

# Koheras HARMONIK

High-power frequency-converted laser system



## SINGLE FREQUENCY, LOW NOISE

### Ideal for cutting-edge quantum physics projects

The HARMONIK is a high-power frequency-converted laser system consisting of our popular low-noise Koheras fiber laser platform, BOOSTIK HP, in combination with our frequency converter module, HARMONIK. The system gives you simultaneous power operation at the fundamental and second harmonic frequency.

This maintenance-free laser system provides a superior low-noise single-frequency signal with a unique combination of narrow linewidth, excellent beam quality, and high output power.

### Applications

- Quantum computing
- Quantum sensing
- Gravimeters & inertial sensing
- Metrology & optical clocks
- Cold atom research & atom interferometry
- Laser cooling and trapping
- Laser-based metrology
- Non-linear optics pump source (SHG, DFG, OPO)

# KOHERAS HARMONIK

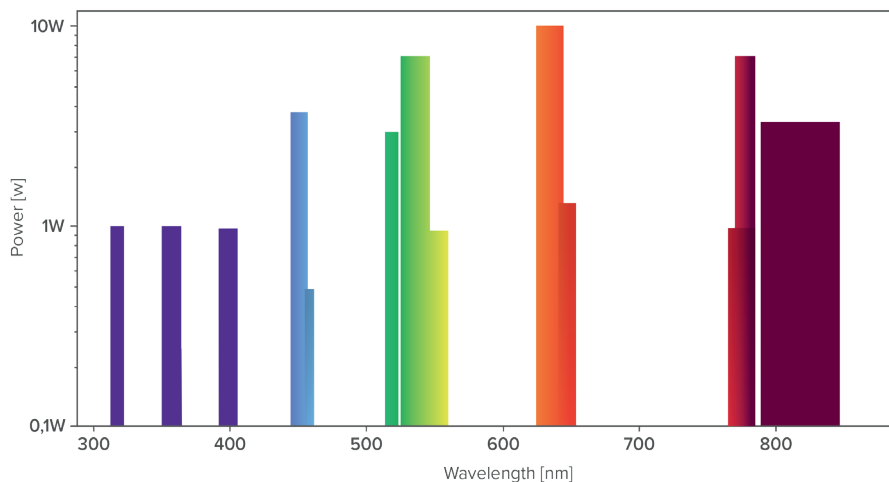
HARMONIK is a high-power frequency-converted fiber laser system. Choose the E15 seeder for the lowest linewidth and phase noise, or the C15 for lowest RIN. Further linewidth and RIN reductions are available.

## High output power and excellent beam quality

The output power of the HARMONIK systems depends on the wavelength with the highest obtainable output of 10 W. The excellent beam quality,  $M^2 < 1.1$ , is suitable for cutting edge quantum physics projects such as quantum sensing and laser cooling and trapping, to mention a few.

## Ideal for quantum optics

With its ultra-stable and narrow linewidth, the HARMONIK is ideal for applications such as quantum optics, computing and other phenomena like optical trapping, optical lattice, Bose-Einstein condensate, atom interferometer, and squeezing.



The graph shows the VIS wavelength capabilities of the HARMONIK. All lasers are pumped by our low-noise fiber lasers in the NIR (not shown), allowing the lasers to be locked to frequency references at either their fundamental or converted wavelengths.

Model	H31	H53	H78	H78	H81	H81
Wavelengths [nm]	317	532	770	780	813	840
Output power [W]	> 1	> 7	> 4	> 7	> 3	> 3
Linewidth [kHz]	< 40	< 40	< 0.4	< 0.4	< 40	< 40

# FEATURES

## Ultra-low noise

The HARMONIK systems offer an ultra-low phase noise as well as low RIN. The RIN is preserved from the pump laser while the linewidth is doubled.

## Fast wavelength modulation

The systems are equipped with easy and user-friendly fast wavelength modulation. This feature is typically used to lock the laser to an external stable reference — such as an atomic transition line or interferometer — to obtain even higher wavelength stability than provided by the free-running laser.

## Thermal tuning

All Koheras fiber lasers are equipped with thermoelectric temperature controllers (TECs).

The TECs stabilize the operation of the laser and makes it insensitive to environmental temperature fluctuations. The TECs also make it possible to tune the center wavelength by changing the operating temperature of the laser.

At standard room temperature (around 20-30°C or 68-86°F) the laser can be thermally tuned to an industry-leading 1000 pm.

## Free-space or fiber output

As default, the HARMONIK systems come with free-space output. If fiber coupling is needed, we can propose an efficient coupling via our unique polarization-maintaining single mode photonic crystal fiber that ensures high-power delivery.

