February 2020

1 – Company Overview

Bright Solutions S.r.l was **founded in 1998** by group of laser scientists and industry experts with significant experience in diode-pumped solid state laser engineering.

From the origin the Company's activity was oriented towards the development of the state-of-the-art DPSS laser sources with a goals of **superior efficiency, compactness and reliability.**

Bright Solutions has many experience veterans of the laser industry, with strengths in setting up **industrial production** and testing, and in guiding professionally skilled personnel in the manufacture of **diode-pumped solid-state lasers.**
Laser sources for **aerospace and scientific applications** are also a considerable part of Bright Solutions capabilities.
Bright Solutions has strong relationships with many experienced commercial Partners, thus securing a worldwide presence for the Company and diffusion of its unique products and solutions.

Bright Solutions is an ISO certified Company (ISO 9001:2015)

1 – Company Overview - news

Bright Solutions set up a **new facility** - closed to the headquarter - for allowing to optimize the organization of the existing departments and for defining new setting up four specialized business units:

- **Bright Aerospace** dedicated to custom projects and programs involving our DPSS laser sources specifically designed for airborne and satellite applications

- **Bright Microlaser** for developing and manufacturing microchip lasers after we acquired the assets of CRC Ltd.

- **Bright System**, the Advanced **sub-systems division and application lab** for investigating about special applications of our DPSS laser sources for micro-machining and material processing and for assisting our customers studying new laser processing opportunities

- **Bright Electron** for designing our proprietary electronics and firmware for our standard and customized platforms

Bright Solutions group grown up in the last years and currently **more than 60 people** are working full time as employees.

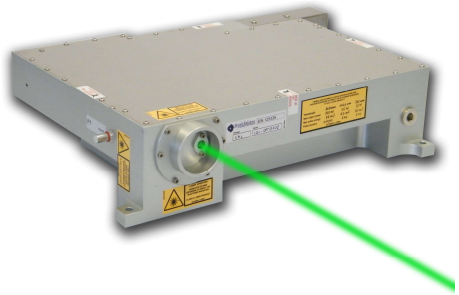
2 – R&D Activities

Industrial

- Development of high efficiency high peak power air cooled Q-switched ns and sub-ns DPSS Lasers
- Design and realization of ns and sub-ns MOPA lasers
- Development of ps laser solutions
- Customized fiber coupled diode modules
- High power optical fiber manufacturing

Aerospace

- Customized DPSS laser sources for LIDAR and Bathimetry
- Development of high pulse energy lasers
- Eye-safe laser modules for ranging
- Laser module development activities and subcontractor in aerospace and military programs.



Instrumentation and Medical

- Development of a laser source for minimally invasive neurosurgery (MIRSURG EU Project - 7th Framework Programme)
- Development of ps mode locked laser, ns Q-switched lasers and tunable OPOs for non linear optics applications.
- DPSS ns laser sources for sub-marine LIDAR

3 – Our Products – ns active Q-Switch DPSS lasers

Sol DPSS

Up to 40W @ 1064 nm
Up to 20W @ 532 nm
6 to 60 ns pulsewidth range
10 to 100 kHz

Onda DPSS

Up to 400kW peak power @ 1064 nm
Up to 300kW peak power @ 532 nm
2 to 10 ns pulsewidth range
266 and 355nm configurations

Wedge HB and XB DPSS

> 3 MW peak power
Single Shot to 1 or 2 kHz
< 2 ns pulsewidth
266, 355, 532, 1064 and 1570 nm

3 – Our Products – sub-ns active Q-Switch DPSS lasers

Wedge HF and XF DPSS

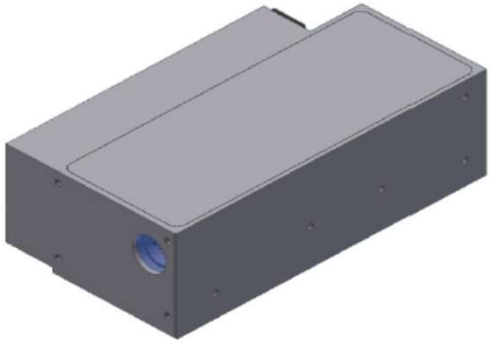
down to 400 ps pulsewidth
up to 100 kHz
up to 200 uJ pulse energy
266, 355, 532 and 1064 nm
M2< 1.3
Low jitter configuration

Vento MOPA DPSS

up to 100W @ 1064 nm
up to 50W @ 532 nm
< 400 ps pulsewidth
up to 100 kHz
THG and FHG options
Single unit design

3 – Our Products – passively Q-Switch DPSS lasers

One DPSS



> 3W @ 1064nm
up to 30 kHz
10 to 20 ns
M2< 1.5
Compact single unit footprint

Microchip lasers

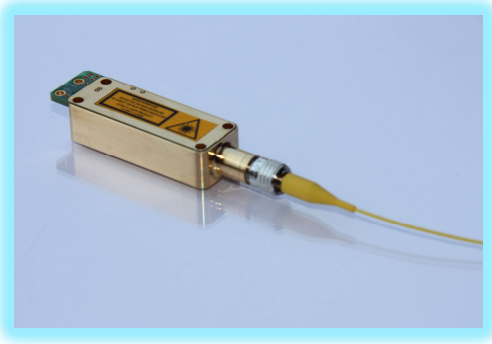
Up to 60 uJ @ 1064nm
<500 ps and <2 ns models
1064, 946, 532, 473, 355,266 nm
SLM
Miniaturized laser head

3 – Our Products – CW and QCW Diode laser modules

BDL series

up to 200 W CW
Up to 400 W QCW
808, 940, 980 nm
SMA output or Free space
Contact cooled
Water cooled

BFP and MDL series



up to 50 W CW
low current operation
808, 980, 1064 nm
Multiwavelength configurations
SMA output or Free space
Contact cooled

3 – NEW High-power and high-stability sub-ns models

Wedge HF Plus

down to 500 ps

up to 4W @ 532nm

up to 200 kW Peak Power

20 to 100 kHz

M2 < 1.3

PtoP RMS < 1.5%

Low jitter configuration

Wedge XF Plus

down to 400 ps

> 2 W @ 532nm @ 100 kHz

> 4W @ 1064nm @ 100 kHz

up to 100 kW @ 532nm

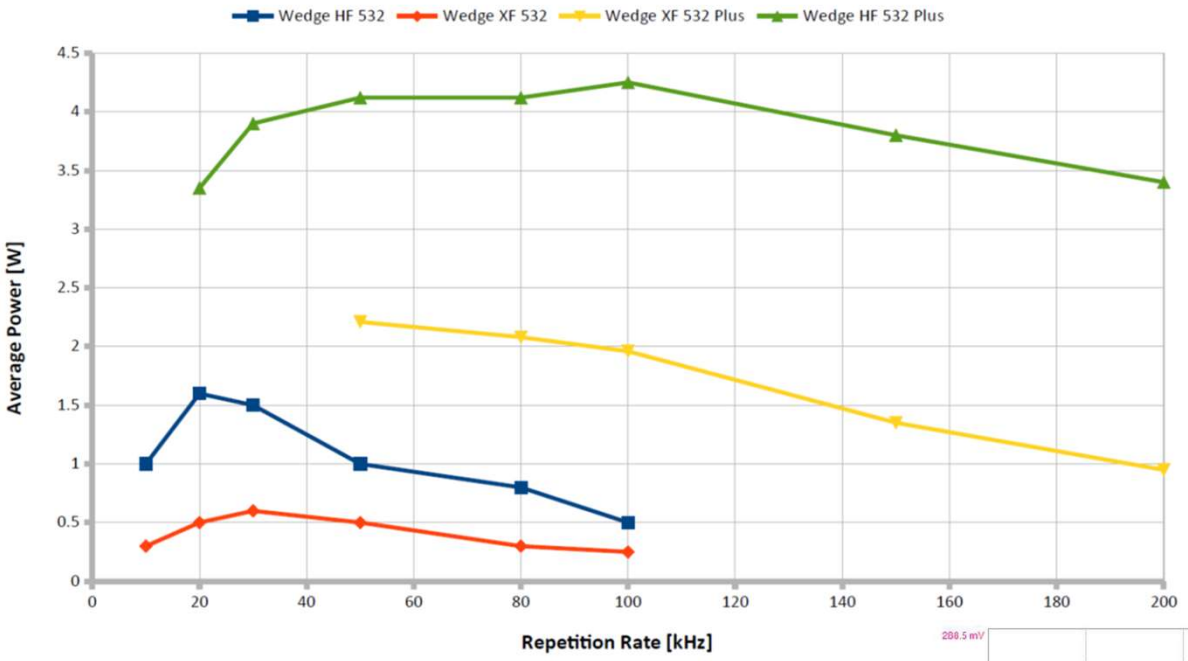
Up to 200 kW @ 1064nm

M2 < 1.5

Low jitter configuration

All the XF and HF Plus new models have the same footprint and IO interface of the standard Wedge XF and HF – overall dimensions: 185 x 95 x 74 mm^3

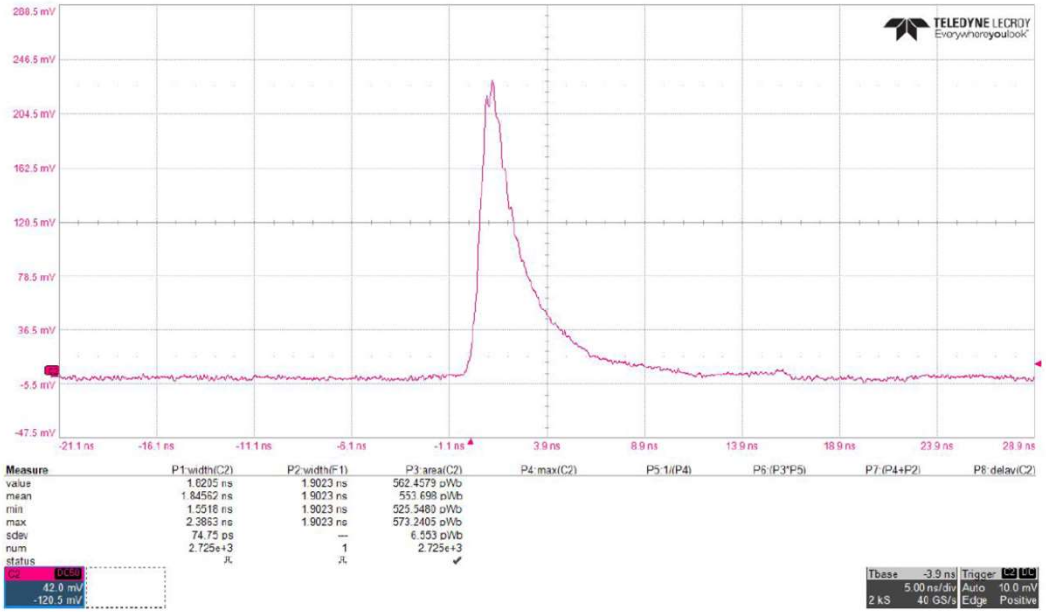
3 – NEW High-power and high-stability sub-ns models



