PHOTON CORE

TECHNICAL / OPERATION MANUAL

v1.0

CO_2 Laser

model : CORE 30 series

DUAL CATALYST TECHNOLOGY

TABLE OF CONTENTS

1. Introduction

Thank you for choosing our CO2 RF laser. This is a technologically advanced device designed for applications in industry, medicine, and scientific research. This manual has been developed to ensure the safe and efficient operation of the equipment, as well as to enable the full utilization of its capabilities.

The CO2 RF laser utilizes radio frequency (RF) excitation technology for laser beam generation, which ensures high efficiency, operational stability, and an extended service life.

Before operating the laser, we strongly recommend reading this user manual thoroughly. It contains detailed information regarding installation, configuration, operation, maintenance, and safety guidelines, all of which are critical for the proper functioning of the device.

Please adhere to all recommendations and procedures contained herein. Proper operation of the device will not only enhance its performance but also ensure long-term, trouble-free use.

Should you have any questions or concerns, please contact our technical support department. We are at your disposal to ensure your complete satisfaction with the CO2 RF laser resonator.

Note: This device is intended for professional use only and must be installed and serviced by personnel qualified in laser technology.

Technical support :
DK Lasertechnik sp. z o.o.
ul.Siwka 25, 31-588 Krakow, Poland
service@photoncore.pl

2. Technical specifications

Model name	CORE 30	CORE 30 - 9,3
Wavelenght	10,6 um	9,3 um
Nominal power	30W	20W
Production output power	min. 35W	min. 25W
Power stability (1)	+/- 5% - air cooling, +/- 3% - water cooling	
M2	<= 1.2	
Beam diameter (1/e2)	2.8mm (+/- 0,4mm)	
Beam Divergence (Full Angle) (1/e2)	<7 mrad	
Elipticity	< 1,2	
Polarization	Linear, horizontal	
Rise or Fall time	<100 us	
Supply voltage	48V DC	
Maximum supplu current	12A	
Power control method	PWM - DC to 100kHz	
Cooling (2)	Air/ water - depending on the version	
Heat load	450W	
Operating temperature (3)	15C - 40C	
Operating humidity	Non-condensing	
Weight	8,5 Kg	

(1) Power stability measured after 5 minutes of continuous wave (CW) operation.
(2) Integrated air cooling (built-in fans), water cooling, air cooling without fans (for custom integration by the user/OEM). The specific markings for these cooling options are described further in this manual.
(3) Published specifications guaranteed at a temperature of 22 °C. Some performance degradation may occur in ambient temperatures above 22 °C. For air-cooled lasers, laser power typically decreases 0.5–1% per degree Celsius increase in ambient temperature.

2.1 Configuration options & customisations

Custom Options In addition to the standard configuration, the laser can be ordered with the options listed below.

The specific option type is indicated on the nameplate (rating plate) in the "**ver: 00000**" section.

	ver: **X**0000	ver: 0**X**000	ver: 00**X**00	ver: 000**X**0	ver: 0000**X**
0	Air cooling, build-in fans	Standard base, top mounting, bottom mounting	Standard beam exit height	Standard version (without Key Switch	Reserved
1	Water cooling	Slim base, bottom mounting	Beam exit lowered by 30 mm	Key Switch	
2	OEM, external forced-air cooling				

Standard version ver: 00000

3. Safety

User and environmental safety is the highest priority when operating the laser. This device generates a high-energy laser beam which, if used improperly, can pose a serious threat to health and life, as well as to the workplace infrastructure. Therefore, strict adherence to the safety rules described in this chapter is mandatory.

The CO2 RF laser is classified as a Class 4 laser product according to the IEC 60825-1 standard. This indicates that the emitted laser radiation can be hazardous to both the eyes and the skin.

The user (integrator) is responsible for ensuring that the final system incorporating the CO2 RF laser complies with all relevant safety regulations and legal requirements.

Please read this chapter carefully and adhere to the guidelines provided during every stage of integration and operation of the CO2 RF laser. Remember that compliance with safety regulations not only protects health and life but also guarantees efficient and trouble-free operation of the device.

Laser CO2 RF are sold as components and therefore are not required to conform to U.S. or European safety regulations. It is the responsibility of the buyer to design and certify any equipment incorporating a laser CO2 RF to meet all local safety regulations prior to sale to the public. The texts of these regulations are available from the respective governing bodies of the countries the equipment is to be sold into.

For more information on EMI standards, refer to local EMI safety regulations.

Never look directly into the laser output port.

European customers should appoint a Laser Safety Officer (LSO) who should refer to and follow the laser safety precautions described in EN60825.1-2007, Safety of Laser Products.

U.S. customers should refer to and follow the laser safety precaution described in the American Nation Standards Institute (ANSI) Z136.1-2007 document, Safe Use of Lasers. Procedures listed in this Standard include the appointment of a Laser Safety Officer (LSO), operation of the product in an area of limited access by trained personnel, servicing of equipment only by trained and authorized personnel, and posting of signs warning of the potential hazards.

3.1 Laser safesy

CO2 Laser Radiation and Its Effects

The CO2 laser resonator generates electromagnetic radiation in the infrared spectrum, with a wavelength ranging from 9 µm to 11 µm. This radiation is invisible to the human eye but carries high energy, making it potentially hazardous if used improperly.

Properties of CO2 Laser Radiation
- Wavelength: 9 µm – 11 µm (Far Infrared).
- Invisibility: The radiation is not detected by the human retina, making the beam difficult to locate and increasing the risk of accidental exposure.
- High Water Absorption: CO2 laser energy is readily absorbed by water, which is a primary component of biological tissues.

Biological Effects of CO2 Laser Exposure

Effects on the Eyes
- Corneal Damage: The CO2 laser beam is absorbed by the surface layers of the eye, specifically the cornea. This can lead to thermal burns, ulceration, and permanent vision loss.
- Reflection and Scattering Risk: Even reflected or scattered beams can cause severe injury; therefore, the use of appropriate shields and safety eyewear is mandatory.
- Lack of Blink Reflex: Since the radiation is invisible, it does not trigger the natural blink reflex, significantly increasing the duration and danger of exposure.

Effects on the Skin:
- Thermal Burns: CO2 laser radiation can cause severe skin burns, particularly upon direct contact with a high-power beam.
- Tissue Damage: The beam's energy is sufficient to evaporate water from skin cells, leading to deep tissue localized damage.
- Ablation: High-power beams cause immediate tissue ablation, leading to the instantaneous vaporization of biological matter.

Secondary Hazards

- Material Ignition: The high power density of the CO2 beam can ignite flammable materials such as wood, fabrics, or paper.
- Toxic Fumes and Gases: Laser processing (cutting/engraving) can release hazardous fumes and gases (e.g., from plastics), which pose a respiratory health risk.

Protective Measures

To minimize the risks associated with CO2 laser radiation, the following safety protocols must be strictly followed:
- Eye Protection: Always wear certified laser safety glasses specifically rated for the 9 um to 11 um wavelength with the appropriate Optical Density (OD). (OD 7+ @ 10,600 nm)
- Skin Protection: Avoid any direct contact with the laser beam and utilize appropriate enclosures or shielding around the work area.
- Access Control: Restrict access to the laser operating area to authorized and trained personnel only.
- Ventilation: Ensure an effective fume extraction system is in place to remove harmful vapors and gases generated during operation.
- Avoid Reflective Materials: Use matte surfaces in the beam path and avoid processing materials with high reflectivity unless the system is specifically designed for it.