Our pre-angled fiber couplers are easy and fast to align. They give a very high coupling efficiency, which does not decrease significantly over time, so it is possible to obtain a long term stable coupling.

## Rack system and table top

The BOOSTIK HP system is delivered in a turn-key 19" rack system and the HARMONIK frequency-conversion modules are supplied as tabletop units that also fit a 19" rack-mount module.

## Features

- Up to 10 W depending on wavelength
- Sub-kHz linewidth
- Ultra-low frequency and intensity noise
- Wide wavelength tunability
- Excellent beam quality,  $M^2 < 1.1$
- Temperature stabilized
- Optional PM fiber delivery
- Plug and Play
- Simple user operation
- Robust and maintenance-free

## Reliability

The Koheras range of single frequency fiber lasers is based on telecom-grade fiber components and built to last thousands of hours with no service or maintenance.

With several thousand lasers installed in environments varying from fully climate controlled national standards laboratories to the demanding environment on oil rigs and submarines, the Koheras line is the most robust single-frequency laser range on the market with an unmatched reliability track record.

# SPECIFICATIONS

## Optical

Model	H31	H40	H53	H55	H63	H76	H78	H81
Center wavelength <sup>1)</sup> [nm]	312-322	392-405	525-546	547-560	624-644	765-769	770-785	789-845
Laser emission	CW - Inherently single frequency							
Beam quality	M <sup>2</sup> < 1.1							
Output power <sup>2)</sup> [W]	> 1	> 1	> 7	> 1	> 10	> 4	> 4 or > 7	> 3
Linewidth [kHz]	< 40	< 40	< 40	< 40	< 20	< 0.4	< 0.4	< 40
RIN peak [MHz]	0.5-2.0	0.5-2.0	1.0-2.0	1.0-2.0	≈ 1	≈ 0.7	≈ 0.7	0.5-2.0
RIN level [dBc/Hz]								
@ peak	< -100	< -100	< -102	< -102	< -100	< -97	< -97	< -100
@ 10 MHz	< -140	< -140	< -140	< -140	< -140	< -132	< -132	< -140
Long term stability (peak-peak, 1h @25°C) <sup>3)</sup> [%]	< 10							
Optical S/N (50 pm res.) [dB]	> 70							
Polarization / PER [dB]	> 20							
Min. thermal wavelength tuning range [pm]	± 70	± 90	± 120	± 120	± 140	± 175	± 175	± 180
Total thermal wavelength tuning range [pm]	200	250	340	340	400	500	500	500
Fast wavelength modulation range [GHz]	> 16	> 16	> 20	> 20	> 8	> 16	> 16	> 16
Fast wavelength modulation [kHz]	Up to 20							
Pump unit(s) size for 19" rack system [U]	8	8	4	4	8	4	4	8
Number of frequency conversion modules <sup>4)</sup>	2	2	1	1	1	1	1	2

1) Center wavelength is selectable within the specified range.

2) Shot noise-limited > 5 Mhz.

3) After a 10-20 minute warm-up.

4) Delivered as tabletop module(s).