Higher average power

Higher Peak Power

Higher Stability



3 – NEW Aero series - High-energy ns DPSS lasers

Aero main features:

Up to 200 mJ @ 1064nm

Up to 100 mJ @ 532nm

10 to 30 ns

Single shot to 100 Hz

THG optional module

Dual unit configuration

24 – 28 V DC

Conductive cooled

3 – NEW Nps series – Narrowband ultrafast lasers

Nps 1064 - 10

7 ps

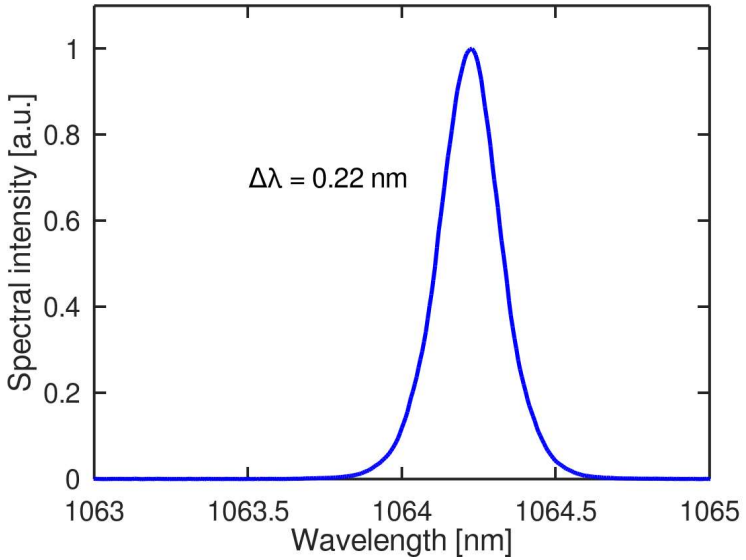
1064.3 nm (+/- 0.1 nm)

Spectral width < 0.3 nm

40 MHz

> 10 mW

M^2 < 1.2



3 – Sol DPSS

Sol is the most compact Q-switched DPSS laser available in the power range 6W to 40W at 1064nm and from 3W to 20W at 532nm.

Sol lasers are offered in a **rugged and lightweight** module, designed to allow easy and reliable integration in micro-machining and marking applications.

$23 \times 10 \times 9\ cm^3 – 4.5\ kg$

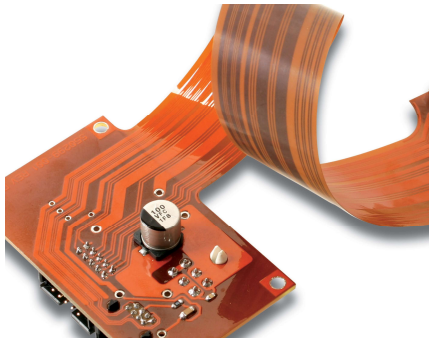
Due to the single enclosure design, optical fibers and other delicate cable connections will not be necessary for system integration.

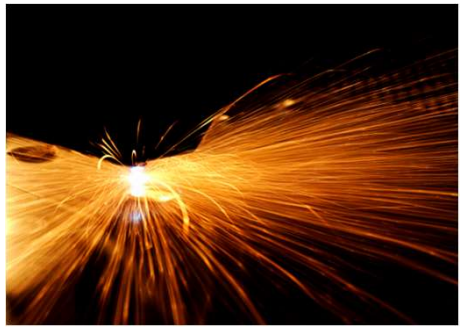
Compactness, insensitivity to environmental conditions and ease of handling guarantee superior operation flexibility and performance/cost ratio.
The high **peak power and the excellent beam quality** of SOL lasers make them the ideal source for the most demanding industrial and scientific applications.

Fast pulse energy modulator, red aiming beam, beam expander and thermostatic fans are always included in the configuration for industrial and laser marking applications.

3 – Sol DPSS

Up to 40 W @ 1064 nm
Up to 20 W @ 532 nm
> 200 kW Peak Power
Up to 100 kHz repetition rate
Electronic Pulse Energy Modulation
Automatic FPS
Rugged Monolithic Design
Air Cooling
24 Vdc





120.000 hours MTBF of Pumping Diodes

More than 5000 lasers on the field
Failure rate < 3%

Options available

Beam expanding and collimating optics
Red aiming beam
Extended frequency range *(Single Shot to 200 kHz)*
Circular Polarization
Monitoring Photodiode
Water and contact cooled versions
Control BOX for testing and diagnostics
AC-DC Power Supply

3 – Onda DPSS

Developed as a high-energy seeder for advanced MOPA systems, Onda is the new DPSS ns-laser platform aimed to high-end applications requiring both **excellent beam quality and high peak power** in order to process metals, glass, plastics, delicate and hard materials.

Onda is available at four different wavelengths:
266, 355, 532 and 1064nm.

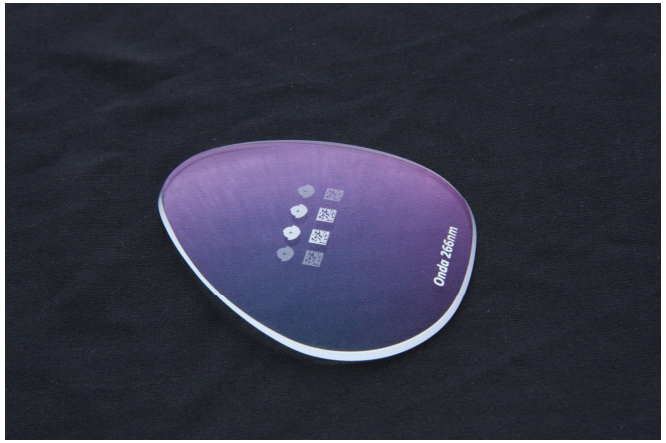
23 x 10 x 9 cm^3 – 4.5 kg

The internal optical layout and the accurate temperature management allow to get relevant pulse energy performances without compromising the lifetime of the THG and FHG stages.
All of Onda models can work from single shot to 50 kHz or up to 100 kHz with a pulsewitdh between **2 and 10 ns** and share the same electronic interface.

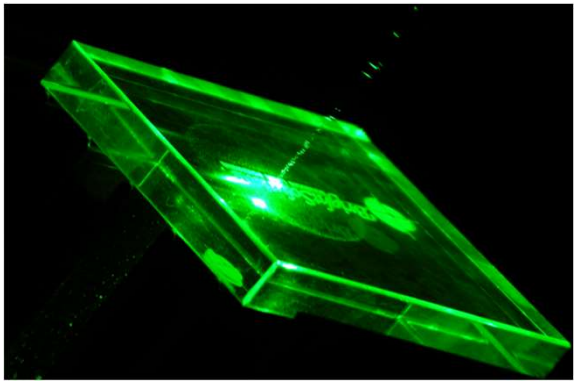
Compactness, insensitivity to environmental conditions and ease of handling allow superior operation flexibility and performance / cost ratio.

3 – Onda DPSS

800 uJ @ 1064 nm
800 uJ @ 532 nm
200 uJ @ 355 nm
80 uJ @ 266 nm
10 to 50 or 100 kHz
Electronic Pulse Energy Modulation
Rugged monolithic design
Field replaceable THG and FHG stages
Air Cooling
24 Vdc



Lens machining



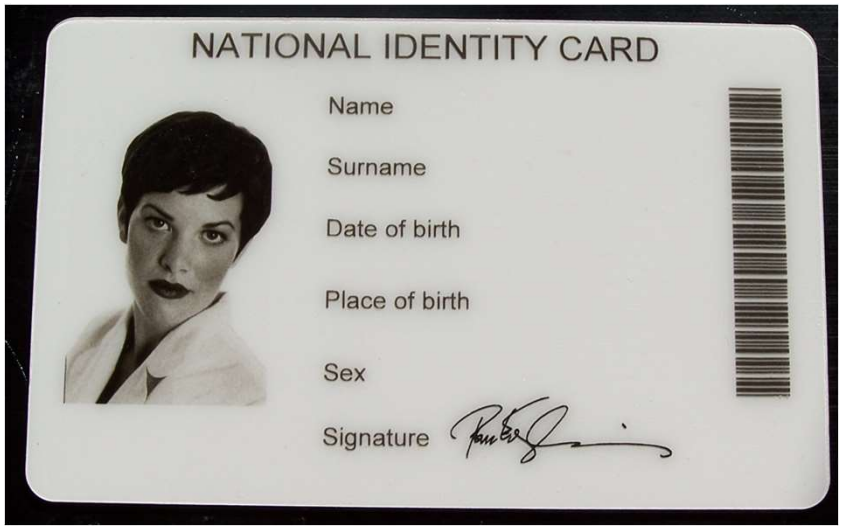
Glass engraving

Options available

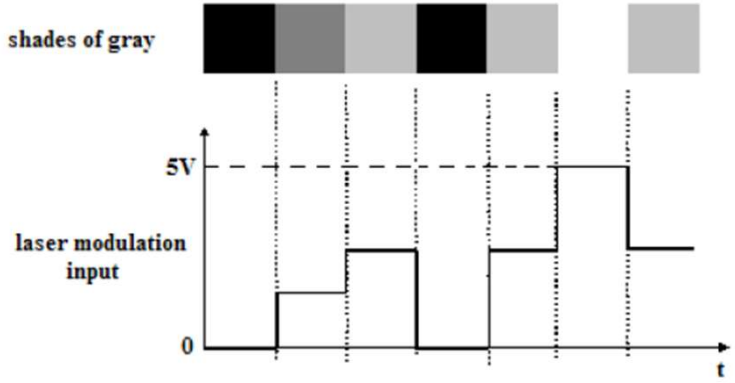
Beam expanding and collimating optics
Red aiming beam
Single Shot to 10 kHz
Circular Polarization
Monitoring Photodiode
Water and contact cooling versions
Extended temperature range
CBOX for testing and diagnostics
AC-DC Power Supply

3 – Sol and Onda for gray scale marking applications

INDUSTRIAL APPLICATIONS



Grey Scale Images obtained using Pulse Energy Modulation



3 – Wedge Family DPSS

WEDGE family has been recently redesigned in order to offer wider performance ranges and add some new models.