Summary

Although invisible, CO2 laser radiation carries significant risks to the user's health and safety. By strictly adhering to safety protocols, utilizing personal protective equipment (PPE), and ensuring regular operator training, hazards can be minimized, ensuring efficient and safe operation of the device.

3.2 Electrical safety

Rezonator laserowy CO2 RF operate at 48 VDC, which is below the voltage limit that is considered dangerous by most safety standards. However, the lasers draw large amounts of current and the power supplies needed to provide the 48 VDC usually require 90-400 VAC to operate. For these reasons, proper safety precautions should be taken with every portion of the electrical system.

For more information on EMI standards, refer to local EMI safety regulations.

Electromagnetic Interference Rezonator laserowy CO2 RF are sold as components and therefore are not required to conform to all U.S. or European safety regulations regarding EMI. It is the responsibility of the customer to design and certify any equipment incorporating a Rezonator laserowy CO2 RF to meet all local safety regulations prior to sale to the public.
However, testing by DK Lasertechnik has demonstrated that with a properly selected power supply and line filtering all Rezonator laserowy CO2 RF will pass the relevant U.S. and European EMI standards for Class A equipment.

3.3 Safety Features and Compliance with Government Requirements

The following features are incorporated into the instrument to conform to several government requirements:

- Europe: European Union product safety mandates are dictated by the Low Voltage Directive (LVD) 2014/35/EU. To comply with the LVD, laser systems must satisfy the criteria of EN 61010-1/IEC 61010-1 ("Safety Requirements For Electrical Equipment For Measurement, Control and Laboratory Use") alongside EN 60825-1/IEC 60825-1 ("Safety of Laser Products"). The CE mark on this laser serves as the official certification of compliance with these European frameworks.

- United Kingdom (Great Britain): Safety mandates within England, Wales, and Scotland are defined by the Electrical Equipment (Safety) Regulations 2016 (SI 2016/1101). These statutory regulations mandate compliance with standards EN 61010-1/IEC 61010-1 and EN 60825-1/IEC 60825-1. The UKCA mark on the unit certifies its compliance with UK national requirements.

- United States: Federal regulations are governed by the Center for Devices and Radiological Health (CDRH) under 21 CFR, Subchapter J, Part 1040. Under US law, integrators who embed Photoncore series lasers into systems destined for the United States commercial market are legally classified as manufacturers. Consequently, they must ensure the final product complies with Federal standards, issue formal certification, and file product reports with the CDRH. For any jurisdictions outside the US, the purchaser is solely responsible for verifying adherence to regional laser safety laws.

- Japan (Electrical Appliances and Materials Safety Act): 本製品に付属する電源コードセット(電源ケーブル)は、本製品専用のものであり、本製品以外の機器で使用することを禁止します。 The power cable assembly bundled with this unit is engineered strictly for exclusive use with this specific product. Utilizing these power cords with any other electrical equipment is strictly prohibited.

3.4 Compliance to Standards Relevant to CE and UKCA Mark

The Photoncore laser series are configured as components, intended for incorporation into comprehensive laser system by a third-party system integrator. Individually, these units have been evaluated and certified to bear the CE mark for the European market and the UKCA mark for the United Kingdom. For comprehensive data regarding the specific harmonized standards and directives applied during testing, the EU and/or UKCA Declarations of DK Lasertechnik can be requested from Coherent via the contact details provided on page ii of this document.

Responsibility for validating the compliance of the final, integrated laser tool rests solely with the system manufacturer. Consequently, the integrator's primary objective is to engineer appropriate enclosures, shielding, grounding systems, cable routing, and safety controls to ensure the completed machinery satisfies all relevant regulatory standards during final certification testing.

3.5 Location of information labels

4. Storage

Proper storage of the CO2 RF laser is essential to maintain its operational integrity and ensure a long service life. Improper storage conditions may lead to component damage or negatively impact the device's performance and operational safety.

Recommended storage conditions

Environmental conditions

- Location: The laser must be stored in a dry, clean, and well-ventilated indoor environment.
- Storage Temperature Range: -20°C to +50°C.
- Relative Humidity: Must not exceed 70% to prevent moisture condensation on sensitive components.

Storage Position and Packaging

- Original Packaging: The laser should be kept in its original shipping container to provide protection against mechanical damage and vibrations.
- Orientation: The device must be stored in a horizontal position to avoid internal mechanical stress.

Precautions

- Contaminants: Avoid storage near heat sources, moisture, dust, or chemical substances that may cause corrosion.
- Direct Exposure: Protect the laser from direct sunlight and rapid temperature fluctuations (thermal shock).

5. Installation and connection

Proper installation and connection of the CO2 RF laser is a key step that has a direct impact on its performance, safety of use and durability of the device.

The laser, as a technologically advanced subassembly, requires precise installation in accordance with the manufacturer's recommendations and proper connection to assistive systems, such as power supply, cooling and control systems.

This subsection contains detailed instructions on how to unpack, assemble, correct electrical connections and the cooling system necessary for its proper operation.

When carrying out these activities, you must follow the safety rules and use only the recommended components and tools.

Please read the guidelines here carefully to ensure the correct integration of the laser with the rest of the system and to avoid potential technical problems or risks resulting from an incorrect connection.

5.1 Unpacking

Proper and careful unpacking of the CO2 RF laser is crucial to maintain its efficiency and long service life. Careless handling during unpacking may lead to damage to the component, or may affect its performance and safety of use.

Preparation for unpacking

Make sure the unpacking site is clean, dry and dust-free.
Prepare the right tools and protective materials, such as anti-static gloves, to avoid accidental damage to the component.

Unpacking steps

Gently open the transport package, following the markings and instructions on the package.
Remove protective elements such as foam, fillers, foil, being careful not to damage the laser.
Check that all delivered items are consistent with the list of contents of the shipment.

Visual inspection

Thoroughly check the laser for mechanical damage, such as dents, scratches or broken parts.
If you find any damage or deficiencies, contact the supplier or manufacturer immediately.

Careful carrying

Do not grab the device by delicate components, such as laser beam output ports, wires, electrical connectors or optical components.

Proceeding after unpacking

After unpacking and inspection, the laser should be placed at the installation site or in a safe storage location.
If the device is not installed immediately, protect it from dust, moisture and mechanical damage.

5.2 Mechanical assembly

Correct mechanical installation of the CO2 RF laser is a key step in ensuring reliable operation of the device. Due to the precise nature of this component, assembly should be carried out with the utmost accuracy and in accordance with the guidelines contained in this manual.
Incorrect execution of this step can lead to malfunction of the laser or damage to the device.

ATTENTION!

Attach the resonator with dedicated mounting points to prevent stress and damage. Incorrect installation can lead to internal bending of the laser and thus its incorrect operation or permanent damage.

Make sure that a proper working space is left around the laser for cooling and servicing.

ATTENTION!

The laser outlet is protected against dust during transport with a safety tape. Remove it before installation or first start-up.
If the laser is started with the protective tape, the optics will get dirty or permanently damaged.

