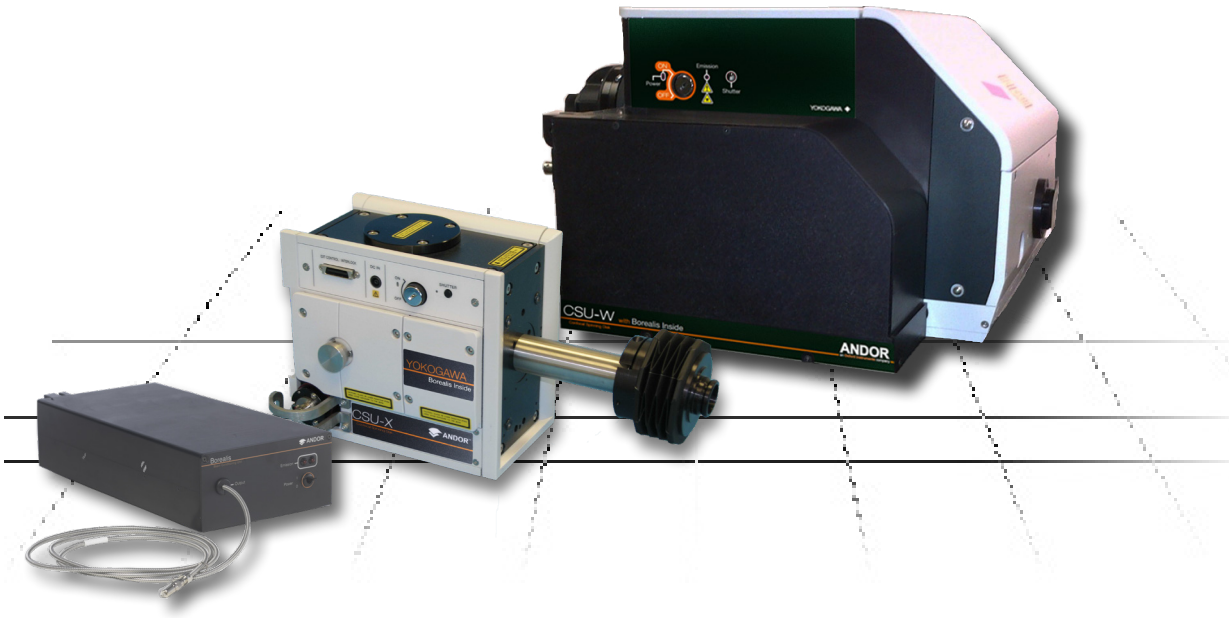
ANDOR
an Oxford Instruments company

Borealis

Version 2.0 revised 03 Mar 2015



User Guide

(covering Borealis enhanced CSU-X and CSU-W models)

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Revision History

Version	Released	Description
Rev A	9 Dec 2013	Initial Release
1.0	28 May 2014	Updated presentation to Andor format and enhanced content (all Sections) Updated and additional laser safety information (Safety and Warning Section) Information on dichroic slider added (Sections 2.2.4 and 4.5.2) Glossary added (Appendix B)
2.0	03 Mar 2015	Updated to include the CSU-W borealis model.

Safety and Warning Information

PLEASE READ THIS INFORMATION FIRST

1. If the equipment is used in a manner not specified by Spectral or Andor, the protection provided by the equipment may be impaired.

CAUTION – USE OF CONTROLS OR ADJUSTMENTS OR PERFORMANCE OF PROCEDURES OTHER THAN THOSE SPECIFIED HEREIN MAY RESULT IN HAZARDOUS RADIATION EXPOSURE.

2. Do not position this product so that it is difficult to operate the Mains disconnecting device. See SECTION 4.1, “Emergency Mains Disconnection”.
3. Before using the system, please follow and adhere to all warnings, safety, manual handling and operating instructions located either on the product or in this manual.
4. Keep this manual in a safe place for future reference.
5. Users must be authorised and trained personnel only; otherwise this may result in personal injury, and/ or equipment damage and impaired system performance.
6. There are no user-serviceable parts inside the product and the enclosure must not be opened. Only authorised service personnel may service this equipment.
7. This product will be used with lasers.
8. IEC Technical Document IEC TR 60825-14 recommends the presence of a Laser Safety Officer (LSO); however, national guidelines should be referred to.
9. This equipment has not been designed and manufactured for the medical diagnosis of patients.
10. Do not attempt to bypass any safety interlocks. They are provided to comply with the safety requirements of various regulatory agencies and must be employed to protect the operator.
11. Protective earth is an integral part of the protection against electric shock in this product, and is provided via the earth pin of the external power supply. Ensure that this is plugged into the building earth system via the mains socket. Do not tamper with any of the earthing measures.
12. Only the correctly specified mains supply should be used.
13. Only the AC/DC external power supply provided with the product should be used.
14. Only the power supply cord provided with the product should be used. Should this not be correct for your geographical area, contact your local Andor representative.
15. Make sure the power supply cord is located so that it will not be subject to damage. If replacement of the detachable power supply cord is required, ensure replacement is of same type and rating.
16. Locate the laser source, BCU, and confocal head within 2 m of each other so that the interconnecting fibres are not stretched, bent, or constrained.
17. While running an experiment, try to keep room temperature as stable as possible.
18. Performance of the system may be adversely affected by rapidly changing environmental conditions or operation outside of the operating conditions specified in SECTION 7 “TECHNICAL SPECIFICATIONS”.