Wedge HB is available both at 1064nm and at 532 nm; pulse energy reaches 2 mJ in less than 1.5 ns. The air-cooled unit measures only 26 x 22 x 8 cm.
A higher energy model, the **Wedge XB**, is also available in a slightly larger footprint both at 1064nm and 532nm.
Maximum pulse energy is **4 mJ @ 1 kHz** with a pulsewith of 1 ns.

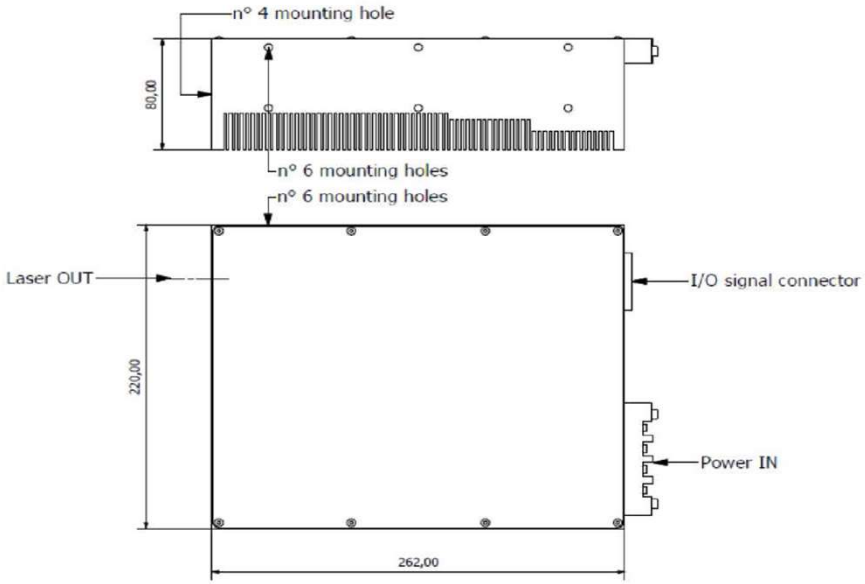
Wedge HF and Wedge XF models are provided in a very compact single unit laser source, only 8 x 9 x 19 cm, both at 1064nm and 532nm.
Repetition rate can reach 100 kHz and pulses can be **shorter than 500 ps**, achieving a remarkably high peak power suitable for **processing glass and special delicate materials.**

Wedge lasers are also available at 266, 355 and at 1570nm and can be optimized in terms of beam quality, pulse stability and operating repetition rate ranges according to user requirements.

Low jitter option – available for all the models – allows the user to better synchronize the laser and the measurement equipment in instrumental applications.

3 – Wedge HB DPSS

Up to 2 mJ Pulse Energy
2 MW Peak Power
< 1.5 ns Pulse Width
Single Shot to 2 kHz
Monolithic Design
Air Cooling
Low heat waste
@1064 @532 @355 @266 nm



WEDGE HB: 26 x 22 x 8 cm^3 – 7 kg

Options available

Beam Expanding and collimation optics
Low jitter option
Circular Polarization
CBOX for testing and diagnostics
Water cooled
AC-DC Power Supply
Parametric generation at 1.5 um and 3 um

3 – Wedge XB DPSS

Up to 4 mJ Pulse Energy
4 MW Peak Power
< 1.5 ns Pulse Width
Single Shot to 1 kHz
Monolithic Design
Air Cooling
Low heat waste
@1064 @532 @355 @266 nm

WEDGE XB: 26 x 25 x 10 cm^3 – 10 kg

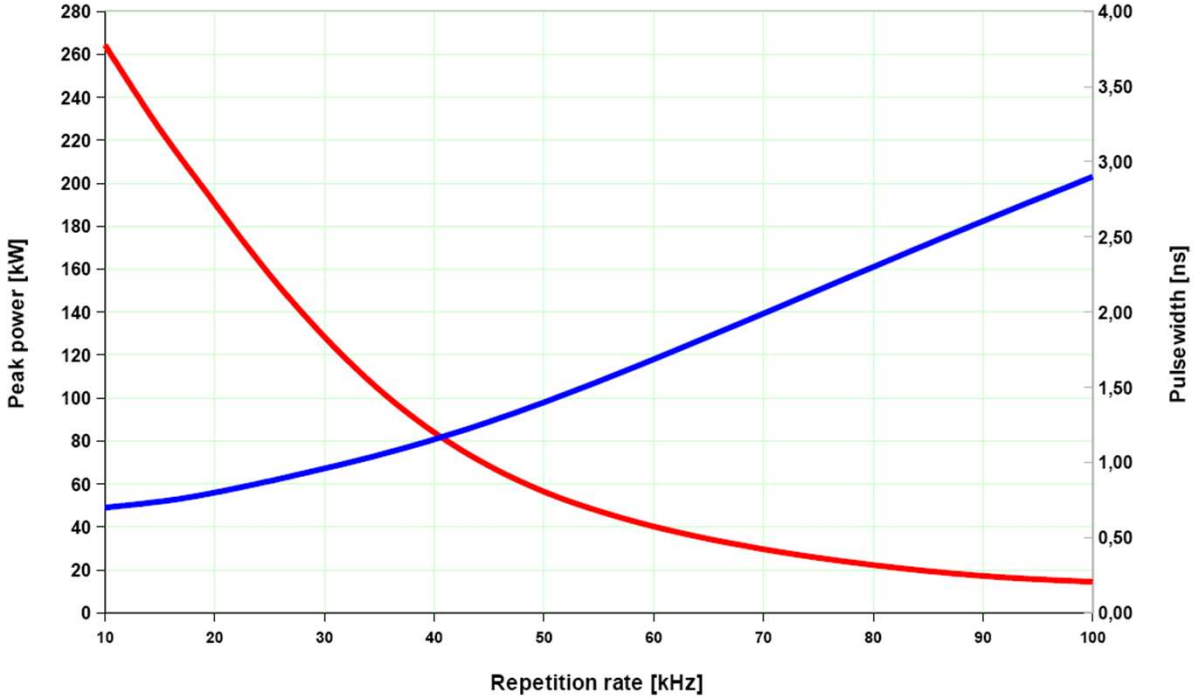
Pollution monitoring installation

Options available

Beam Expanding and collimation optics
Low jitter option
Circular Polarization
CBOX for testing and diagnostics
Water cooled version
AC-DC Power Supply
Parametric generation at 1.5 um and 3 um

3 – Wedge HF DPSS

Up to 200 uJ
Up to 250 kW peak power
$M^2 < 1.3$
700 ps to 3 ns
Up to to 100 kHz repetition rate
Low Jitter input
Aerospace qualified Design
Low heat waste
@1064 @532 @355 @266 nm

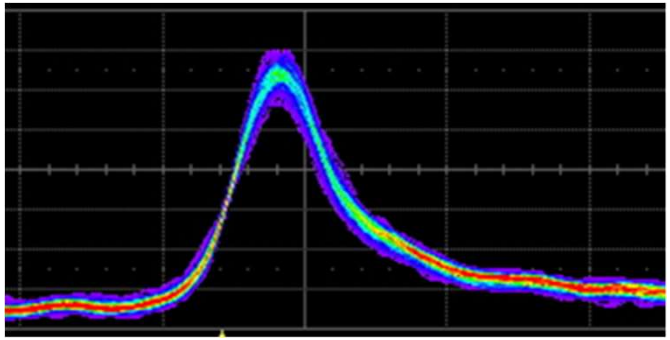


19 x 9 x 8 cm^3 – 2 kg

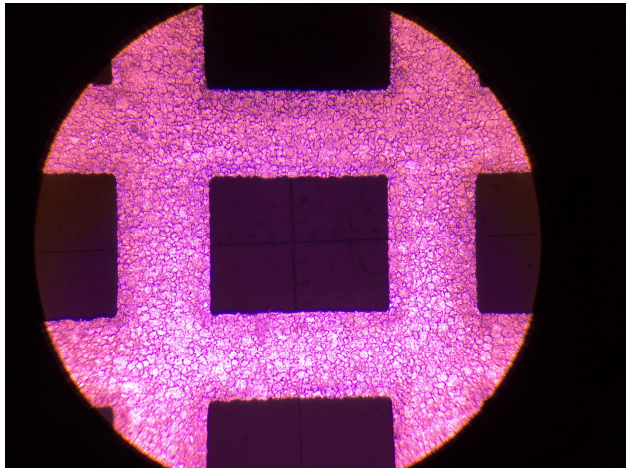
Air cooled / Water cooled / Contact cooled

3 – Wedge XF DPSS

Up to 150 uJ
Up to 300 kW Peak Power
$M^2 < 1.2$
Down to 400 ps
Up to 100 kHz
Low jitter input
Low heat waste
@1064 @532 @355 @266 nm



< 400 ps @ 10 kHz



OLED masks processing

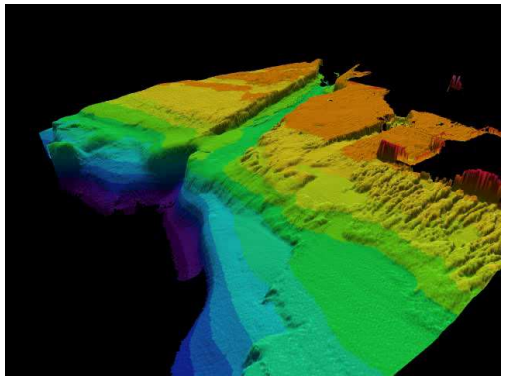
Available Options for HF and XF models :

- Beam Expanding and collimation optics
- Red aiming beam
- Circular Polarization
- Single Shot operation
- Output PD monitor
- CBOX for testing and diagnostics
- AC-DC Power Supply

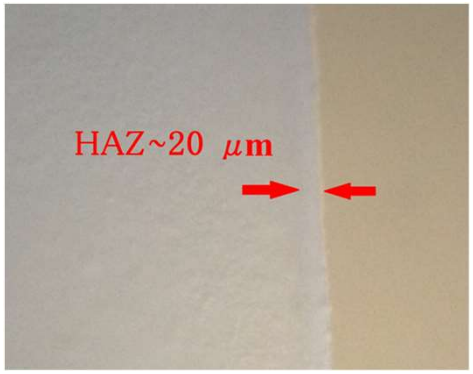
3 – Vento MOPA DPSSL

up to 100 W @1064 nm
up to 50W @ 532 nm
< 400 ps pulsewidth
up to 100 kHz
M2 < 2
Low jitter input
Single unit design