Beam output orientation

Position the laser so that the output of the laser beam is in the optical axis of the receiving system (e.g., the lens system or scanner).

Beam output alignment

When using measuring tools such as a collimator or laser pointer, make sure that the laser beam is directed according to the application requirements.
Make minor adjustments to the position of the laser, if necessary.

After assembly

Check that the laser is securely attached and does not show mounting clearance.
Make sure that all fittings are tightened, but not excessively, so as not to damage the structure of the laser resonator.
Make sure the laser is fixed in a way that prevents accidental displacement during operation.
Verify that there is no risk of collision of the laser with other components of the system.

Additional notes

Mechanical assembly should be carried out by qualified technical personnel.
All guidelines contained in this documentation must be followed.
If you encounter difficulties or ambiguities, please contact DK Lasertechnik technical support.

Properly performed mechanical assembly is necessary to achieve optimal performance of the CO2 RF laser and to ensure its reliable operation over a long period of use.

ATTENTION!

The laser body has a 3-point mounting system. On the bottom plate there are precise mounting surfaces (3 pieces with a diameter of 12mm) and threads or holes for fixing with screws. The laser tube should be in contact with the installation site only at these three points and be screwed to the device with 3 screws. The exact arrangement of the mounting points and mounting screw locations is indicated in the technical drawings - see chapter 6. Technical drawings.

ATTENTION! The laser tube must come into contact with the place where it is installed only in the described 3 mounting points!

Failure to comply with this rule may cause the resonator to bend, which will result in damage.

5.3 Electrical connection (power supply)

Power supply

Use only power supplies provided or recommended by the manufacturer to ensure stability of operation and protection against overvoltages.
The power supply should be equipped with appropriate protections, such as fuses, EMC filters and surge arresters.

Preparation for electrical installation

Before starting the assembly, make sure that the power in the work area is turned off to avoid the risk of electric shock.
Use wires of appropriate diameter and insulation that meet the current requirements of the laser.
The wires must be resistant to temperature and laser radiation if they are conducted near the beam.
When connecting the device, use antistatic protection measures (e.g. wristbands) to avoid damaging the laser's electronics.

Power connection

Connect the power cables to the dedicated laser terminals, according to the pole designations (+ and -) for DC power supply and power cables for AC power supply.
Make sure the joints are solid and properly tightened to prevent accidental disconnection or sparking.

If the laser requires power to additional systems, such as cooling, make sure that all connections are in accordance with the manufacturer's recommendations.

Testing and inspection after connection

Check all electrical connections to make sure they are correct and safe.
Verify that the wires are not tense or exposed to mechanical damage.
Turn on the power and check that the laser is working properly (i.e. whether the LED indicator indicates the correct state).
Make sure there are no irregularities such as sparking, overheating, or unexpected noise.

In case of any electrical problems, please contact a qualified DK Lasertechnik technical service.

Additional notes

Electrical installation should be carried out in accordance with the guidelines contained in this manual and in compliance with applicable electrical safety standards. All work related to the electrical installation must be carried out by qualified technical personnel.

Description of the connector and power cord

The laser is equipped with an AMASS XT60 series power connector. As standard, comes with a 1m long power cord ending on one side with an XT60 plug (matching the laser).
As standard, wires with a cross section of 2.5 mm2 are used. in red (+) and black (-).

Drawing of the connector on the side of the power cables.

Drawing of the connector from the laser side.

48V DC power supply requirements

A good quality 48 volt DC power supply should be used to power the laser. Nominal output should not exceed 48 volts and regulation should be within +/- 0.5V under 100% load.
The power supply should have good transient response characteristics to handle the fluctuating current requirements caused by modulation of the laser. The power connector provides one pins each for 48 volt and ground connections to the power supply. A single 2.5mm2 wire each is sufficient for 48 volts and ground on laser.
Careful attention should be paid to power entry filtering when designing to meet Class A conducted EMI regulations. In order to meet Class A emitted EMI regulations.

Required power supply parameters:
- Output voltage 48V DC
- Minimum continuous output current 12A

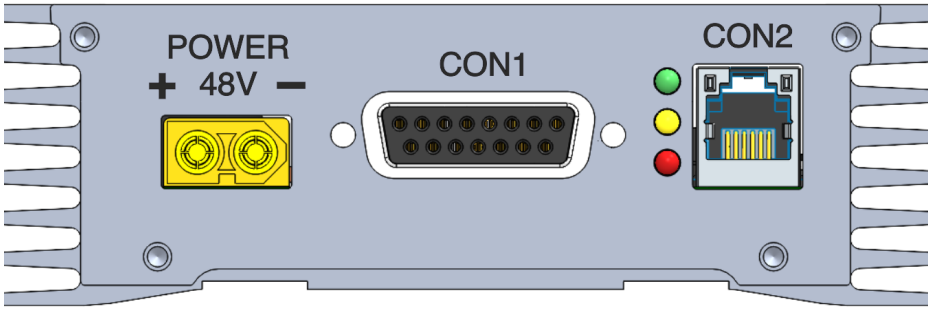
5.4 Connection of control signals (connector description)

Before connecting, read this manual and the electrical diagram of the control system in detail. Make sure that all cables and components comply with the specification of the device.

Before starting, check the correctness of the connections, verify that all wires are connected according to the documentation.

The laser body is equipped with two signal connectors:
- CON1 - control connector: D-Sub 15 female
- CON2 - optional connector for monitoring laser resonator parameters (power supply voltage, temperature, errors, etc.) : RJ12 (6p6c) pin socket. RS232 standard 12V

All signal inputs and outputs on the CON1 and CON2 connectors are opto-insulated. For proper operation of the laser resonator, simply use the CON1 connector



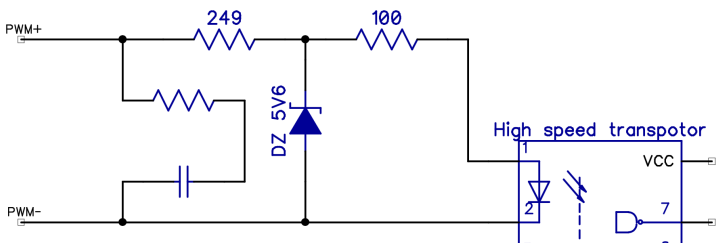
Opis złącz

CON1 - D-SUB 15 Female			
Pin 1	PWM +	Input	5V
Pin 2	PWM -	Input	
Pin 3	GND ISO		
Pin 4	+ 5V ISO	Output	max 40mA
Pin 5	GND ISO		
Pin 6	Status GND		
Pin 7	Status 1	Output	max 20 mA
Pin 8	Status 4	Output	max 20 mA
Pin 9	(optional) Key switch +	Input	5V
Pin 10	(optional) Key switch -		
Pin 11	Select mode (tickle mode)	Input	Connect do ISO GND (pin 5 or pin3)
Pin 12	Interlock +	Input	5V - 24V

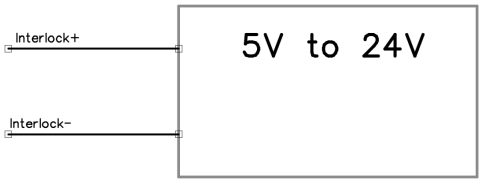
Pin 12	Interlock +	Input	5V - 24V
Pin 13	Interlock -	Input	0V
Pin 14	Status 2	Output	max 20 mA
Pin 15	Status 3	Output	max 20 mA

"Optional Key switch" depends on the version. It does not occur in the standard version.

