C-WAVE GTR

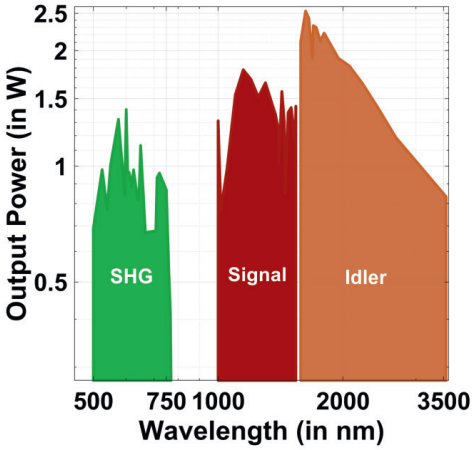
Widely Tunable | High Power | CW Optical Parametric Oscillator

Applications

High-resolution spectroscopy
Quantum technology
Holography
Raman spectroscopy
Fluorescence microscopy
Detector calibration

- Wide gap-free tuning ranges in the visible and near-infrared 510 - 750 nm, 1020 - 1500 nm and 1.7 - 3.4 µm
- Fully automated wavelength approach
- More than 20 GHz mode-hop free tuning range in the visible
- Single frequency operation with < 500 kHz typical linewidth
- Output powers up to Watt-level

C-WAVE GTR
Typical output power



Continuous-Wave Laser Emission – from Green to Red

C-WAVE "Green-To-Red" (GTR) combines user-friendly and fully-automated handling with wide tunability in the visible. It offers Watt-level of mode-hop-free tunable single-frequency emission in a nearly perfect Gaussian beam with a beam quality factor $M^2 < 1.2$. In addition, C-WAVE GTR covers the near-infrared spectrum between 1.0 and 3.4 µm.

C-WAVE GTR provides outstanding spectral purity with a side-mode suppression ratio, which is typically >100 dB, making it ideal for high-resolution spectroscopy applications. Finally, the excellent pointing stability even when tuning over hundreds of nanometers make C-WAVE GTR a flexible tool for demanding applications.

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C-WAVE GTR

Specifications

	SHG (GTR)	Signal (NIR-I)	Idler (NIR-II)
Wavelength range	510 - 750 nm (typ. 500 - 760 nm)	1020 - 1500 nm (typ. 1000 - 1520 nm)	1.7 – 3.4 µm (typ. 1.6 - 3.5 µm)
Accuracy of Emission Frequency - Automated approach w/o wavemeter - Using ext. reference & AbsoluteLambda™	< 2 THz (typ. < 1 THz, corresp. < ~1-2nm) < 2 MHz (depending on wavemeter)	< 1 THz < 1 MHz (depending on wavemeter)	
Output Power	> 300 mW (typ. > 500 mW) > 800 mW @ 600 nm	> 600 mW* (typ. > 800 mW)	> 1W @ > 1.7 - 2.2 µm > 500 mW @ > 2.2 - 3 µm > 200 mW @ > 3 - 3.4 µm
Longterm Power Stability (typ. values over 8 hrs)	< 5 %	< 5 %	< 10 %
Noise (typ. values, 10 Hz - 10 MHz)	< 1% rms		
Beam Diameter at Aperture (1/e², typ. values)	1.5 mm	2 mm	2 mm
Beam Symmetry (typ. values)	> 0.90:1		> 0.8:1
Beam Divergence (full angle)	< 250 µrad	< 500 µrad	
Beam Pointing Stability (wavelength-to-wavelength)	< 250 µrad (typ. < 50 µrad)	< 50 µrad	< 50 µrad
Beam Polarization	linear, horizontal		
Spatial mode (TEM00)	$M^2 < 1.2$		$M^2 < 1.4$
Linewidth	< 1 MHz (typ. < 500 kHz)		
Single Mode Supression Ratio (wavelength setpoint +/- 10 nm)	> 100 dB		
Mode-hop free tuning	> 20 GHz	> 10 GHz	
Warranty	12 months, unlimited operation hours		

* Specifications not valid from 1450 - 1500 nm.