Water Cooled Single Unit



Mapping



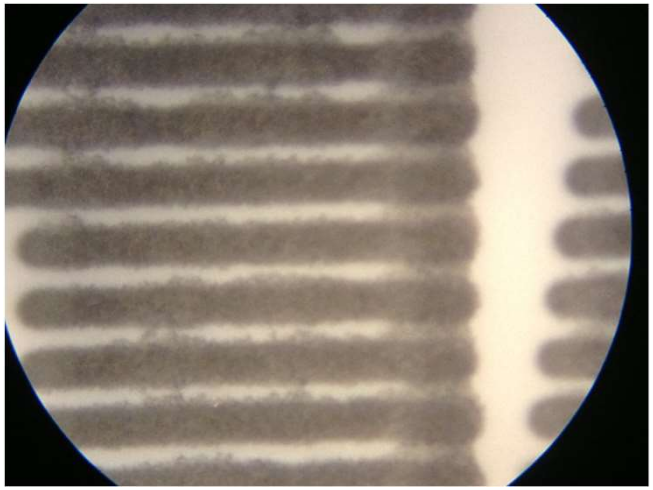
Dielectric cutting

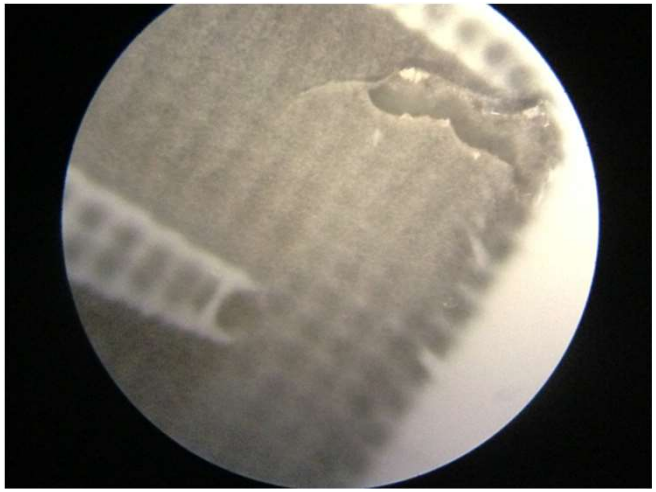
Available Options
:

Beam Expanding and collimation optics
Circular Polarization
Single Shot operation
High IP grade configuration
CBOX for testing and diagnostics
AC-DC Power Supply

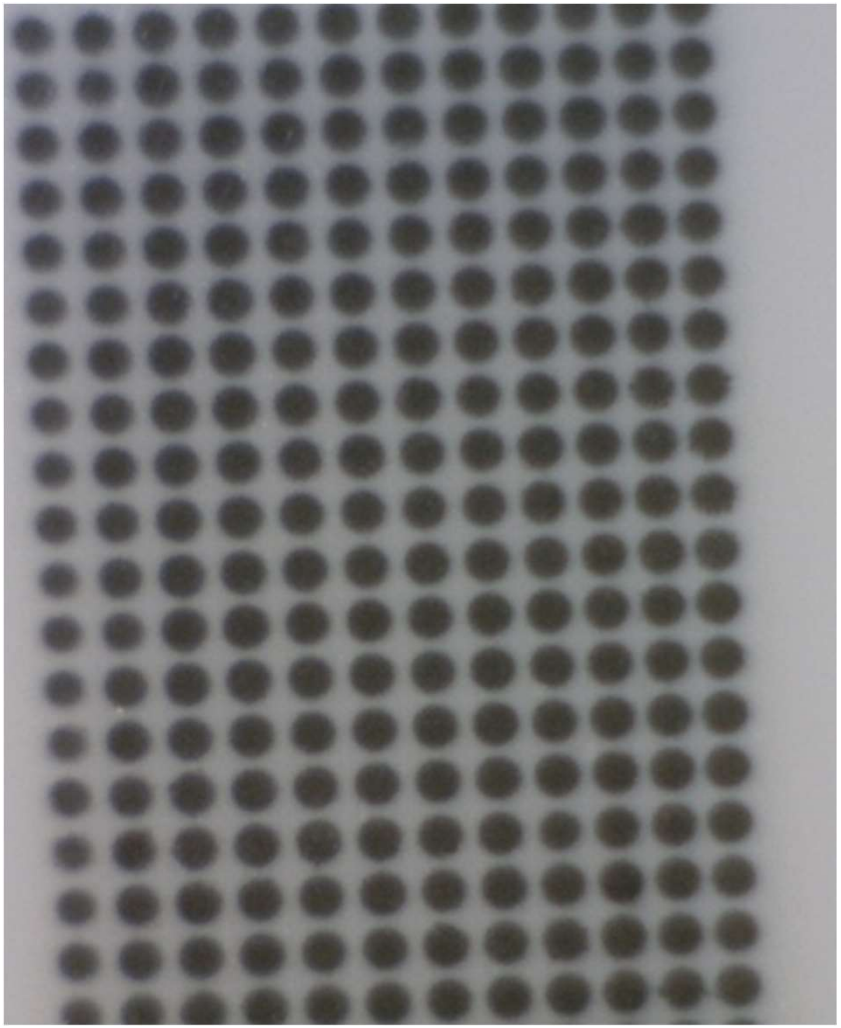
3 – Comparison between ns and sub-ns DPSSL

ns laser marking effect
on sensitive material

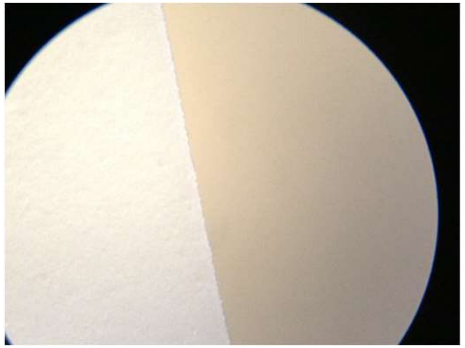




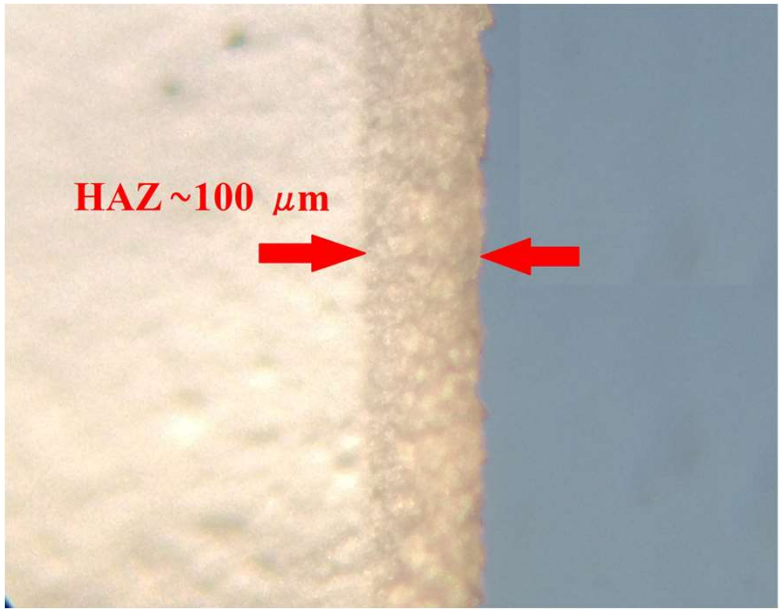
sub-ns laser marking effect
on the same sensitive material



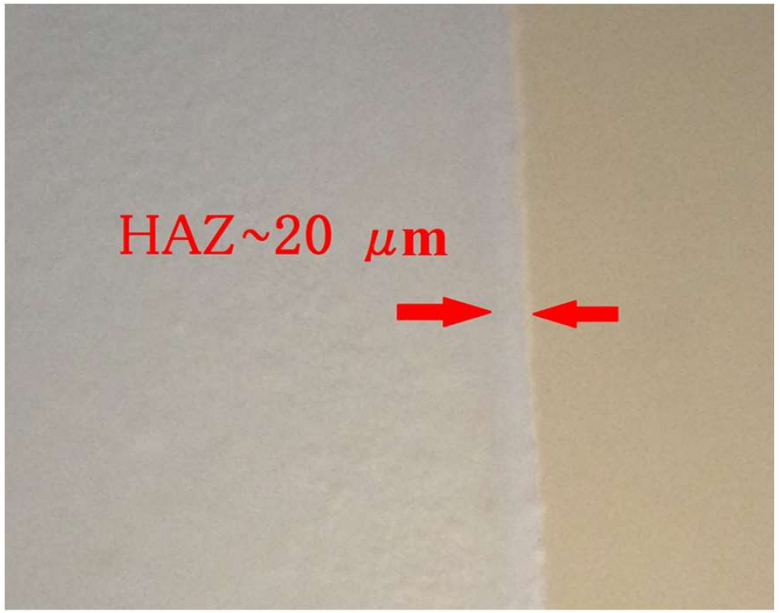
3 – Comparison between ns and sub-ns DPSSL



ns laser cutting of ceramic film



sub-ns laser cutting of ceramic film

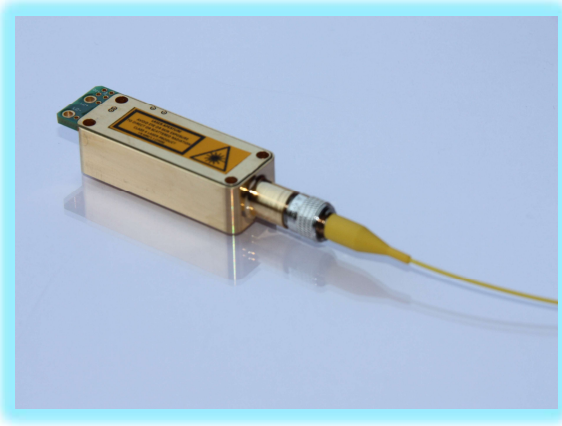


Benchmark ns and sub-ns DPSSL

Parameter @1064nm	**Sol**	**Onda**	**Wedge HF**	**Wedge XF**
Average power	6W to 40W	15W	4W	4W
Pulsewidth range	**5 – 50 ns**	**2 – 10 ns**	**0.7 – 3 ns**	**0.4 – 1 ns**
Pulse Energy	up to 2000 uJ	up to 800 uJ	up to 200 uJ	up to 150 uJ
Peak Power	**Up to 250 kW**	**up to 400kW**	**up to 250 kW**	**up to 300 kW**
Rep. Rate	10 to 100 kHz with SS option available			
Polarization	Linear (100:1) (option: circular polarization)			
Beam Diameter	2 – 4 – 6 mm with integrated BEX			
Beam quality (M2)	1.5 to 2.5	< 1.5	< 1.3	< 1.3
Cooling	Air cooled (option: water cooling)			
Weight	4.5 kg	4 kg	2 kg	2kg

3 – BDL and BFP Diode Lasers

The BDL line of fiber-coupled diode lasers is available in various sizes from 5W to 400W. The integrated optical design, accurate test and selection of **high quality semiconductor materials** and efficient thermal management make these devices the ideal choice for applications requiring reliability, long lifetime and simple conductive cooling in a small footprint.