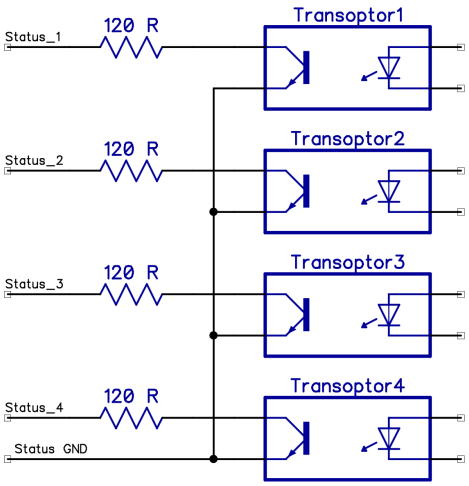
CON2 - RJ12 socket (6p6c)			
Pin 1	RX	Output	12V standard RS232
Pin 2	TX	Input	12V standard RS232
Pin 3	NC		
Pin 4	NC		
Pin 5	GND ISO		
Pin6	GND ISO		



Internal diagram of "PWM" inputs



Internal diagram of INTERLOCK inputs



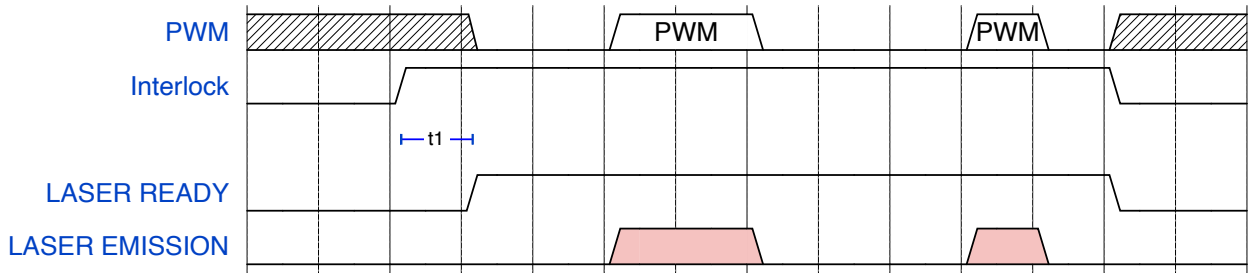
Internal diagram of STATUS outputs

5.4.1 Signals required

For the laser to work properly, it is enough to connect the Interlock signal and the PWM signal.

Power regulation and modulation are carried out using the PWM input.

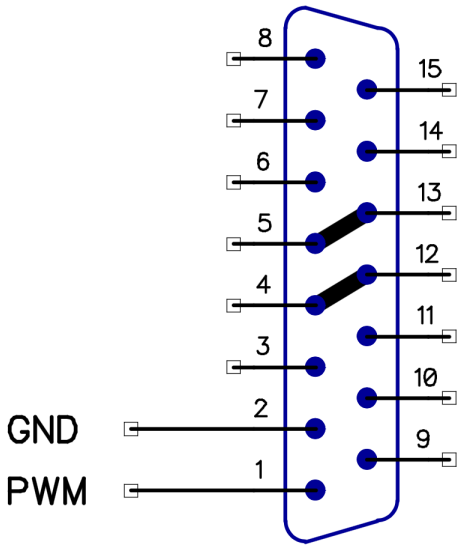
ATTENTION! Do not modulate the Interlock signal. It is only used to arm the laser!



t1 = 1 sek

Basic plug connection diagram

Interlock signal permanently enabled, control only via PWM signal. The Interlock signal is active all the time. To power the Interlock signal, the output voltage of 5V (galvanically isolated from the power supply of the tube) was used from the pins: Pin4 + 5V, Pin5 ISO GND



View from the plug-in side

ATTENTION! It is recommended that the interlock signal be activated by the controller of the device in which the laser works, e.g. via the key.

5.4.2 Optional signals

The laser has optional signals that can be used by the laser control system.

- "Interlock" - internal power supply activation signal and RF generator
- "Key" - optional signal depending on the laser version
- "Tickle" - internal Tickle generator off / on signal
- "Status 1..4" - status signals (outputs)

Interlock

The interlock signal is used for hardware disarming of the laser (disabling the internal RF generator by disconnecting the power fastener to the RF section).
It is recommended to use this signal as an additional protection against accidental laser beam emission. An example of the use of controlling this signal is the flap lifting sensor, covers in a laser plotter.

Key

In the laser version with active Key input. The Key signal is used to activate the laser emission. The 5V voltage to the Key input activates the laser 5 seconds after the input of this signal.
ATTENTION! The Key signal should be given after the Interlock signal is given. If the signals are given at intervals of less than 1 second. The laser will not be active.

Tickle

Signal to choose how tickle signals are generated. When the input is not connected, the internal (built-in) tickle signal generator is active - it has optimal parameters set during production.
When we give the GND ISO (pin 3 or pin 5 of the CON1 connector) to the input, the generator is turned off. The user must generate this signal himself. See chapter: 5.4.4 Tickle of this manual

Status

Status signals inform about the current state of the laser tube (e.g. beam emission, error, etc.)

Status 1	Laser on to power
Status 2	Laser armed (ready to work)
Status 3	Laser beam emission
Status 4	Error

The status signal is active when the output is shorted to the ground via the built-in transoptor.

5.4.3 RS232 diagnostic connector

The connector is used for advanced laser diagnostics. I am sending you information about the current laser temperature, supply voltage, laser status and any errors.

Transmission lines are in the RS232 12V standard and are galvanically separated.

Transmission parameters: 9600 baud, parity: none, 8 bits, stop bits: 1, ASCII
Transmission reception ended with a CR sign (Hex: D)

Send	Received	Description
01	01:xxx	Supply voltage
02	02:xxx	Temperature
03	03:xxx	Laser status
04	04:xxx	Error

Supply voltage

Example: xxx = 480 Description: 48.0V

Temperature

Example: xxx = 246 Description: 24.6 Degrees Celsius

Laser status

XXX code	Description
001	Laser ready to armed (no error)
002	Laser armed (ready to emission)
003	Laser ERROR

Laser Error

XXX code	Description
000	No error
001	Low voltage supply
002	Too high supply voltage
003	Laser temperature high
004	Laser temperature low

005	Damaged cooling fans
006	Internal damage to the RF generator or controller
007	Internal damage to the RF generator or controller

5.4.4 Tickle

If the Tickle selection signal is not connected (pin11 on the CON1 connector is not connected), the internal tickle signal generator of the RF generator is activated. Its parameters are factory set to the optimal level.

TICKLE is the excitatory signal of the RF generator of the CO2 laser resonator. Its purpose is to maintain the laser resonator in a state of partial excitation, ensuring minimal ionization of the gas mixture while at the same time no laser beam emission.