WARNING VISIBLE AND INVISIBLE LASER RADIATION

Avoid eye or skin exposure to direct or scattered radiation.
Class 4 Laser Product

Classified per IEC 60825-1:2014

CE

C-WAVE GTR

Operational Environment

Power Supply	110 V / 230 V
Communication Interface	Ethernet / RJ45
Intended use environment	Laboratory, air free of dust (recommended ISO 9)
Mounting surface	Vibration-isolated optical table
Storage Temperature	10 – 40 °C
Storage Humidity	0 – 90 % relative humidity, non-condensing
Operating Temperature Range	20 – 25 °C , constant
Operating Humidity	10 - 85 % relative humidity, non-condensing
Ambient Air Pressure	950 – 1050 mbar
Power Consumption	< 200 W

Interfaces

Beam Output	Free space, optional Fiber Coupling for SHG	
Optical Monitor Output OPO (optional)	< 20 mW of OPO Signal	FC/APC
Electrical Monitor Output (Channel 1, Channel 2)	-5V to 5V out	SMA
Electrical Trigger Output	0V to 5V, TTL out	SMA
12 VDC in	Connects with the enclosed power supply	
Common Ground	GND	Flat Plug 6.3x0.8
Aux In	0V to 5V in	SMA
Purge In	0.1 to 0.5 sccm	4mm hose, dry air or N2 gas
Interlock	Remote Interlock	SMA (short plug provided)

Mechanical Specifications

Dimensions (C-WAVE GTR w/o pump laser)	645 x 486 x 133 mm³ (L x W x H)
Weight (C-WAVE GTR w/o pump laser)	44kg
Shipping Weight, incl. Pump Laser, w/o Pallet	98 kg

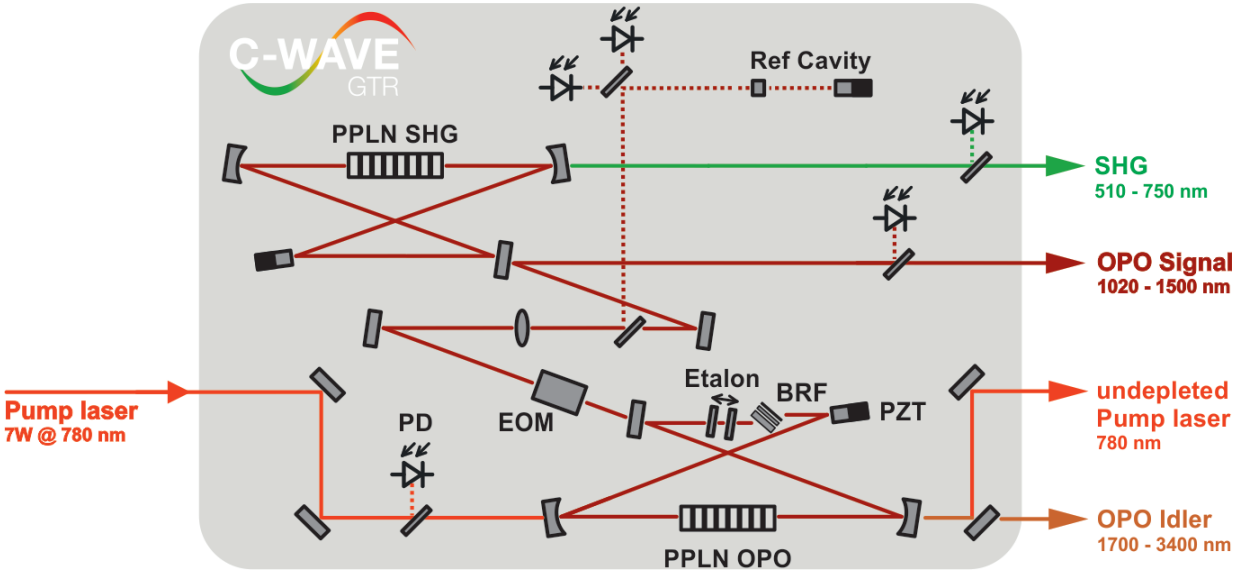
C-WAVE GTR

Operation principle

C-WAVE GTR combines two nonlinear processes to achieve its outstanding spectral coverage:

In the first step (OPO), a 780 nm laser pumps a nonlinear periodically-poled crystal (PPLN). Signal and idler photons with tunable frequencies in the near-infrared wavelength regime from 1020 nm to 1500 nm and 1.7 µm to 3.4 µm are generated.
Subsequent second harmonic generation (SHG) using a frequency doubling crystal leads to conversion of the signal photons into colors from green to red (510 – 750 nm).