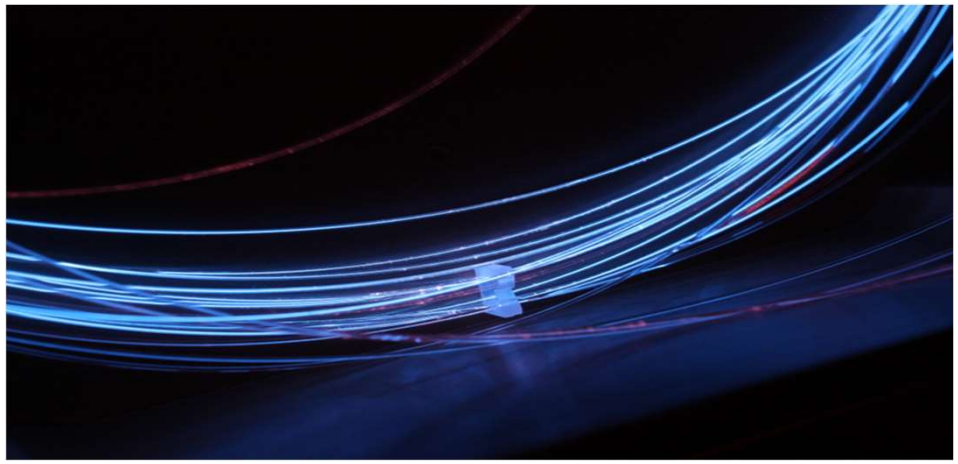


The BFP line of high power fiber coupled diode lasers is also available in different packages from few Watts to 50W of output power.
Based on an integrated **multi-single emitter design**, they are particularly suited for pumping applications and medical, ensuring long lifetime, low current operation and the highest brightness in a **miniaturized package**.

BFP packages can be coupled to standard optical connectors like SMA and FC and can include a variety of accessories from aiming beam to integrated controllers, aimed to medical, industrial, scientific and aerospace direct applications.
Multi-wavelength solutions (MDL) are well suited for a variety of medical applications; up to 4 different wavelengths can be available in one module.

3 – BDL

25 W to 200 W CW
Up to 400W QCW
808, 940, 980 nm
200 to 600 um fiber coupled
SMA output connector
Contact cooling
Sealed and rugged



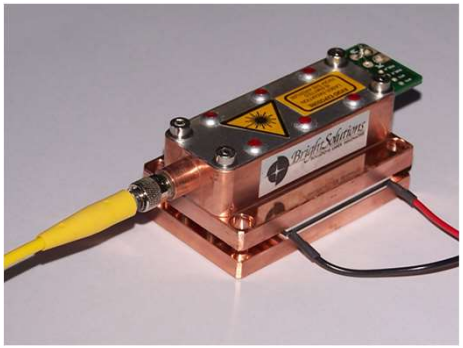
Available in 5 different packages:
A – D – E – F - K

Options available

Monitoring photodiode
Red aiming beam
Fiber presence sensor
TEC cooler
Free space propagation
Integrated Current and Temperature controller
Custom solutions

3 – BFP

5 W to 50 W
808, 976, 1064 nm
100 to 600 um fiber coupled
Low operating current
Multiwavelength
SMA output
Contact cooling
Deteachable optical fiber



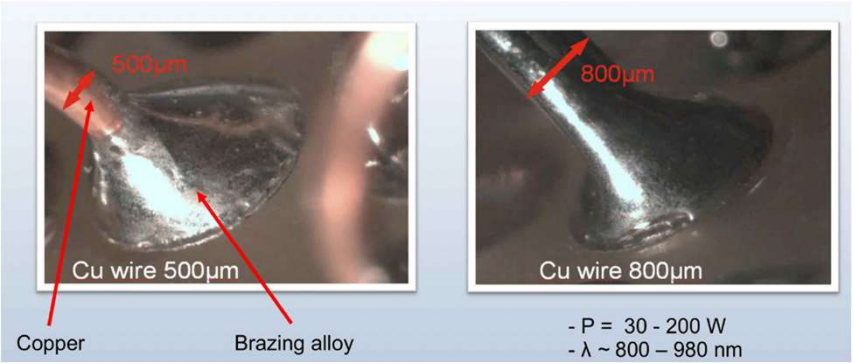
High flexibility in wavelength and power configurations

Options available

Monitoring photodiode
Red aiming beam
Fiber presence sensor
TEC cooler
Free space propagation
Integrated Current and Temperature controller
Custom solutions

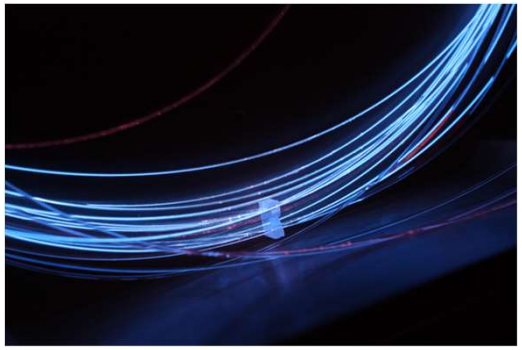
3 – BDL and BFP Applications - Industrial

DIRECT APPLICATIONS



Soldering

Plastic Welding



Fiber laser pumping

Solid state laser pumping

3 – BDL and BFP Applications

MEDICAL APPLICATIONS

- Physiotherapy
- Photodynamic therapy
- Vascular
- Dental
- Biostimulation
- Surgical
- Aestethic Treatment
- Veterinary

AEROSPACE and MILITARY APPLICATIONS

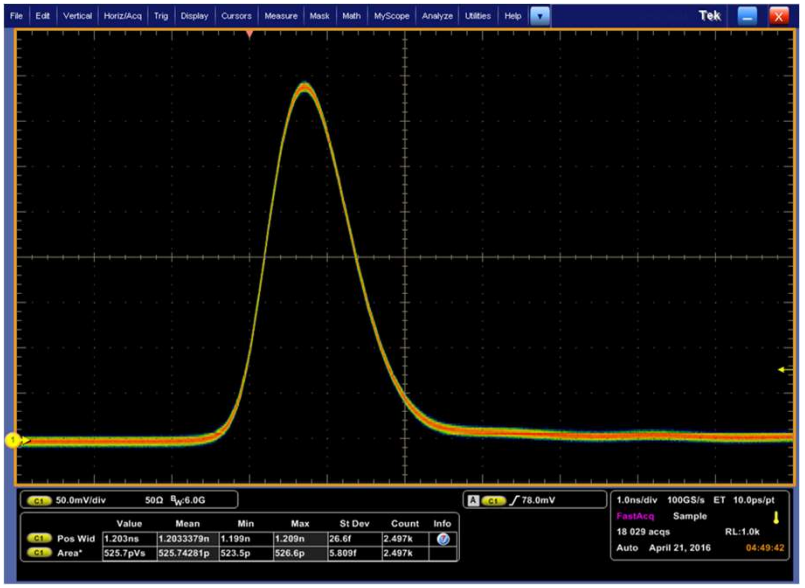
- Target illumination and designation
- Ranging

3 – microchip lasers

Bright Solutions has acquired the inventory and technology assets of Concepts Research Corporation (CRC), a leading US manufacturer of microchip lasers.

Typical features:

- pulsewidth: down to 300 ps
- repetition rate: up to 100 kHz
- available wavelength: 1064, 532, 355, 266 nm
  946, 473, 315, 213 nm
- single frequency – narrow line
- pulse energy: up to 60 uJ @ 1064 nm
- low noise operation: <1% pulse instability
  at all wavelengths



2uJ- 1kHz - 266nm model

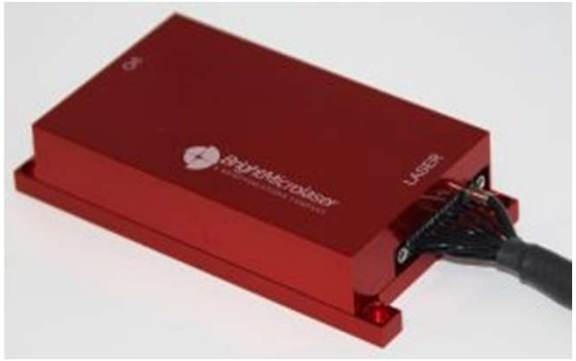
Options:

- drivers
- photodiode
- heatsink

	Value	Mean	Min	Max	St Dev	Count	Info
C1 Pos Wid	1.203ns	1.2033379n	1.199n	1.209n	26.6f	2.497k	
C1 Area*	525.7pVs	525.74281p	523.5p	526.6p	5.809f	2.497k	

3 – microchip lasers

Nowadays many applications, such as unmanned aerial vehicle (UAV) LiDAR, biophotonics instruments, automotive and handheld LIBS demand high performance solutions with reduced size, weight and power consumption (SWaP).



New smart laser driver

Miniaturized laser head footprint

This is exactly what Bright Microlaser is pursuing while launching a new laser package for UV microchip lasers (P4 package) and the new smart laser driver which is more user friendly than the previous versions, yet still compatible with older models.

Excellent beam quality, spectral properties and long-term stability have been tested and proven in all application environments, from research labs to industrial, automotive and airborne.

The new laser driver is meant for smarter laser operation, offering OEM integrators a higher degree of monitoring and control capabilities of key laser parameters, real time feedback with a remote-control connection and new and improved GUI software.