# SPECIFICATIONS & DRAWINGS

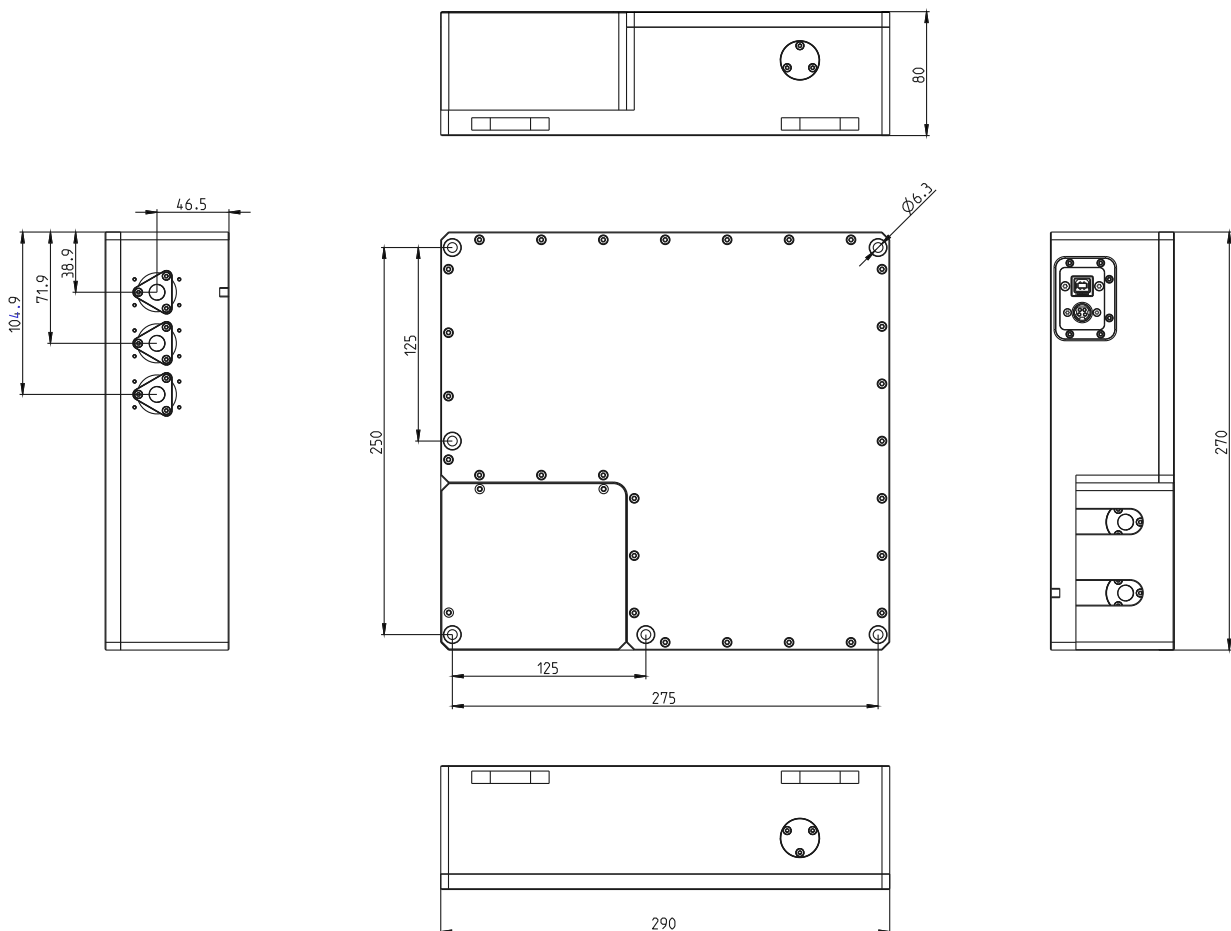
## Mechanical/Electrical

HARMONIK <sup>1)</sup>	
Power supply requirements [VAC, Hz]	100-240 VAC, 50-60 Hz
Digital interface	Ethernet 10/100
Monitor output	Standard: Free-space Optional: 2.5m high power, single mode fiber delivery < 2 W: FC/APC; > 2 W: SMA905
Dimensions DFG/SFG (WxHxL) [mm]	270 x 80 x 290
Dimensions red SHG (WxHxL) [mm]	173 x 62.5 x 240
Dimensions green SHG (WxHxL) [mm]	198 x 80 x 240
Weight <sup>2)</sup> [kg]	6-26

1) For the BOOSTIK HP system, please refer to the BOOSTIK HP datasheet.