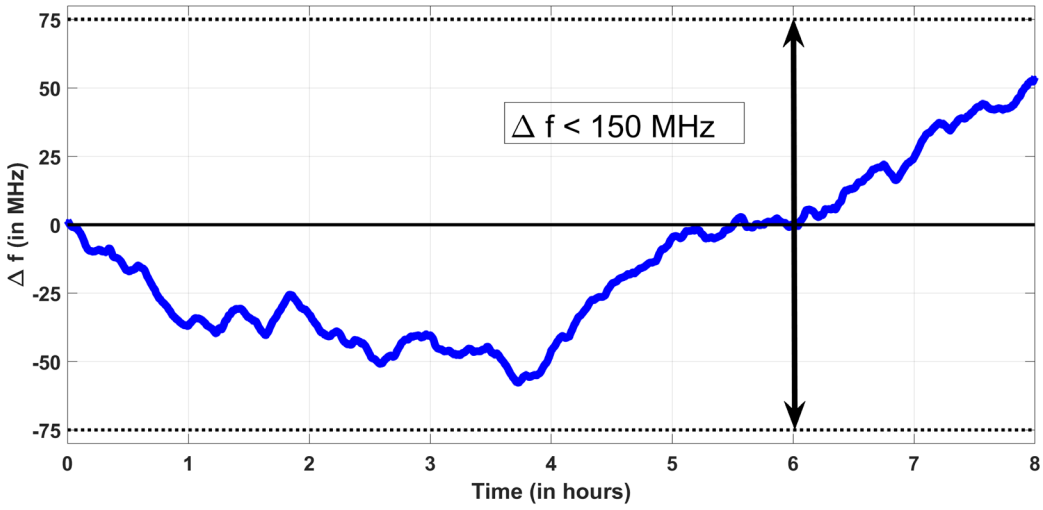
C-WAVE GTR - Optical layout



C-WAVE GTR delivers high quality CW output with typical linewidths of < 500 kHz corresponding to typical coherence lengths well above 100 m throughout both the visible and the near-infrared tuning range.

Thereby, a long-term frequency stability of < 150 MHz over hours is routinely achieved at typical lab conditions based on the internal reference cavity and a Pound-Drever-Hall locking scheme. For applications with the highest demands, the performance characteristics can be further improved by operating the system in conjunction with an external wavelength measurement device using the AbsoluteLambda™ option for C-WAVE.

C-WAVE GTR - Typical frequency stability
Using internal reference cavity at a wavelength of approx. 1100 nm