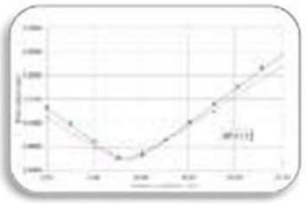
3 – microchip lasers

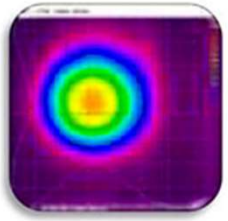
Series Technical Specifications			
Pulsewidth Ranges	Nanoseconds		Picoseconds
	< 2.5 ns	< 1.3 ns	< 400 ps
Pulse Energy	up to 35 µJ	up to 40 µJ	up to 2 µJ
Repetition Rates	up to 5 kHz	up to 15 kHz	up to 100 kHz
	internal and external triggered		
Output Peak Power	up to 15 kW	up to 30 kW	up to 5 kW
Package	FP3, FP4	FP3, FP4	FP2, FP3, FP4
Output Wavelengths	1064, 946, 532, 473, 355, 315, 266, 236.5, 213 nm		
Beam Quality (M^2)	<1.2		
Electrical Requirements	DC power supply 5 V, <25 VA		
Size	35×50×16 mm^3 (*)		
Weight	< 0.15 Kg (*)		
Operating Temperature	+10 to +40 °C		
Storage Temperature	-20 to +60 °C		

(*) FP3 package

Options Available:

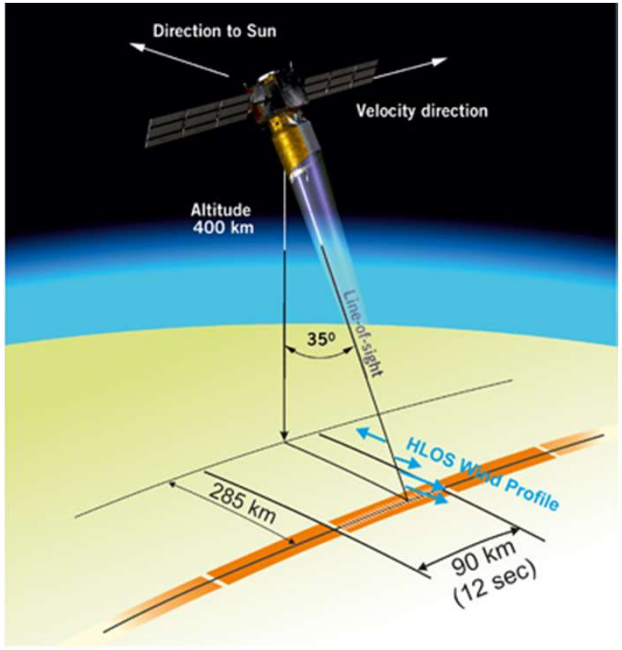
- Internal photo-diode
- Beam Expanding and Collimating optics
- Circular Polarization
- Cooling: Heat Sink
- AC DC Power Supply
- Custom packaging

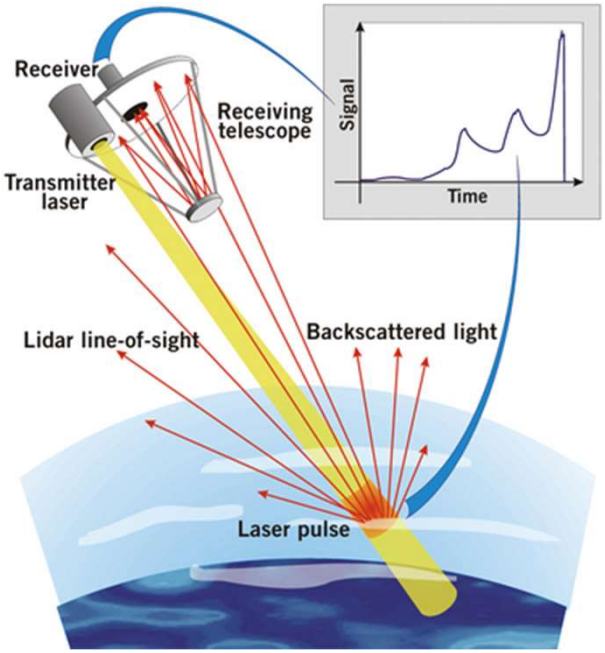




VISIT THE SPECIFIC WEBSITE: WWW.BRIGHTMICROLASER.COM

3 – Custom products - aerospace



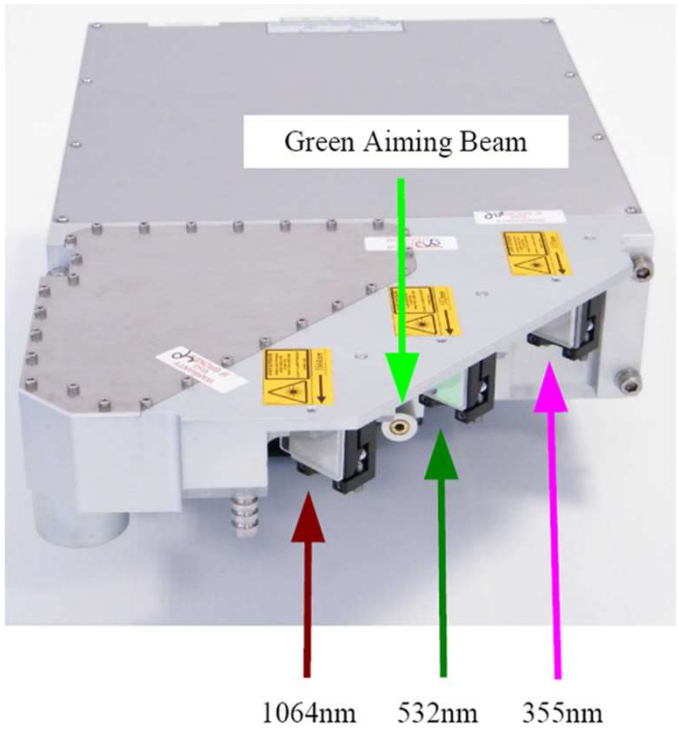


2004 **E.S.A.** Project: **ALADIN** (Atmospheric Laser Doppler Instrument), **ADM-Aeolus Satellite.**
Development of laser oscillator and THG for the LIDAR transmitter prototype:
>100 mJ @355nm, stabilized SLM.

2005 **E.S.A.** Project: **WALES** (Water Vapour Lidar Experiment in Space).
Development of a high energy **Ti:Sa tunable narrow-band** laser source operating in the range **920-950nm, 150 mJ, 10 ns, injection seeded stabilized SLM.**

3 – Lasers for atmospheric LIDAR

Etna volcano monitoring station installed in Catania, Sicily



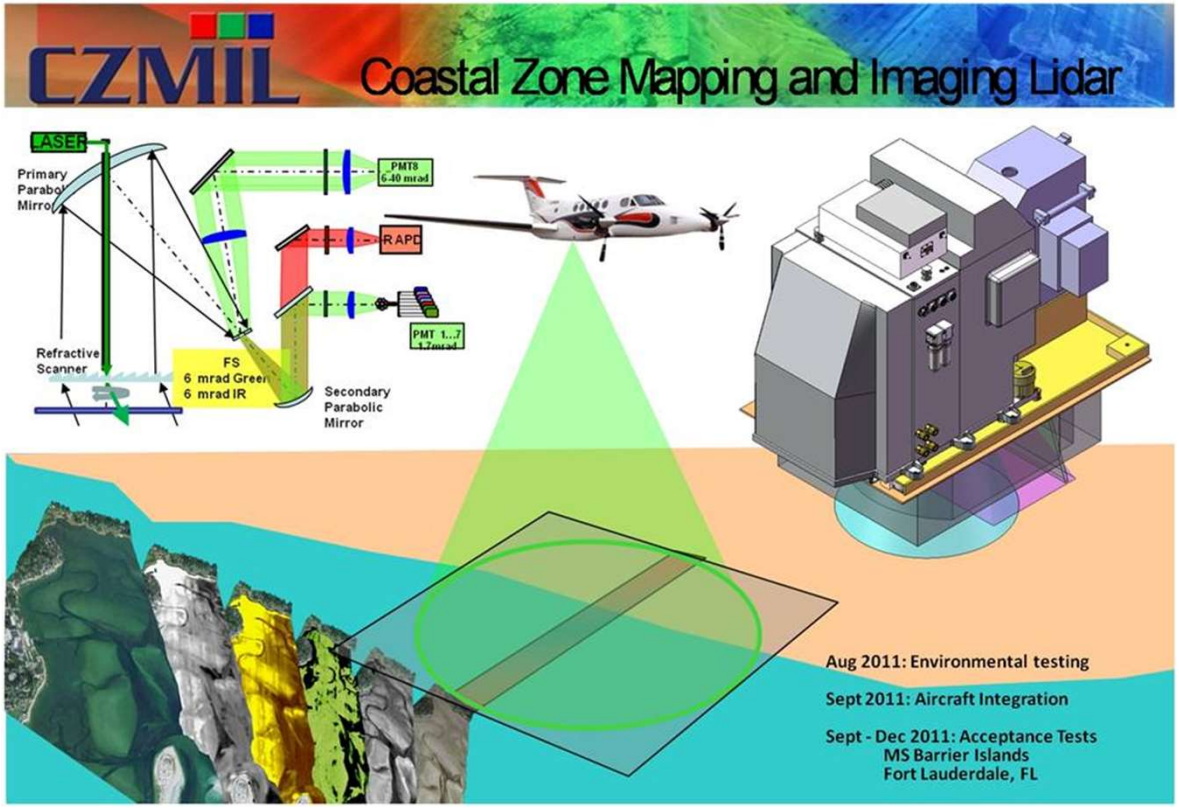
Pollution monitoring over Beijing sky

Custom laser source with 4mJ pulse energy in 1.5ns 1kHz.

Three laser output beams at 355nm, 532nm and 1064nm are individually selectable

LIDAR for monitoring atmospheric pollution, volcanic activity, aerosol, etc.

3 – Custom products - aerospace

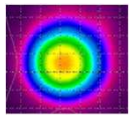


http://www.erdc.usace.army.mil

2010 **CZMIL** US Program (Coastal Zone Mapping and Imaging Lidar)
Development of a custom laser source with **6mJ** pulse energy in 2ns (3 MW) at **10 kHz**.
Two collinear laser beams, 35W at **532nm** and 25W at 1064nm, are provided at laser output.
The beam at 532nm detects the sea bottom, radiation at 1064nm detects the sea surface.
Several rugged units have been delivered, accumulating hundreds of flight hours each.