19. Electromagnetic Compatibility: This is a Class A product. In a domestic environment this product may cause electromagnetic interference, in which case the user may be required to take adequate measures.
20. This product has been designed and tested to perform successfully in a normal (basic) electromagnetic environment, e.g. a typical life science test laboratory, as per the EU EMC Directive. It is not designed to operate in a harsh electromagnetic environment, e.g. close to the following equipment: EMI/RFI generators, electrostatic field generators, electromagnetic or radioactive devices, plasma sources, arc welders, x-ray instruments, intense pulsed sources, or other similar sources of high energy fields whose emissions are not within the normal range expected under the EU EMC Directive.
21. Your product is a precision scientific instrument containing fragile components. Always handle it with care.
22. When transporting the BCU, ensure that the fibre cables are not bent tightly as this may damage the internal optical fibre. For transport or storage, fibre cables should be coiled with a diameter of 300 mm or greater.
23. Do not wet or spill liquids on the product, and do not store or place liquids on the product.
24. If spillage occurs on the product, switch off power immediately, and wipe off with a dry, lint-free cloth.
25. If any ingress of liquids has occurred or is suspected, unplug the mains cables, do not use, and contact Andor Customer Support.
26. Do not expose the product to extreme hot or cold temperatures.
27. Do not expose the product to open flames.
28. Do not allow objects to fall on the product.
29. See SECTION 5.1, “Cleaning and Decontamination”.

Laser Safety

CAUTION – USE OF CONTROLS OR ADJUSTMENTS OR PERFORMANCE OF PROCEDURES OTHER THAN THOSE SPECIFIED HEREIN MAY RESULT IN HAZARDOUS RADIATION EXPOSURE

This product is designed to be integrated with lasers that cover the entire visible spectrum and extend into the invisible infra-red spectrum. This section of the manual is designed to make the end-user aware of the hazards of the product due to these lasers. Laser safety hazards differ from those of normal light sources and users must be familiar with the hazardous properties of lasers as these are highly-concentrated, low divergence beams of radiation.

Andor recommend that all facilities have an established system for the safe use of lasers as per their national frameworks and Occupational Health and Safety legislation. Laser Safety standards IEC 60285-1 and American National Standard Z136.1-2007 - Safe use of Lasers may be useful references for good practice.

Laser Product Classification

The Borealis system does not contain any embedded or external Laser Sources but it is intended to be integrated with a compatible Laser Source and has therefore been designed to safely accept, and handle Laser Radiation. The BCU and all ancillary components of the Borealis system have been designed and labelled to be compliant with IEC 60825-1 and CDRH Title 21 CFR 1040.10.

The Borealis product includes an upgraded Yokogawa CSU spinning Disk Unit which has been classified and labelled as a Class 3B Laser Product in accordance with IEC 60825-1 and CDRH Title 21 CFR 1040.10.

This Classification is not inherited by the Borealis Product as a whole as it may modify the specified laser wavelength and emission properties of the CSU device.

When assembled and integrated in the intended manner, Borealis will form part of a unique Laser Product formed by the entire Confocal Microscopy System. The Classification of this product will depend entirely on the Laser source connected and the individual combination of components in the Microscopy System. Therefore the final assemblage must be assessed, Classified and labelled in accordance with the requirements of IEC 60825-1 and CDRH Title 21 CFR 1040.10.

This must be performed by a competent, trained individual, e.g. the site's Laser Safety Officer. In the case of the System being installed by an Andor representative, it is Andor's responsibility to assess and classify the final system. The Customer Support Engineer will be competent and trained to perform this and ensure that the system is correctly classified and labelled. Please refer to section 3.5 for guidance on the assessment and classification procedure.

Laser Safety and Product Compliance Labels

The label below is located on the rear panel of the BCU. It indicates compliance with the applicable standards. It also provides information on the manufacturer and identifies the model, serial number, and manufacturing date (month, year).

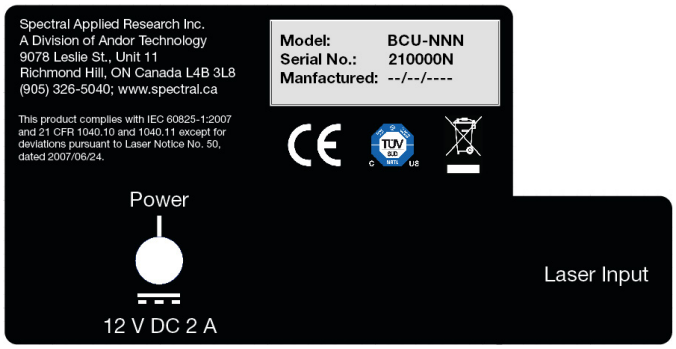

Figure 1: Compliance and Serial Identification labels on rear panel of the BCU

All relevant safety compliance information is visibly displayed on the Beam Conditioning Unit as per the International Laser Safety Standard IEC 60825-1 and the U.S. Laser Product Performance Standard 21 CFR 1040.10.

As the Borealis system will form part of a unique configuration of components it cannot be classified in isolation. Therefore when integrated, it may form part of a system with one of the classifications described below. A label in the format depicted below will be included for application by the System Integrator following assessment and classification. The Borealis may be configured as part of a larger system that includes multiple Class 3B and Class 4 lasers. A number of separate emission wavelengths can also be available in any one system. In some very rare occasions another classification label may be used, this will be explained in additional documentation as appropriate.