Basic functions of Tickle signal:
- Maintains sub-threshold energy of the laser resonator's interior
- Reduces the plasma ignition time after the control signal appears
- Stabilizes the RF generator operating point at transitions between standby state and full emission state

Proper use of the tickle signal allows for rapid modulation of the laser beam while maintaining an even power distribution (no uncontrolled power "peaks" at the start of the beam emission or slow "rising" of the laser power)

When a tickle selection signal is connected (pin11 on the CON1 to ISO GND connector - pin 3 or pin 5), the built-in tickle generator is turned off. This signal must be delivered to the laser resonator yourself via the PWM input. This signal must be combined with the power control signal.

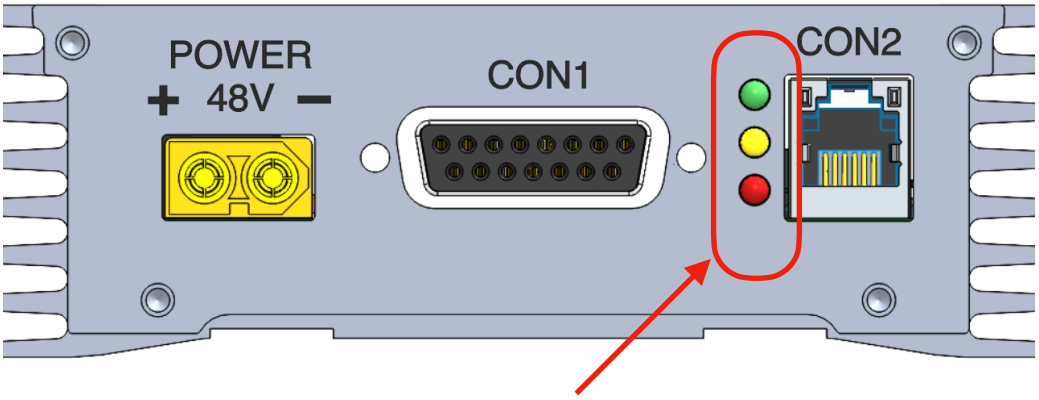
Tickle pulses must be sent at the end of every 200-µs interval in which a PWM Command signal is not applied.

Signal parameters:
- frequency 5kHz - 7kHz
- Pulse duration (from 1us to 4us). Parameters should be selected so that the laser power emission after the control signal is given appears without unnecessary delays. Too long duration of the tickle pulse will cause a „leak laser emit" of power when the control signal is off. (The laser will emit a beam with minimal power). In turn, too short a tickle duration will cause a delay in the emission of the laser beam.

Summary:

The tickle signal is nothing more than a PWM signal that controls the laser power but with specific parameters (5kHz - 7kHz, pulse duration from 1us to 4us). It must be generated all the time when the laser should be turned off (so as not to generate a beam but to keep the laser in the pre-excitation state).

5.4.5 Status LED's and error codes



Green LED	Laser power on
Yellow LED	Laser ready to emision
Red LED	Laser emission / Laser error (error code)

	Laser power ON	Laser ready to emission	Laser emission	Error
Green LED	ON	ON	ON	OFF
Yellow LED	OFF	ON	ON	OFF
Red LED	OFF	OFF	ON	FLASHING

Laser error code (flashing)

Number of flashes	Type of error
1	Low voltage supply
2	Too high supply voltage
3	Laser temperature high
4	Laser temperature low
5	Damaged cooling fans
6	Internal damage to the RF generator or controller
7	Internal damage to the RF generator or controller

Error codes are marked by flashing the red LED. The number of flashes determines what error occurred. Error codes can appear individually or in several sequences (when there is more than one error).

6. Cooling

The cooling system is a very important element and is necessary to ensure stable thermal operating conditions of the laser resonator.
The operation of the laser without proper heat dissipation can lead to deterioration of the beam parameters, a significant shortening of the laser's life or its permanent damage.

The laser is equipped with internal temperature monitoring protections. If the permissible operating conditions are exceeded, the control system will automatically turn off the device. The user is obliged to immediately remove the cause of the alarm before restarting the system.

The laser comes in three varieties related to cooling:
- Air cooling using built-in fans (standard version)
- Air cooling using foreign air - OEM version
- Water cooling

If the laser is to work in an environment with elevated ambient temperature or highly dusty, we prefer the choice of water cooling.

6.1 Air cooling - built

Laser version in factory-built air cooling (high-quality fans)
This is a standard production version.

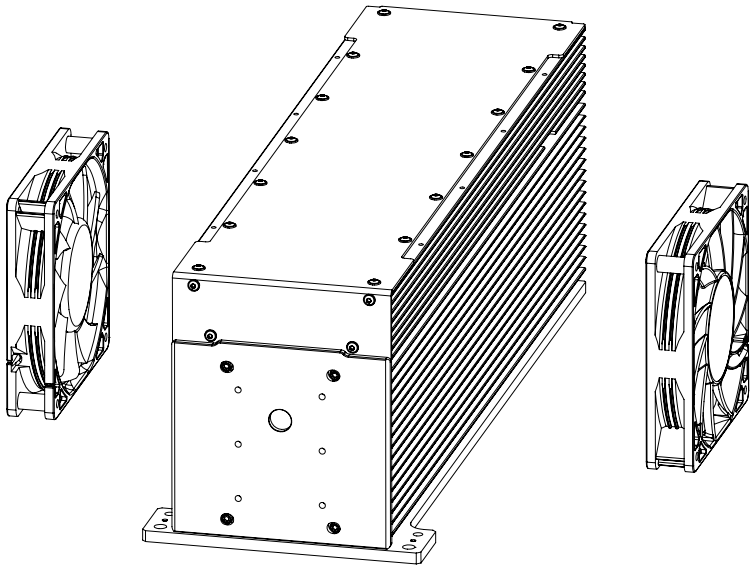
The laser is equipped with an intelligent fan speed control system, which translates into a greater work culture (less noise)

The built-in fans also have tachometric sensors, which results in safe shutdown of the laser in the event of a possible failure.

Attention! Remember not to cover the air inlet and outlet openings.

6.2 Air cooling - external (OEM version)

A version of the laser adapted to air cooling, but without built-in fans and without control. The user / integrator must install the appropriate air cooling system himself.



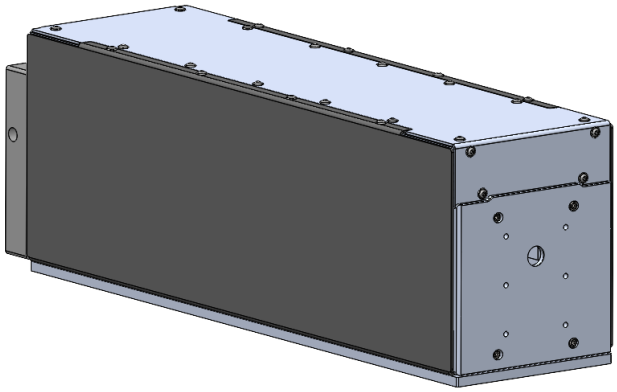
It is recommended that the laser be cooled by two fans (one for each side). - see figure above.

Recommended fan parameters:
- Size : 120x120
- Air flow min. 230 m3/h
- Static pressure min. 130 Pa
- Distance of fans from the laser body max. 10mm

If you encounter difficulties or ambiguities in the selection of cooling, please contact DK Lasertechnik Technical Support.