3 – Custom products - aerospace

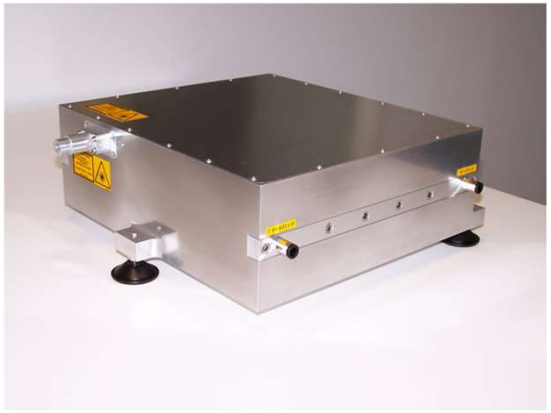
2W @ 1064 nm
20 kHz - 600 ps
< 200 ps pulse jitter
M^2 < 1.2
Rugged and sealed
MIL compliant
Application: OPTICAL RADAR
Actual size: 18 x 9 x 7 cm^3



C-WHF-2W-1064-M

(picture does not represent exactly the module realized)

400uJ @ 10 kHz @ 532 nm
600 ps - 200 ps pulse jitter
Rugged and sealed
Qualified for flight
Water cooled
Applications:
PRECISION BATHYMETRY
THz GENERATION



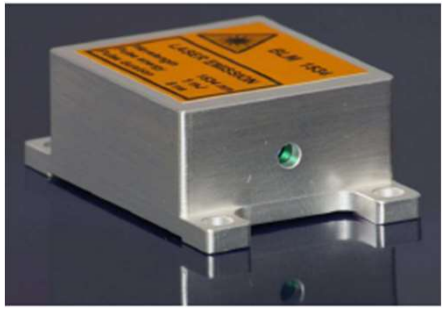
PW090402-0.4mJ-532-10kHz

3 – Custom products - military

5W @ 808nm @ 100um fiber
Built-in integrated driver and temperature control
Customized RS422 interface
Rugged and sealed
Operating temperature: - 40 to +60 °C
Airborne, MIL qualified
Actual size: 13 x 6 x 4 cm^3

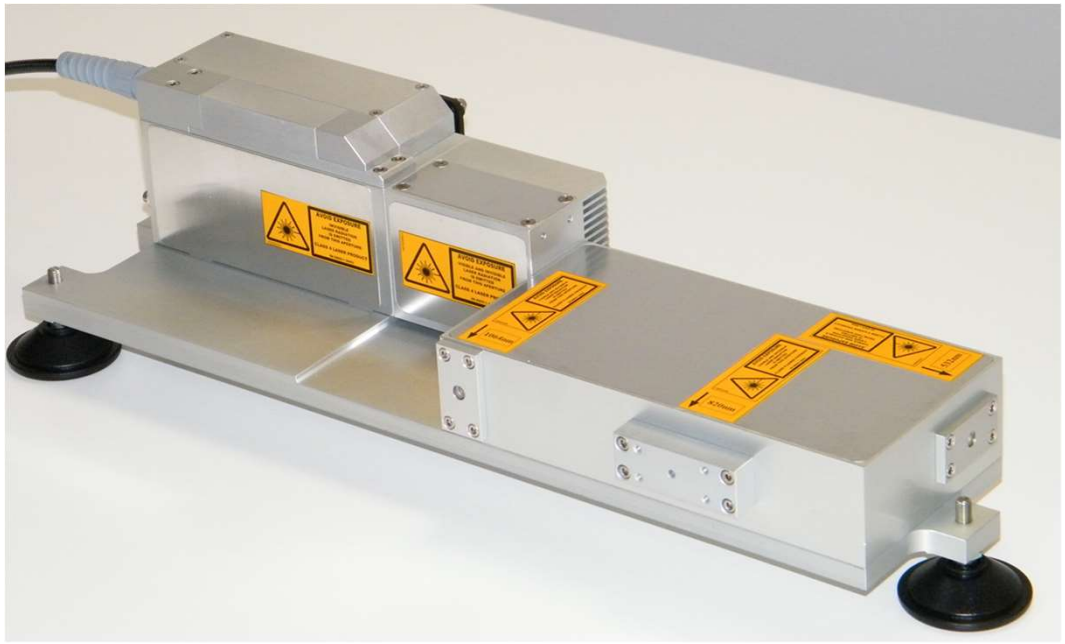
C-BFP-5W-808nm-F1
(picture does not represent exactly the module realized)

1 mJ @ 1534nm
Repetition rate: 1 Hz
Pulsewidth: 8 ns
Operating temperature: - 40 to +60 °C
2 x 3 x 4 cm^3 <50 g
MIL compliant



BLM-1534-1mJ-1 Hz

3 – Custom products - scientific



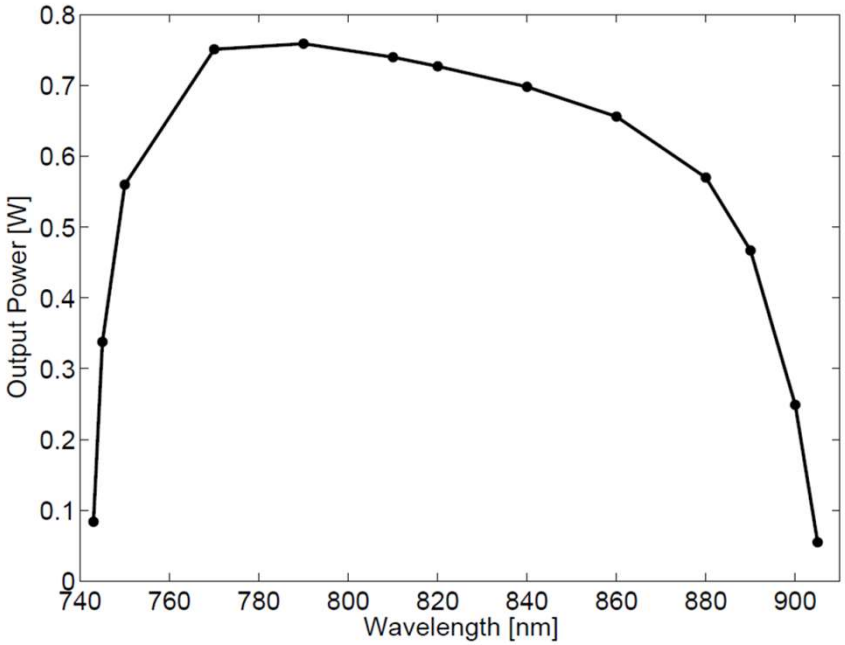


Fig. 3. The output power of the tunable Ti:Sapphire laser from 743nm to 905nm.

2010 **Widely Tunable Ti:Sa**, 1W, 10 kHz, 10 ns

750-900 nm
10 kHz
0.5 – 1 W
10 ns
Application: In Vivo Medical Diagnostics (University of Arkansas for Medical Sciences).

3 – Custom products – XHP 250W 1064nm

250W @ 1064nm

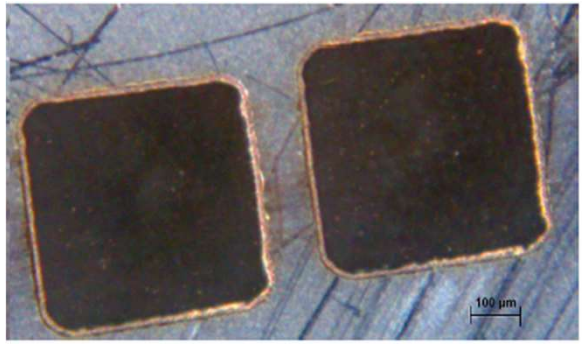
100W @ 532nm

10 – 50 kHz rep. rate range

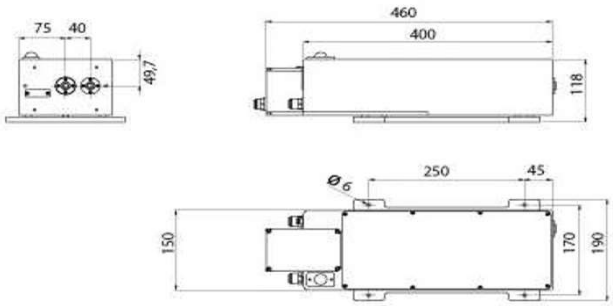
Flat top beam profile

Water cooled

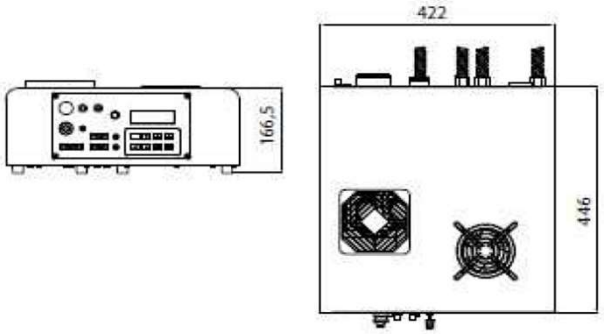
RS-232 interface



Square spot beam shaper

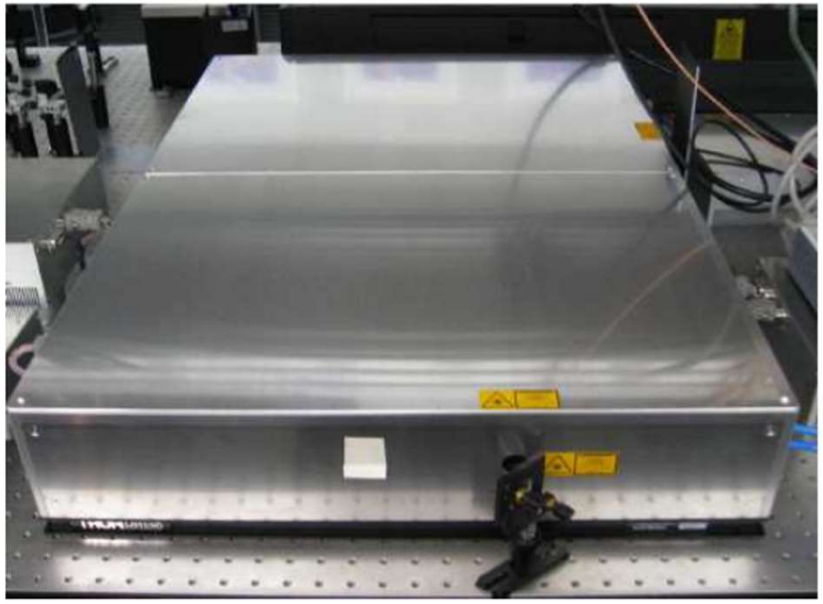


Laser Head (dimensions in mm)



Power Supply module (dimensions in mm)

3 – MIRSURG program



www.mirsurg.eu

The main objective of MIRSURG is to develop advanced table-top solid-state laser sources for a specific wavelength in the mid-IR spectral range, as a practical, reliable and cost effective alternative to large scale FELs, for application in minimally invasive surgery. The target is a pulse energy of **10 mJ @ 6.45 µm** at a repetition rate of 100 Hz (an average power of 1 W).

The program has been coordinated by the **Max Born Institute** in **Berlin** and involved several European photonic companies and research institutes.

Bright Solutions has been the laser group coordinator and developed the **ps-macro-pulse** DPSSL source, emitting equalized bursts of **8 ps** pulses at **455 MHz** rep rate with **50 mJ** total energy in 1 us burst.