Class 1

Laser products that are safe during use, including long-term direct intrabeam viewing, even when exposure occurs while using optical viewing instruments (eye loupes or binoculars).

Class 1 also includes high power lasers that are fully enclosed so that no potentially hazardous radiation is accessible during use (embedded laser product). Intrabeam viewing of Class 1 laser products which emit visible radiant energy may still produce dazzling visual effects, particularly in low ambient light.

Class 3B

Laser products that are normally hazardous when intrabeam ocular exposure occurs (i.e. within the NOHD) including accidental short time exposure. Viewing diffuse reflections is normally safe. Class 3B lasers which approach the AEL for Class 3B may produce minor skin injuries or even pose a risk of igniting flammable materials. However, this is only likely if the beam is a small focused spot.

Note: There exist some theoretical (but rare) viewing conditions where viewing a diffuse reflection could exceed the MPE. For example for Class 3B lasers having powers approaching the AEL, lengthy viewing of greater than 10 s of true diffuse reflections of visible radiation and viewing at distances less than 13 cm between the diffusing surface and the cornea can exceed the MPE.

Class 4

Laser products for which intrabeam viewing and skin exposure is hazardous and were viewing of diffuse reflections may be hazardous. These lasers also often represent a fire hazard.

Laser Aperture

The following label is attached to the end of the optical fibre output cable of the BCU. These labels indicate that during installation laser radiation may be emitted from the optical fibres when disconnected. When properly installed, no laser radiation will be emitted from these points during use.

Figure 2: Laser aperture warning label on BCU optical fibre output

The System Integrator MUST ensure that the final system's Laser Aperture is suitably labelled e.g. the microscope's Objective is identified by a label on the microscope's stage top. An example is shown below.

The appropriate aperture label is included with the documentation for application by the System Integrator.

Figure 3: Example of Laser emission warning label on microscope

Description of Emitted Radiation from the Laser Product

Parameter	Values	Notes
Wavelengths	400-800 nm	Exact outputs will depend on the integrated laser source, please refer to it's Explanatory Label and User Documentation
Beam Divergence	0.3-1.4 NA	Exact divergence will be dependent on the objective in use, please refer to the microscope's User Documentation
Maximum Power or Energy Output	<500 mW	The maximum output power will depend on the integrated laser source and the configured optical elements but will be significantly less than 500mW
Pulse Duration	N/A	All recommended laser sources for the Borealis Product are Continuous Wave output
Pulse Repetition Rate	N/A	All recommended laser sources for the Borealis Product are Continuous Wave output
Irregular Pulse Pattern	N/A	All recommended laser sources for the Borealis Product are Continuous Wave output

Description of Emitted Radiation from the Integrated Laser Source

This is dependent on the laser source integrated with the Borealis system. As there are multiple options available from Andor or Borealis may be integrated with a customer's existing laser source please refer to the Laser Source's Explanatory Label and User Documentation for a description of its Emitted Radiation.

Recommended Responsibilities of a Laser Safety Officer

These include, but are not restricted to, the following; however, national guidelines should also be referred to:

1. Ensuring all personnel requiring access to the product are fully trained in both using the product and the general use of Class 3B and Class 4 lasers (see below).
2. Ensure users are familiar with the hazardous properties of lasers; namely that laser safety hazards differ from those of normal light/radiation sources as they are high-intensity, highly collimated beams of electromagnetic radiation.
3. Ensuring the equipment is used in a controlled area by trained end users in accordance with national guidelines.
4. Ensuring end-users are familiar with the operation of the laser's key switch control, interlocks, emission LEDs and other safety features.
5. Ensuring that all interlocks are connected and functioning correctly.
6. We recommend that a copy of IEC 60285-1 is purchased by the laser safety officer for reference.

Guidelines for Safe Operation of Laser Products

1. Read the safety instructions supplied with all equipment in the system.
2. Never look into a laser beam either directly or indirectly.
3. Do not attempt to disassemble the unit housing the lasers or any part of the system. If there is a problem please contact Andor directly (see SECTION 1.1, "Help and Technical Support").
4. Restrict and control access to the area(s) where laser(s) are in use to those persons who are trained in the dangers of lasers and trained on the safety precautions to be observed when working with lasers.
5. Ensure suitable laser warning signs are prominently displayed in the area the system operates.
6. If the system is not in use turn the laser off using the key switch.
7. On a daily basis, or before every use, verify that the laser interlock circuit is working by confirming that the laser emission indicator on the source turns off when any of the following are done:
    - The microscope binocular eyepieces are in the open position.
    - The articulated transmitted light arm on inverted microscopes is tilted back from the functional vertical position before using the system.
8. Fluorescent cards should be used to visually locate and indicate the output of invisible wavelengths at all times
9. Additional precautions may need to be implemented as the necessary precautions will be specific to each Borealis System's installed configuration and typical mode of use. The responsible Laser Safety Officer must assess and implement the necessary precautions to avoid possible exposure to hazardous radiation during use.

Eye Protection

Eye Protection is not required for the safe use of the device as the only radiation observable (without intentional misuse) is directionally stable, diffuse and highly divergent from the designated aperture which is static and labelled.Eye protection must be used by all Installation and service personnel when accessing any radiation during any installation or service procedure.