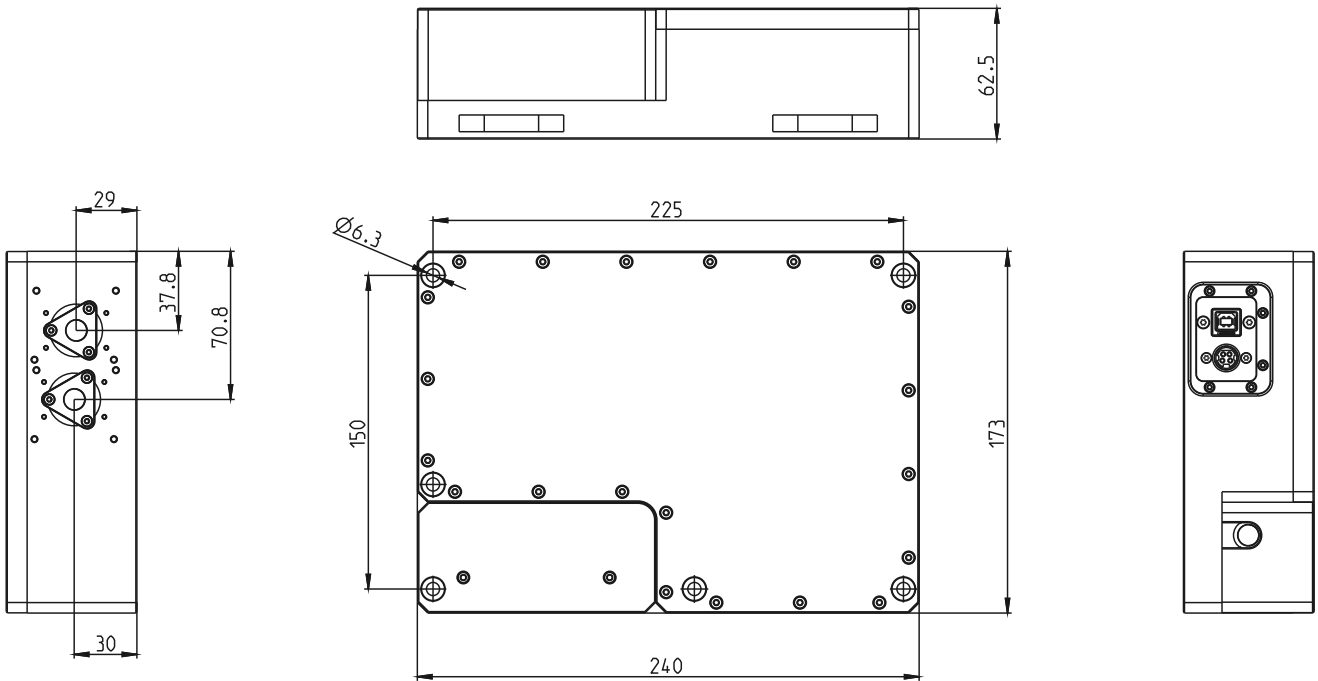
2) Depending on the exact configuration.

## HARMONIK DFG/SFG module

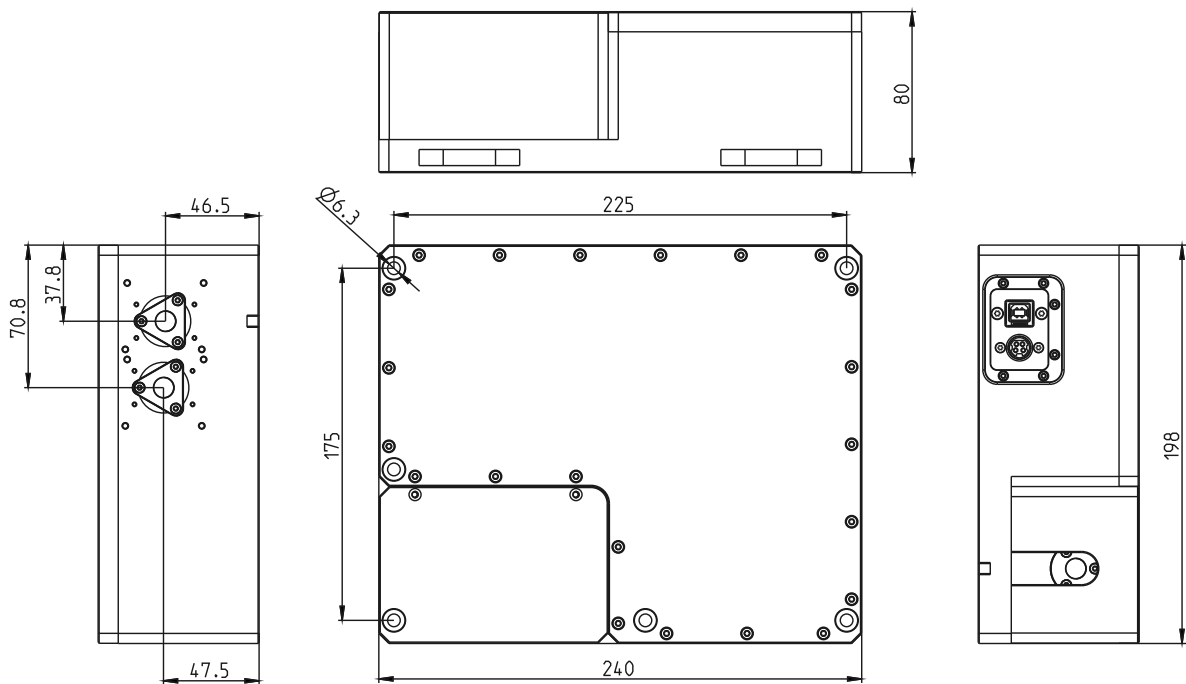


# DRAWINGS

## HARMONIK red SHG module



## HARMONIK green SHG module



All Koheras products are produced under our quality management system certified in accordance with the ISO 9001:2015.