6.3 Water cooling

Laser version adapted for water cooling.



Cooling system requirements (chiller parameters)

Flow rate	4 lpm - 8 lpm
Water temperature	18 C - 22 C (Always below the dew point !)
Inlet pressure	max 4 bar
Heat load	min 600W
Temp precision	min 0,5 C

Dew point table

Temp. C	RH_10%	RH_20%	RH_30%	RH_40%	RH_50%	RH_60%	RH_70%	RH_80%	RH_90%
10	-20.2	-11.9	-6.8	-3.0	0.1	2.6	4.8	6.7	8.4
14	-17.1	-8.6	-3.3	0.6	3.7	6.4	8.6	10.6	12.4
18	-14.1	-5.3	0.2	4.2	7.4	10.1	12.4	14.5	16.3
22	-11.0	-2.0	3.6	7.8	11.1	13.9	16.3	18.4	20.3
26	-8.0	1.3	7.1	11.3	14.8	17.6	20.1	22.3	24.2
30	-4.9	4.6	10.5	14.9	18.4	21.4	23.9	26.2	28.2
34	-1.9	7.8	13.9	18.5	22.1	25.1	27.7	30.0	32.1
38	1.1	11.1	17.4	22.0	25.7	28.9	31.6	33.9	36.1

ATTENTION !

Remember to always set the water temperature above the dew point.
Starting the laser below the dew point results in permanent damage to the laser!

The following materials are used in the cooling path of the laser:

- Copper
- POM-C
- Viton
- Stainless steel

If you encounter difficulties or ambiguities in the selection of cooling, please contact DK Lasertechnik Technical Support.

7.0 Technical drawings

This chapter contains detailed technical drawings.

ATTENTION!

Laser tubes come in two types of fastening:
- Standard
- Slim

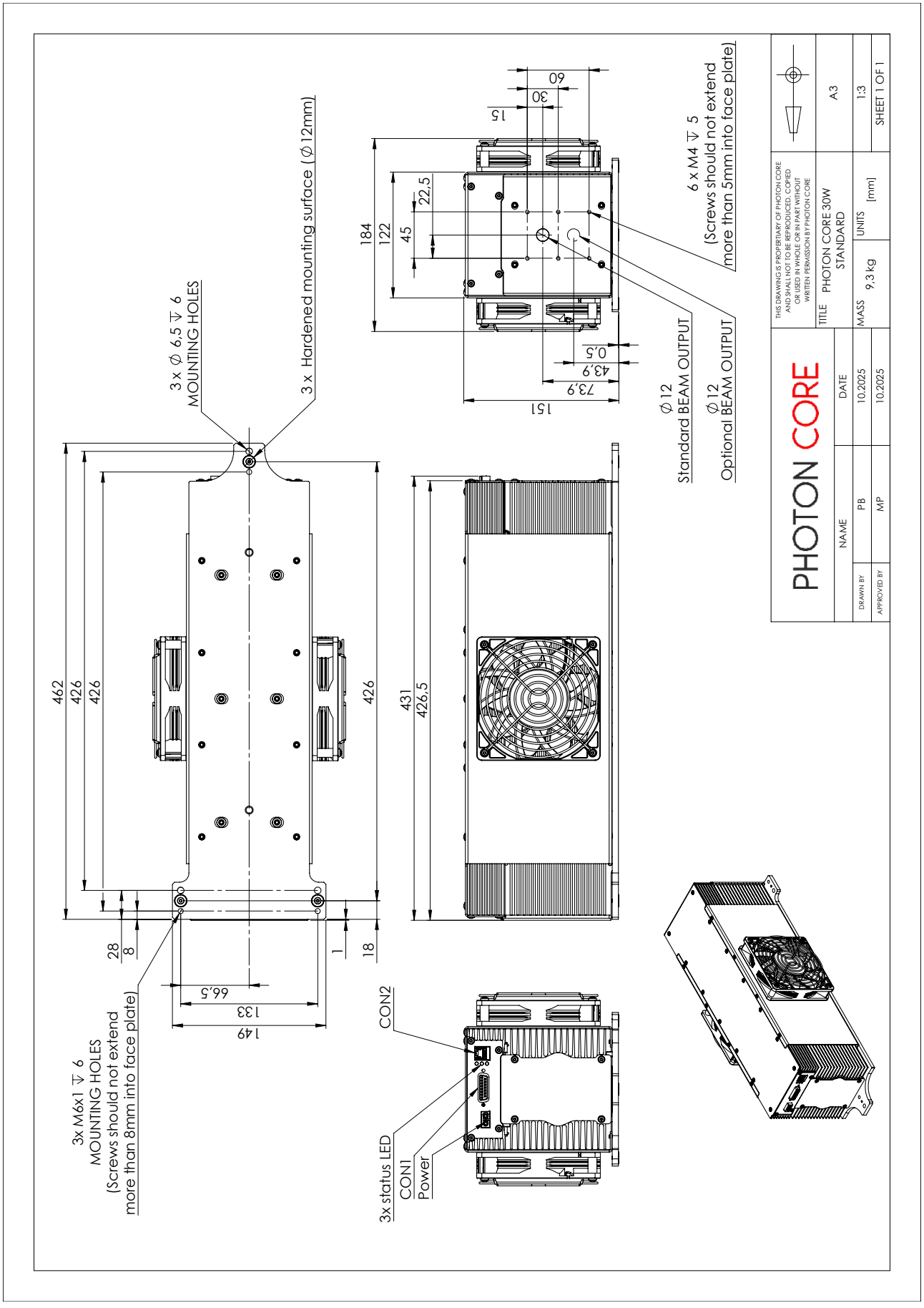
The "Standard" version allows mounting from the top or from the bottom.
It has a broader basis.

The "Slim" version has a mount only from the bottom side.
It has a narrower base.