If eye protection is deemed desirable by the local Laser Safety Officer, Andor recommends the following products:

- 360 nm – 510 nm – Kentek KXP-4001 Spectacles
- 510 nm – 670 nm – Kentek KRA 6702 Spectacles

Working with Optical Fibres

1. Only service personnel authorized by Spectral or Andor should remove or inspect fibres.
2. The laser radiation passing through fibres is potentially hazardous, so great care should be taken to avoid damage that may lead to exposure to this hazardous radiation.
3. The fibre can be easily damaged by bending or general mishandling. Ensure that the minimum curvature is never exceeded when handling. Recommended minimum bend radius is 30 mm.
4. Optical fibres are prone to damage by bending local to the connector.
5. The coupler is not designed to withstand pulling of the fibre. If the fibre is pulled the system performance could be compromised or the system may fail.

SECTION 1: INTRODUCTION

This manual provides an overview of the Borealis upgrade to a Yokagawa CSU-X (CSU-X1) or CSU-W (CSU-W1) and its integration and function as part of a confocal spinning disk imaging system. Borealis, developed by Spectral, provides a range of enhancements that enable you get the best performance from your system:

- Increased uniformity of illumination
- Increased throughput
- Flexible bellows attachment to the microscope
- Switchable field lens tubes

Borealis Beam Conditioning Unit manufactured, and CSU enhancements performed by:

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1.1 Technical Support

If you have any questions regarding the use of this equipment, please contact the representative* from whom your system was purchased, or:

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BT12 7AL

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* The latest contact details for your local representative can be found on our website.

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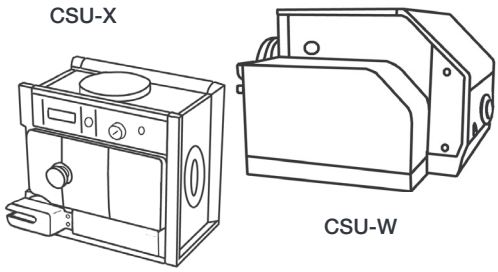
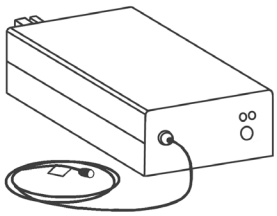
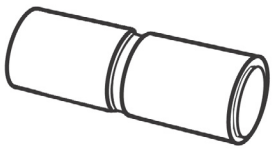
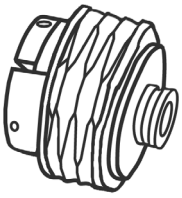
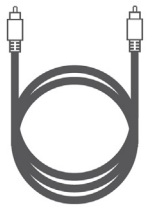
1.3 Copyright and protective Notices

1.4 Trademarks and Patent Information

Spectral Applied Research Inc. is a Division of Andor Technology. Andor and the Andor logo are trademarks of Andor Technology. Andor Technology is an Oxford Instruments company. All other marks are property of their owners. Borealis includes technology covered by the following patents: US Patent No. 8,275,226, EP Patent No. 2196839, US Patent No. 8,670,178 and CA Patent No. 2779146.

Changes are periodically made to the product and these will be incorporated into new editions of the manual. New versions of all Andor manuals will be made available through MyAndor http://my.andor.com/login.aspx. If you do not have an account please register at http://my.andor.com/Register.aspx.

1.5 Supplied Components

Description		Quantity
	**Borealis enhanced CSU**[1] Typically existing CSU-X1 or CSU-W1 model fitted with Borealis upgrades, or supplied with Revolution XD system.	1
	**Beam Conditioning Unit (BCU)** Includes Multi-mode Fibre (2 metre) for connection to CSU. Includes external power supply	1
	**Field Lens Tube**[2] (size as selected at time of ordering)	1
	**Bellows Adaptor** (Microscope specific)	1
	**Multi-mode Fibre (2 metre)** For connection of laser source to BCU	1
	**User Guide** on CD	1

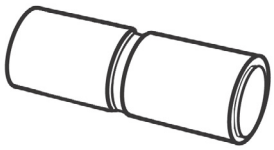
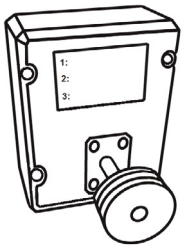
Notes

1. Manual CSU model may be ordered with 3-position Dichroic Slider (see Section 1.6)

2. Additional Field Lens Tubes may be supplied as ordered (see Section 1.6)

1.6 Optional Components

There are a range of optional components available for the Borealis including:

	**Additional field lens tubes** (to adjust pinhole, magnification and working distances)
	**3-position dichroic slider option for manual CSU models only** (dichroic options installed as specified at time of ordering)

Please contact your nearest Andor Sales Representative for further information on these and other system components available.

SECTION 2: PRODUCT OVERVIEW

This section provides an overview of the main Borealis system components:

- Beam Conditioning Unit (BCU)
- Borealis Enhanced CSU (including field lens tube and bellows adaptor)

2.1 Beam Conditioning Unit (BCU)

The BCU homogenizes the laser beam output from the laser engine multi-mode (MM) fibre. It is coupled to the laser source through a MM fibre with fibre optic couplings (FC/APC). The output fibre (FC/APC) is of the armoured type and not removable, and connects to the Borealis Enhanced CSU. The MM output fibre has a square core cross section which is ideal for use with square format cameras e.g. iXon Ultra 897 or Zyla 4.2.