3 – UTOFIA program

A new, compact and cost-efficient concept for underwater range-gated imaging system

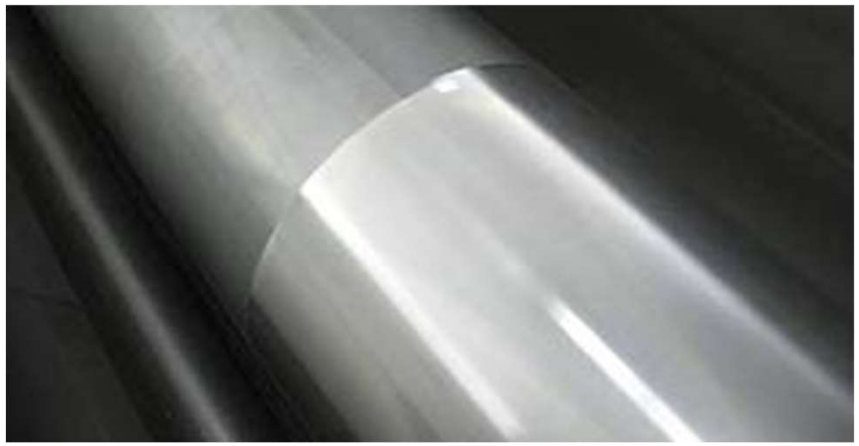
UTOFIA, a H2020 project (633098) started in February 2015, will offer a compact and cost-effective underwater imaging system for turbid environments. Using range-gated imaging, the system will extend the imaging range by factor 2 to 3 over conventional video systems. At the same time, the system will provide video-rate 3D information.

This will fill the current gap between short-range, high-resolution conventional video and long-range low-resolution sonar systems. UTOFIA offers a new modus operandi for the main targeted domains of application: marine life monitoring, harbor and ocean litter detection, fisheries and aquaculture stock assessment, and seabed mapping.

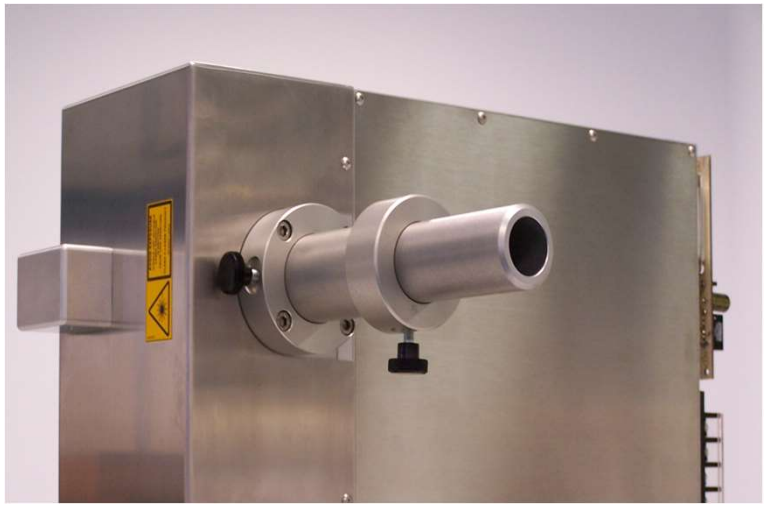
http://www.utofia.eu

3 – Custom products - industrial

Industrial Laser CLEANER
LUCE and SoI based system
Up to 30 W output power @ 1064nm
Air-cooled or water-cooled



Anylox Printing Cylinder

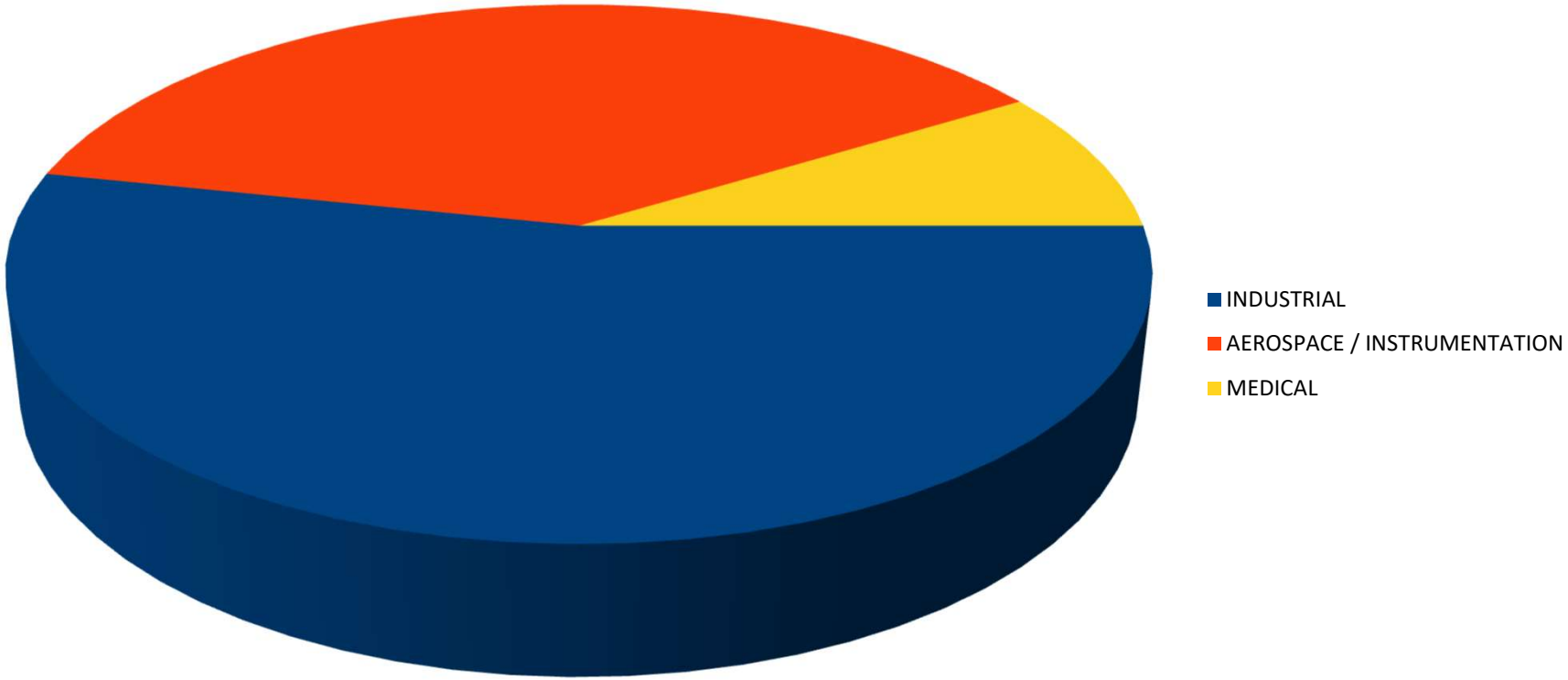


Customized electronic interface
Automatic fast scanning module
Telescopic objective and focusing head
Rugged and sealed

4 – Worldwide presence

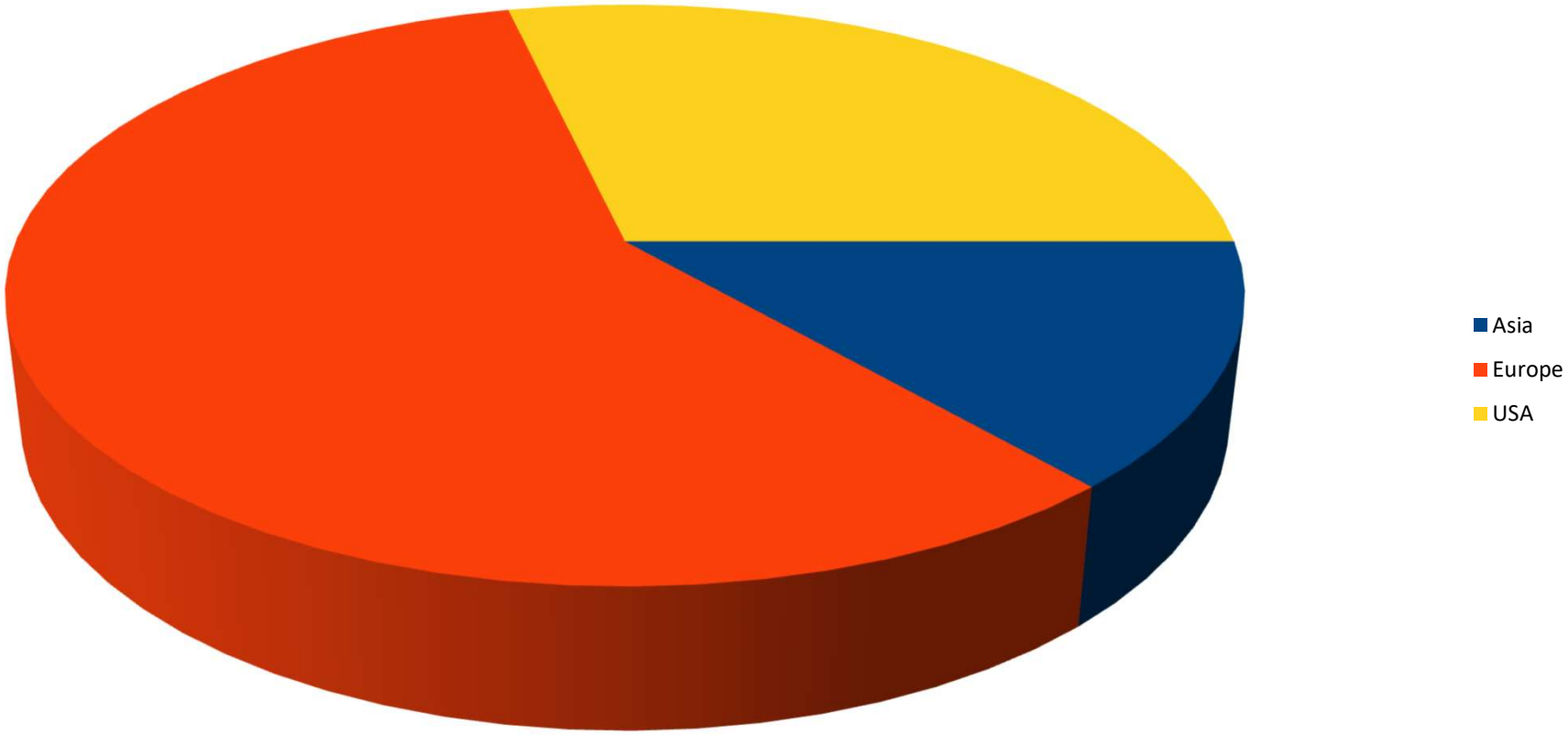
5 – Sales and Financial Highlights

Market Share in Revenues in 2018



5 – Sales and Financial Highlights

Worldwide Sales Distribution in 2018



THANK YOU