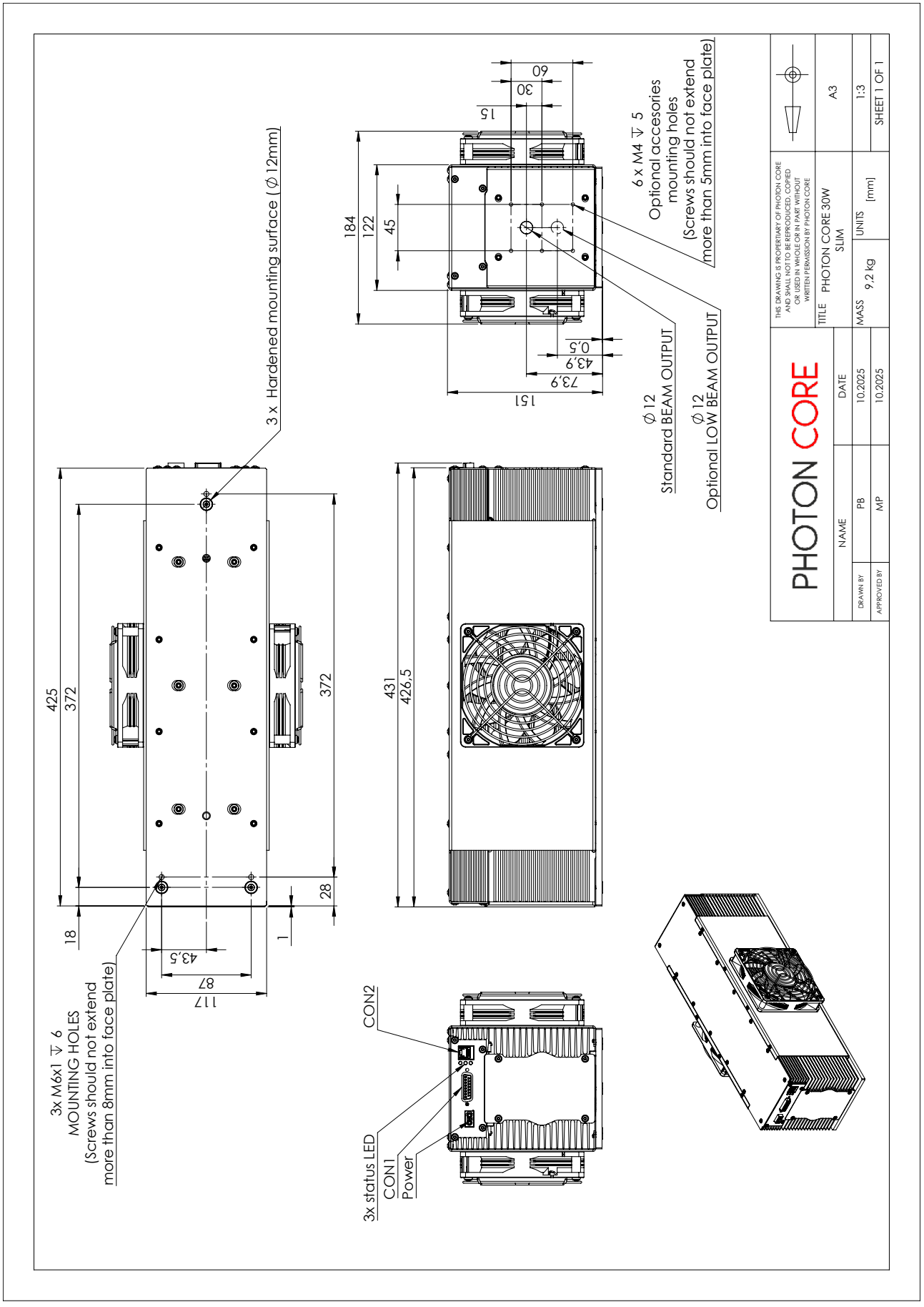
Each version can have two variations that differ in the height of the laser beam output:
- Standard Beam Output (height 73,9 mm)
- Optional Beam Output (height 43,9 mm)