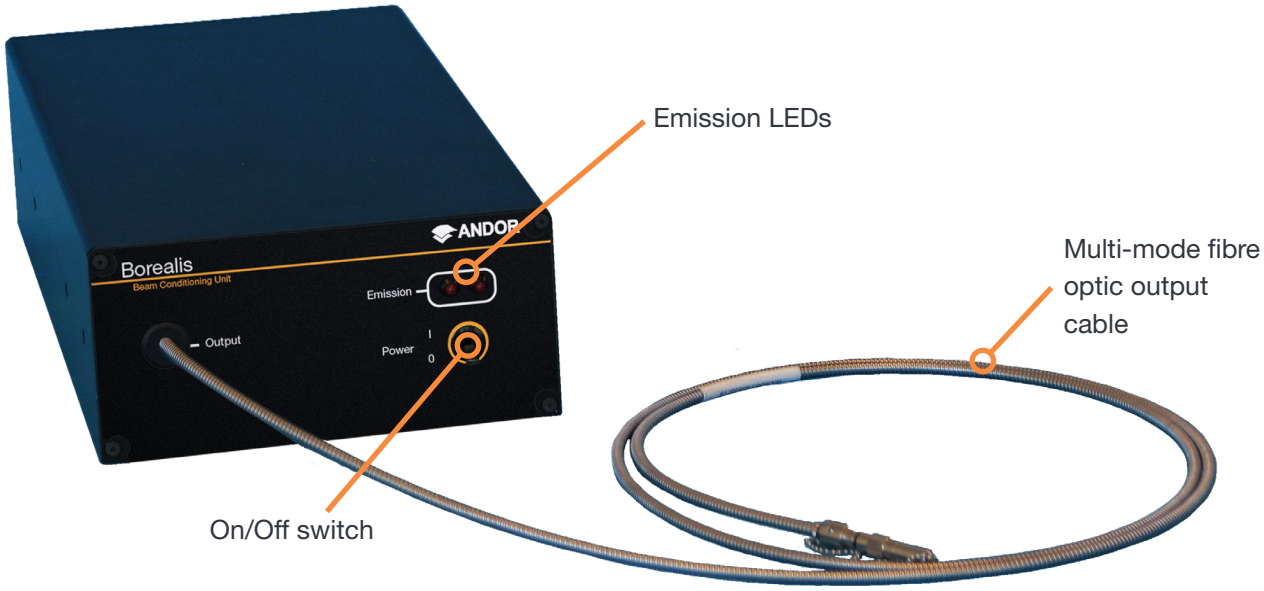


Figure 4: The Borealis Beam Conditioning Unit

2.1.1 Emission Indicators

Emission LEDs on the front panel of the BCU show the status of the unit. When these are lit, laser emission is possible. **Please note: there are two LEDs to provide redundancy for the laser emission status.**

2.1.2 On/Off Switch

A toggle switch is located on the front panel of the BCU. This controls the power to the unit.

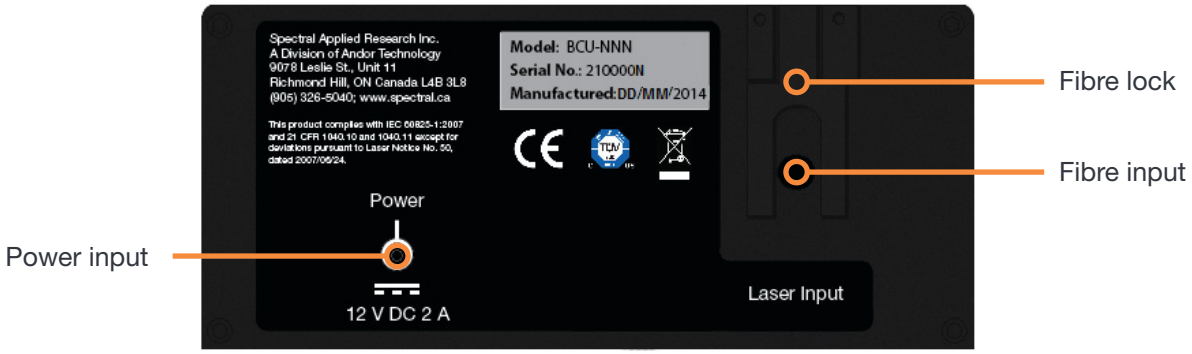


Figure 5: Rear panel of the Beam Conditioning Unit

2.1.3 Power Input

A 2.1 mm input connector is used to provide DC power from the power supply unit to the BCU.

2.1.4 Fibre Lock

A locking mechanism is provided on the rear panel of the BCU that closes over the input MM fibre coming from the laser source. This fibre lock must be put in place at time of installation by the installer.

WARNINGS:

- **NEVER REMOVE THE FIBRE LOCK WHEN IN OPERATION.**
- **THE CABLE SHOULD ONLY BE DISCONNECTED BY QUALIFIED SERVICE PERSONNEL. A TOOL IS REQUIRED TO OPEN THE LOCKING MECHANISM ONCE CLOSED.**

2.1.5 BCU Fibre Input

A MM fibre is provided to connect the laser source to the BCU. This connection is made to the fibre input connection on the rear panel of the BCU using the FC connector provided and locked in place with the fibre lock (see Fibre Lock description above).

