-HHL module demonstrates outstanding high-frequency performance. Although the nominal 3 dB cutoff is above 300 MHz, measurements show that the amplitude modulation remains detectable well into the multi-GHz range beyond the nominal cutoff point. Although the modulation depth gradually decreases, the system retains more than 20 dB of dynamic range relative to the background pick-up signal.

This extended bandwidth confirms the RF-HHL's suitability for advanced applications requiring fast, high-frequency modulation such as free-space optical communications, high-speed spectroscopy, and fast feedback control.