C-WAVE GTR

Tuning Mechanisms

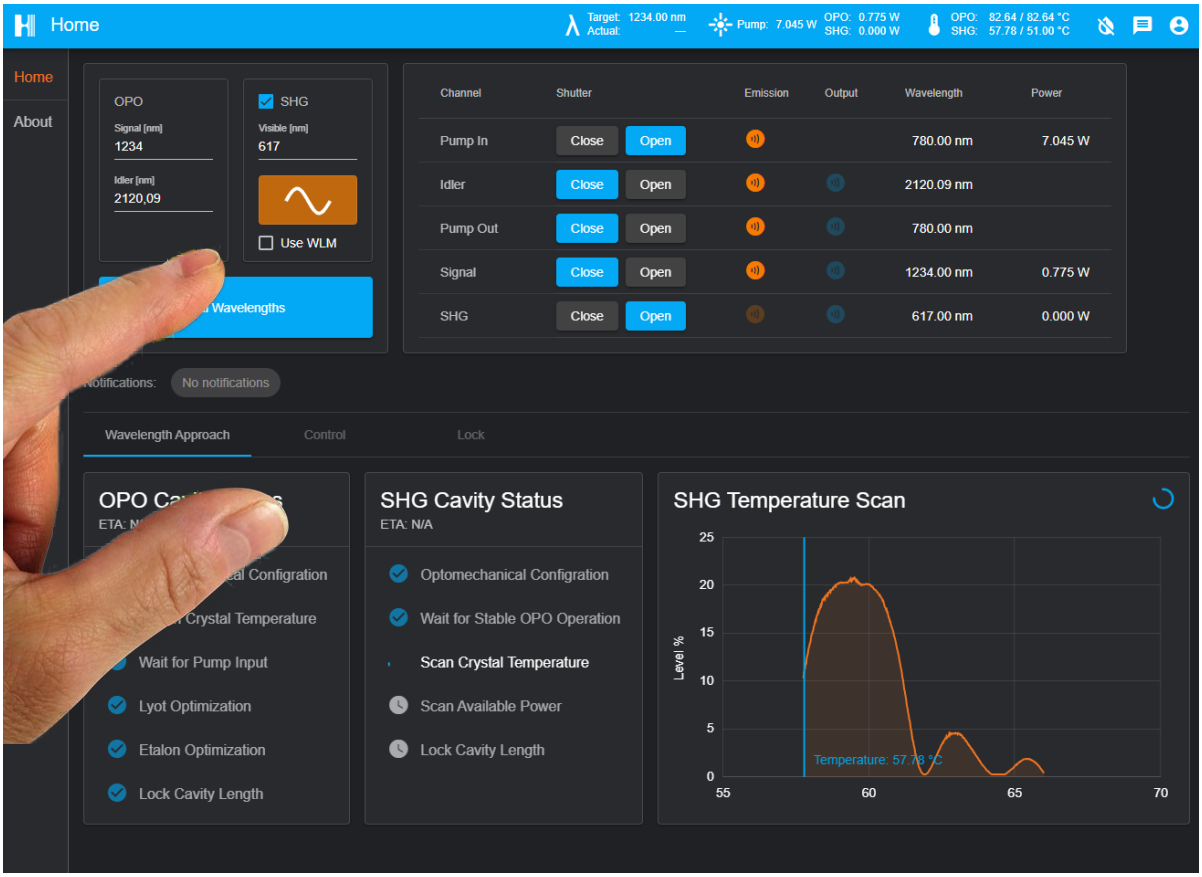
C-WAVE GTR can be wavelength tuned based on multiple mechanisms. The main three wavelength tuning mechanisms accessible are temperature tuning of the non-linear crystal (coarse tuning), intra-cavity Etalon scanning (quasi-continuous stepwise tuning) and scanning the OPO cavity length by a piezo-element (continuous mode-hop free tuning).
These mechanisms can be combined and fully automated for truly continuous wavelength coverage.

	Range		Resolution	
	NIR	VIS	NIR	VIS
Coarse - Crystal Temperature	Full System Range		< 1 THz	< 2 THz
Stepwise - Intracavity Etalon Position	50 GHz	100 GHz	< 3 GHz	< 6 GHz
Continuous, Mode-hop free - Intracavity Piezo Mirror Position	10 GHz	20 GHz	100 kHz / mV	200kHz / mV