2.1.6 Power Supply

⎓ The BCU is supplied with a 12V DC 2A certified power supply. Do not use any other power supply.

Figure 6: BCU Power Supply

PSU Specifications	
Input	90-264 V AC, 47-63 Hz
Output	12 V DC, 2A

2.2 Borealis Enhanced CSU

The Borealis Enhanced CSU features proprietary modifications to enhance the input and illumination optics as part of the Borealis upgrade. These enhancements cover CSU models: CSU-10, CSU-21, CSU-22, the CSU-X1 shown in figure 7, and the CSU-W1 shown in figure 8. The operation and the existing functionality of the original model of CSU are retained. This includes key switch operation, shutter behaviour and access panel interlocks*.Please refer to the supplied manuals for general information on the standard CSU units.

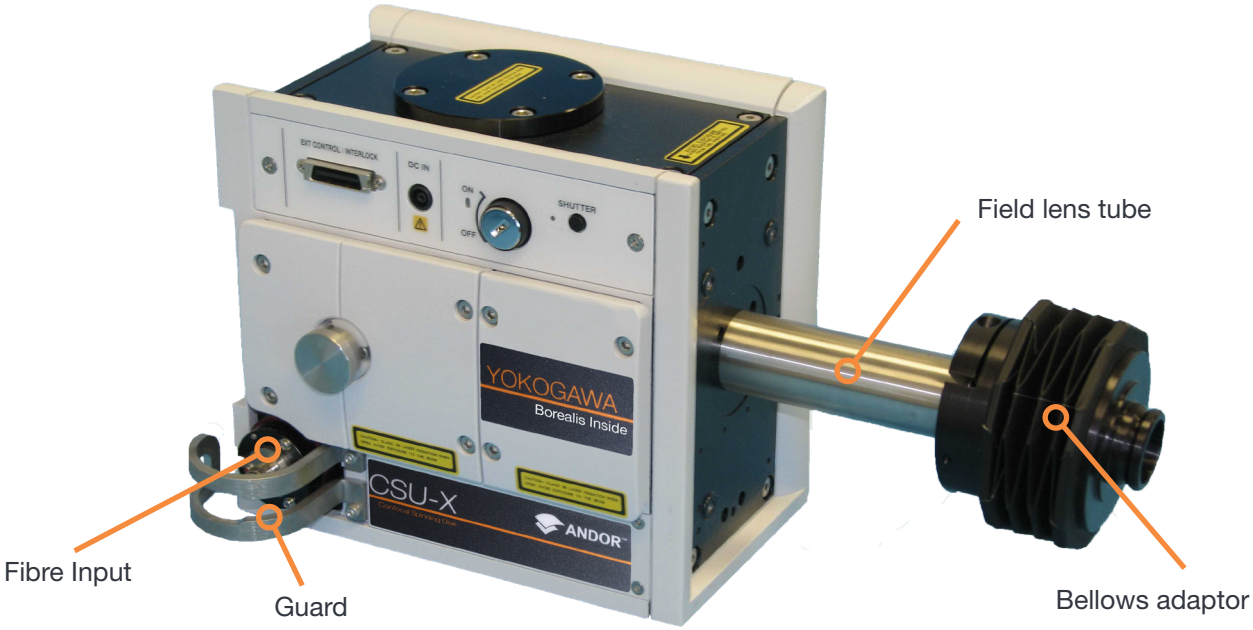


Figure 7: Borealis Enhanced CSU-X shown with Field Lens tube and Bellows Adaptor

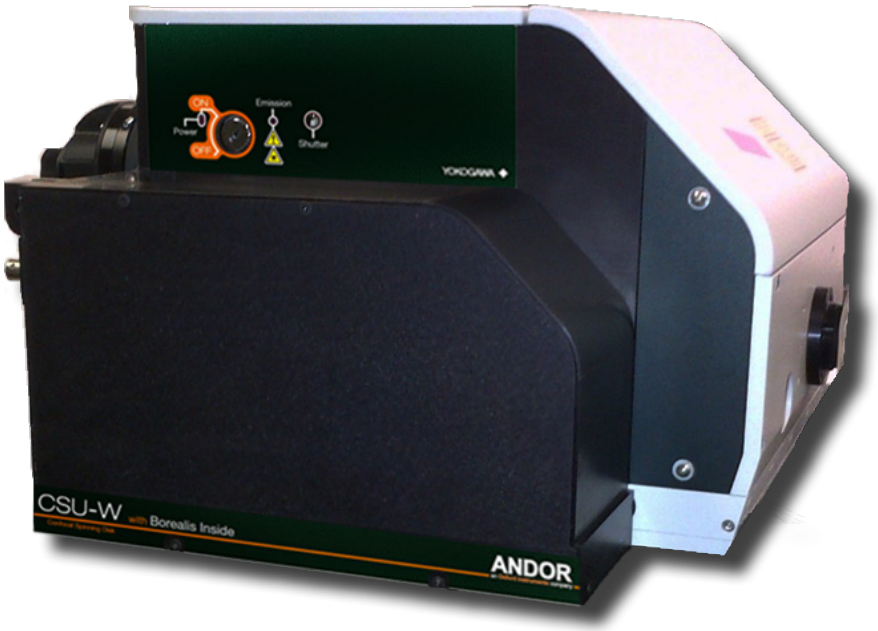


Figure 8: Borealis Enhanced CSU-W

*Please note that the Borealis Enhanced CSU-W has an Interlock Output Connector that must be interfaced to the Laser Controller to ensure that the device's safety behaviour is maintained.