How to encode the version is described in chapter 2.1

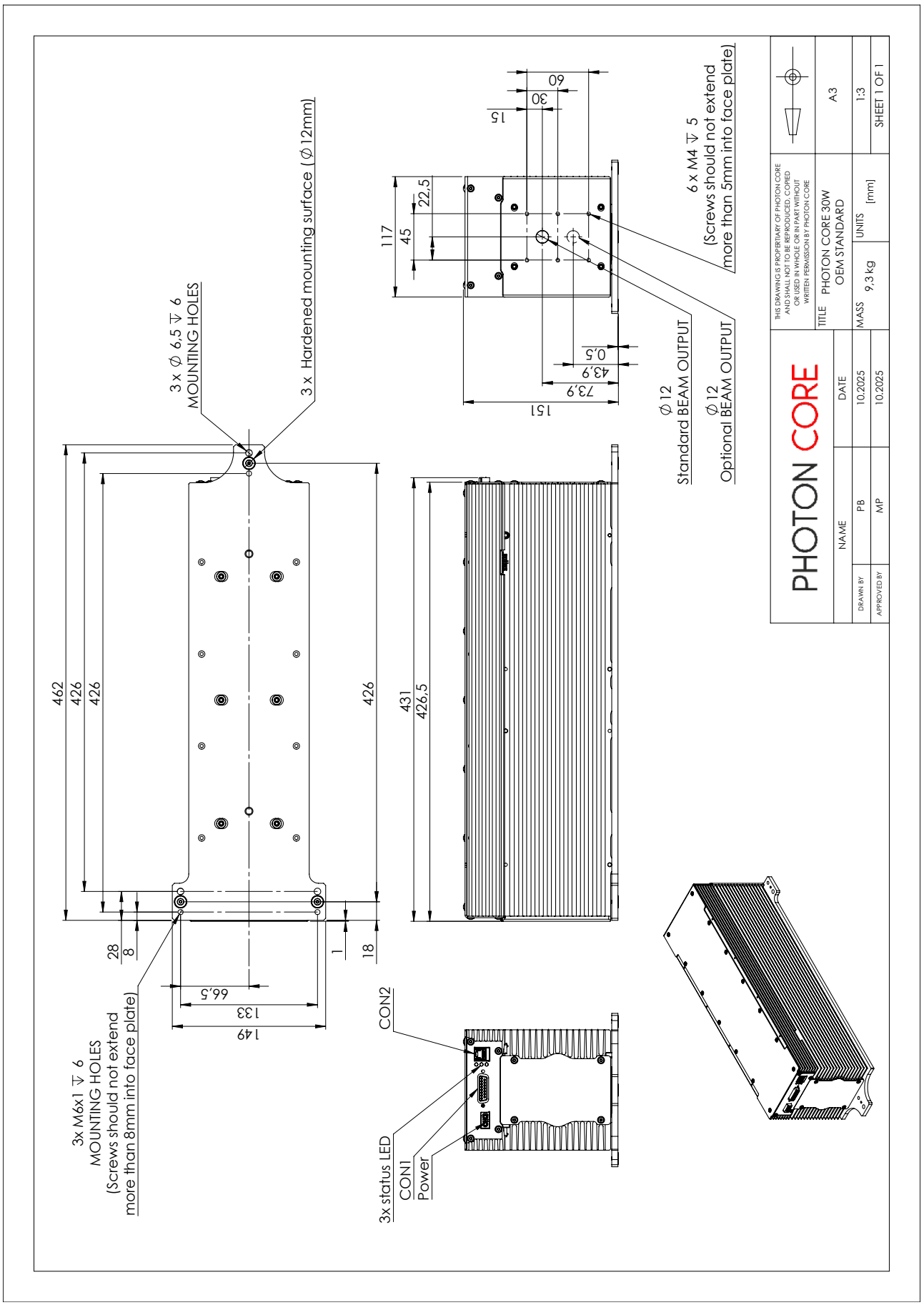
7.1 Standard version



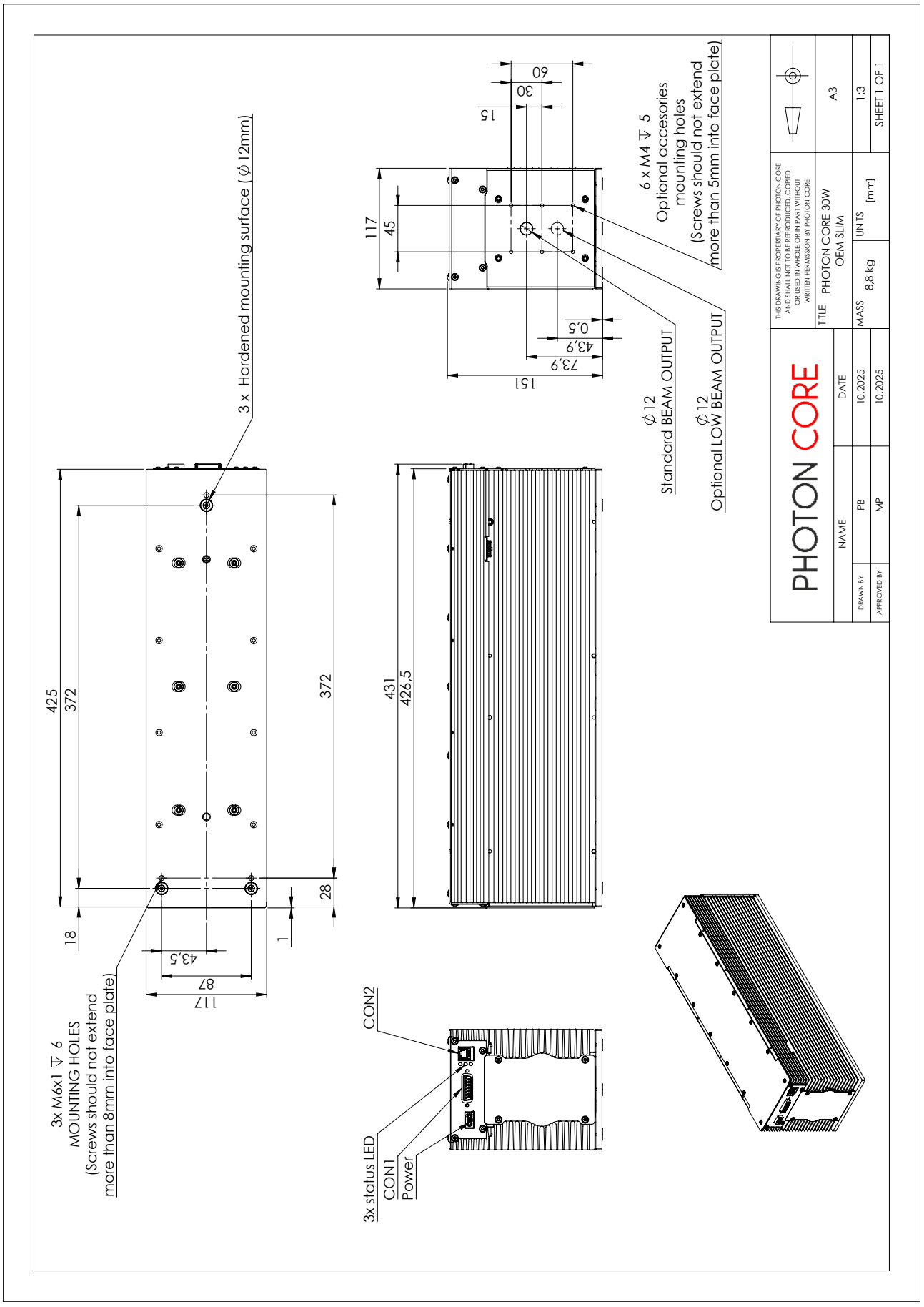
7.2 Standard slim version



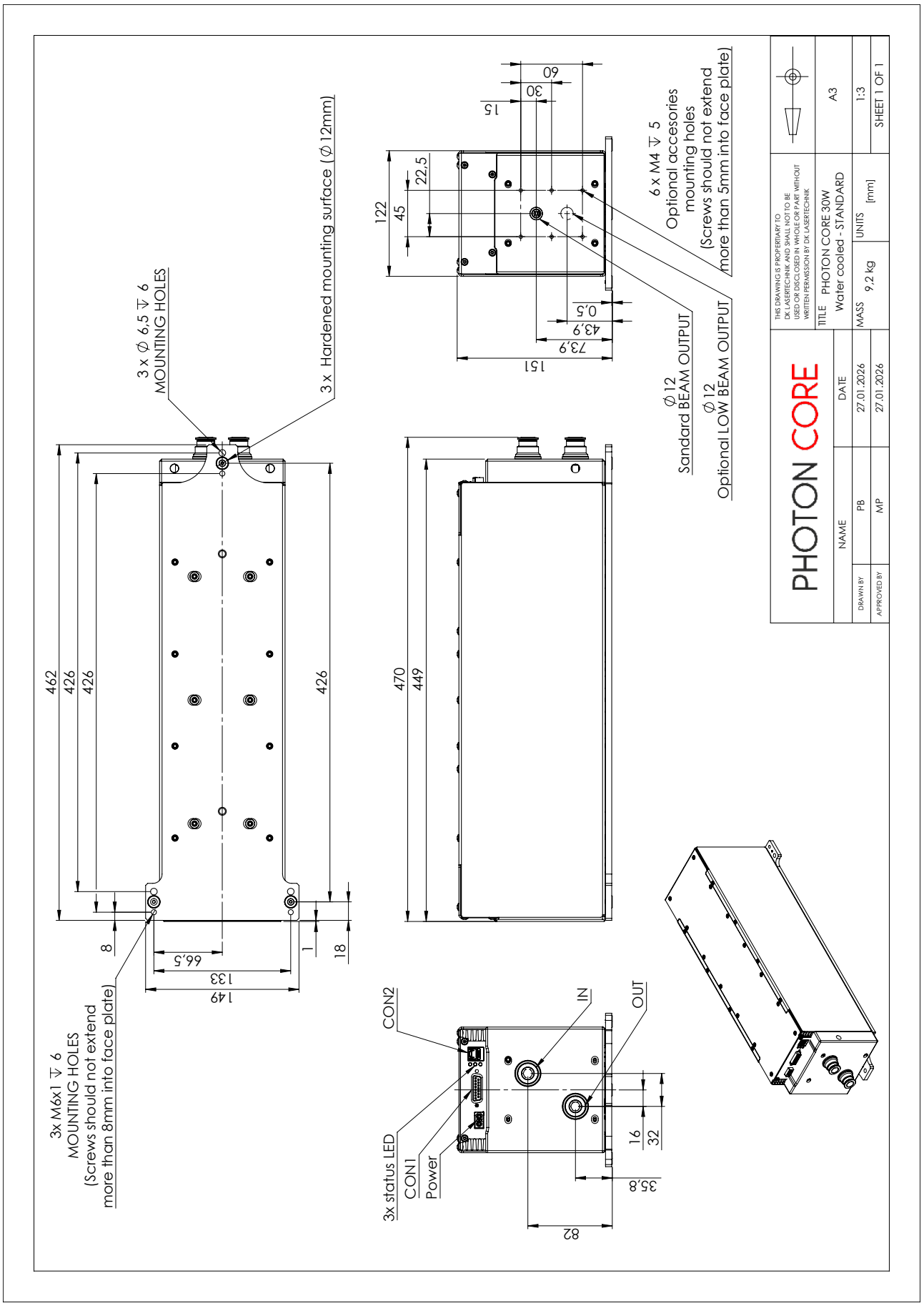
7.3 OEM version



7.4 OEM slim version



7.5 Water cooling version



7.6 Water cooling slim version