Control Software

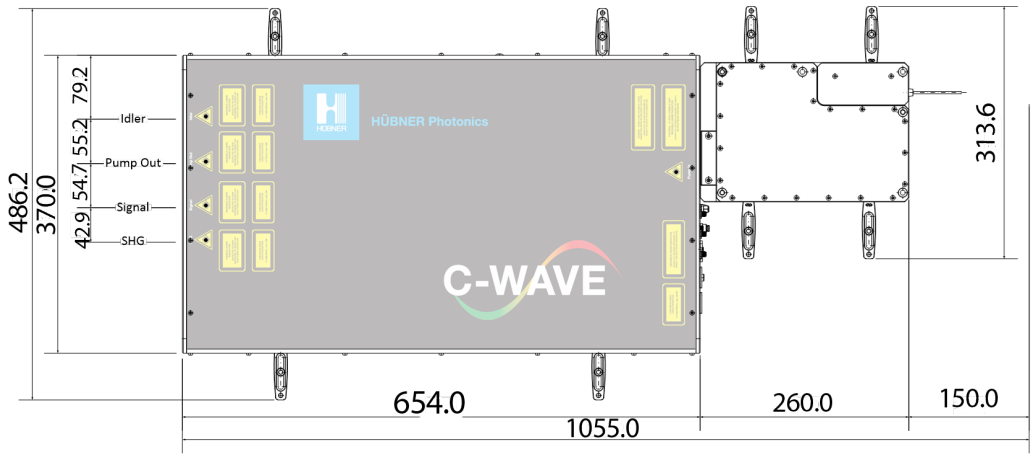
C-WAVE GTR can be controlled via the intuitive user interface on a web browser from any device within your network.
The user interface provides fundamental functionalities, such as automated wavelength approaches by the click of a button.
In advanced mode, users get comprehensive access to control actuators and parameters of C-WAVE GTR. The user interface comprises real-time monitoring of all internal sensor readings making the control of C-WAVE GTR highly responsive and user-friendly.

Communication with C-WAVE GTR is based on websockets, allowing for flexible platform independent integration of the system into your software environment regardless of which programming language you prefer. Python bindings and example code are included.

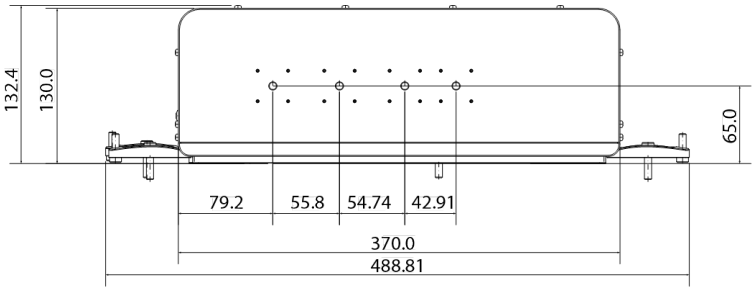


C-WAVE GTR

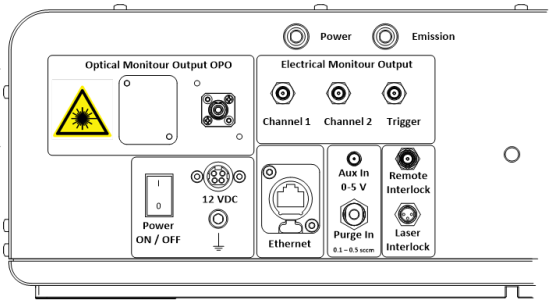
Top view



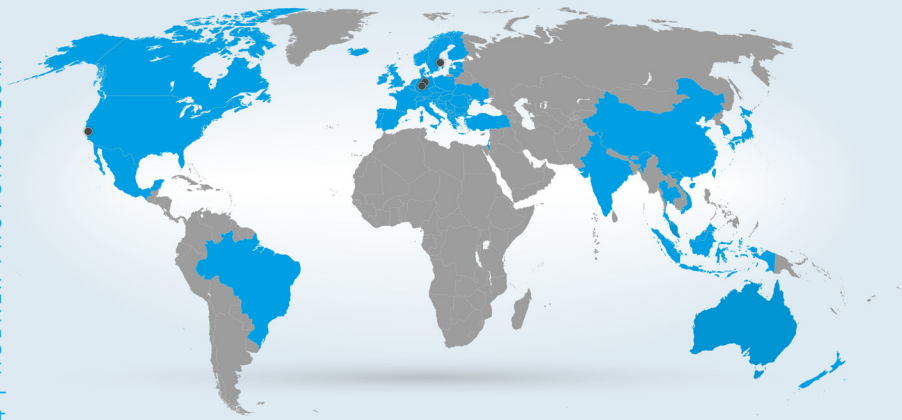
Front view



Rear view



All dimensions are given in mm.



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