2.2.1 CSU Fibre Input

CSU-X

The CSU-X fibre input coupler has been revised to permit the use of the square core MM output fibres of the BCU. A guard protects the fibre coupling and must be in place during normal operation.

CSU-W

The Borealis enhanced CSU-W includes a fibre lock mechanism to secure the square core MM output fibre of the BCU. This fibre lock must be in place during operations.

2.2.2 Field Lens Tube

In a Borealis enhanced system, a range of field lens tubes are available to enable adjustment of the effective pinhole size. Adjustment of the pinhole size allows the CSU to be used with lower magnification objective lenses and take advantage of their longer working distances. The Field Lens Tube is inserted into the optical path in between the microscope bellows adaptor and the CSU device as shown in Figure 7.

2.2.3 Bellows Adaptor

The bellows adaptor replaces the standard rigid C-mount connection to the microscope. The bellows adaptor facilitates strain-free alignment and connection of the CSU to the microscope. Adaptors are specific to the microscope model and are compatible with the Andor XD tilt stage and Andor WD mounting kit.

2.2.4 CSU Dichroic Slider

The optional 3-position dichroic slider unit replaces the single-position excitation dichroic holder of the CSU-X. This sealed unit permits safe and repeatable switching between the three user specified dichroic filters for additional flexibility in your experiments (dichroics are specified by the user at time of ordering). **Note: The CSU-X should be powered off when changing positions.**

2.3 Laser Sources

The Borealis is compatible with a wide variety of laser sources including the ILE and and the ALC-601 from Andor. Refer to the information supplied by the manufacturer for each laser source.

2.4 System Overview

The Borealis may be configured in a variety of ways. An example set-up is provided below:

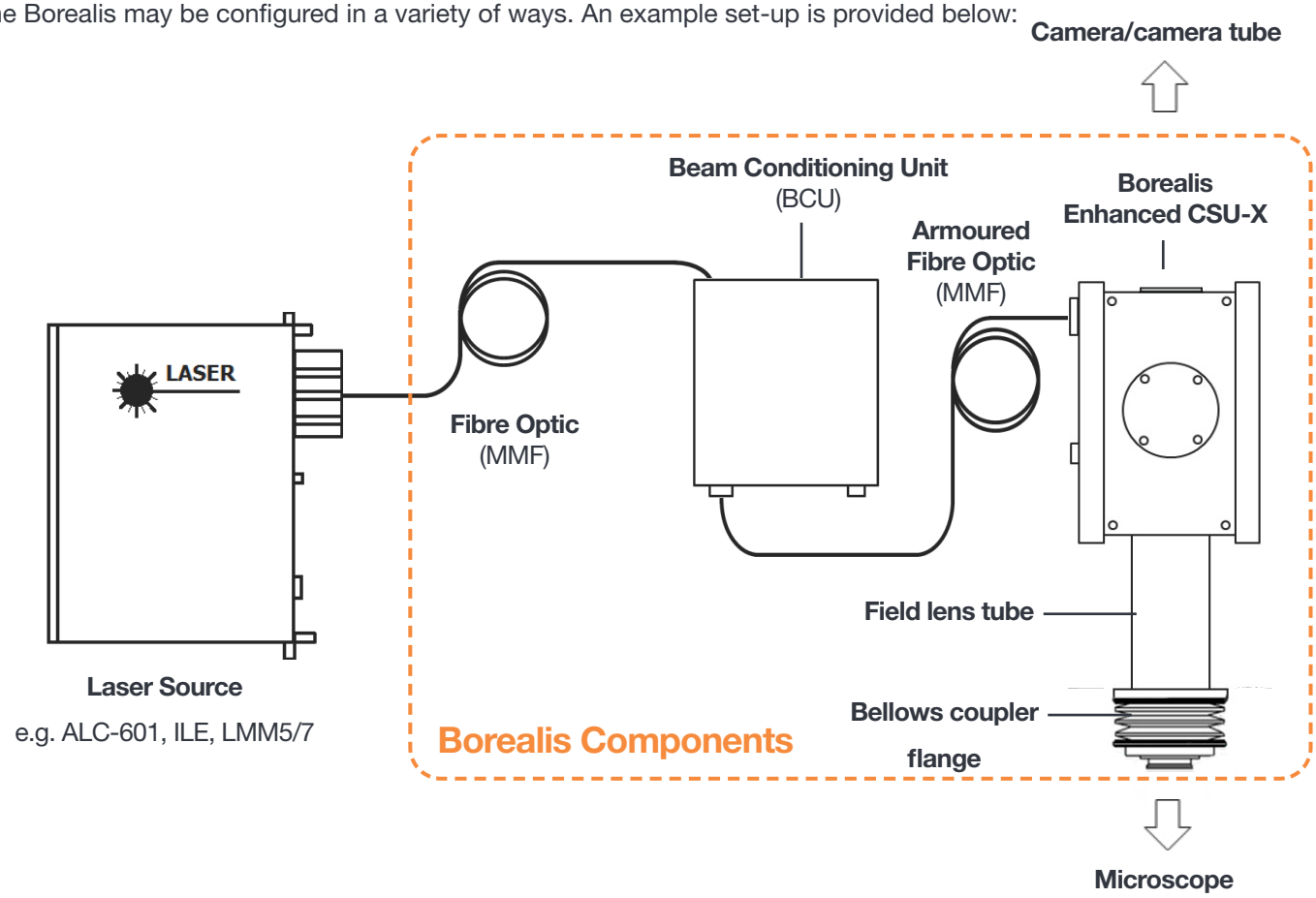


Figure 9: Overview of Borealis enhanced CSU-X as part of an overall system

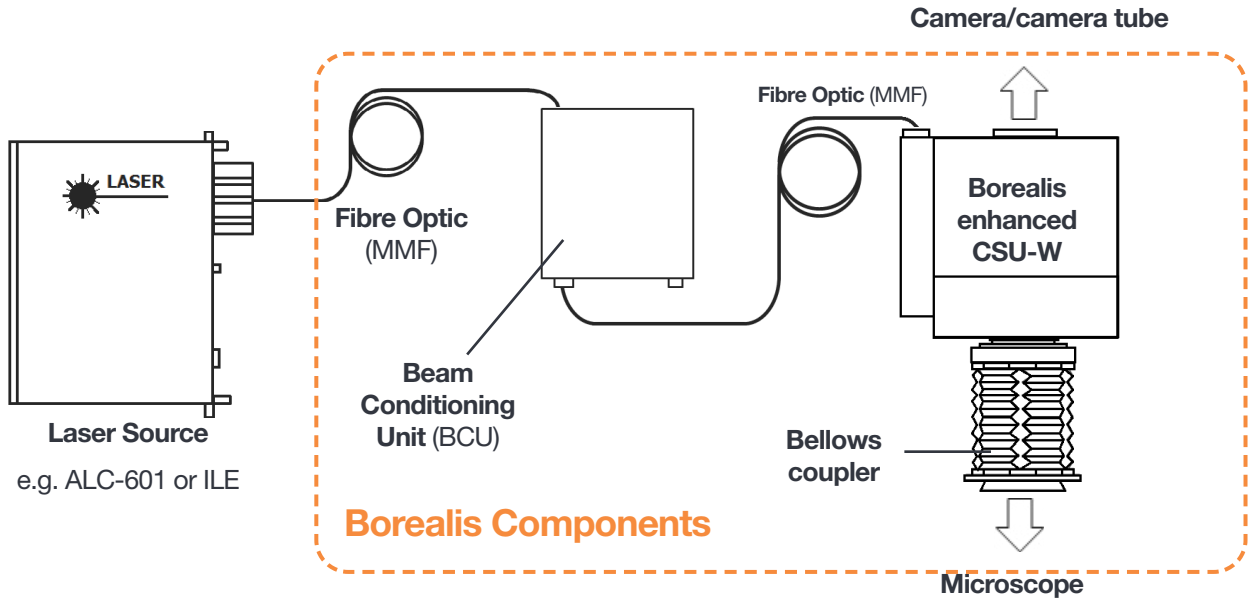


Figure 10: Overview of Borealis enhanced CSU-W as part of an overall system

SECTION 3: INSTALLATION

WARNINGS:

- **THE BOREALIS SYSTEM MUST BE INSTALLED BY AN AUTHORIZED INSTALLATION ENGINEER ACCORDING TO THE INFORMATION PROVIDED BY SPECTRAL AND ANDOR**
- **ANY INSTALLATION STEPS INVOLVING LASERS MUST BE PERFORMED BY QUALIFIED PERSONNEL USING PERTINENT LASER SAFETY PROTOCOLS**
- **SETUP AND OPERATION OF OTHER SYSTEM COMPONENTS ARE DESCRIBED IN THEIR RESPECTIVE GUIDES.**

3.1 Location and Mounting

- Temperature and humidity must meet the specifications defined in SECTION 7.
- Operational vibrations should be reduced as much as possible for stability of the imaging train.
- Power cabling and control cables should be routed to prevent accidents, damage and accidental unplugging while avoiding bend radii of less than 30 mm.

3.2 Ventilation

Do not cover equipment during operation.

3.3 Assembly

This product requires no assembly and is recommended to be installed by an installation engineer authorized by Spectral, Andor or authorized distributor.

3.4 Interlocks

CSU-X

The CSU-X uses an internal shutter to block the laser path when the key switch is turned OFF.

CSU-W

In the CSU-W, the internal shutter has been disabled but this function has been replaced so that the interlocking to the laser source provided by the Interlock Output connector will shut off the laser source when a programming command is received to close the shutter or the Keyswitch is turned OFF. The Interlock Output connector must be connected with an appropriate cable to the laser source to ensure this functionality.

3.5 Classification of an Installed System

The proposed installation scheme of all systems is captured and assessed for all orders received by Andor. To breach the Class 4 limits for accessible emissions, due to known standard attenuations, the input laser power would have to be in excess of 5W. We know this configuration is not possible at present and can therefore safely classify the majority of systems at Factory QC as Class 3B products.

The only case to re-assess the accessible emissions is if the beam path appears to be fully enclosed. The following test criteria should be applied if a system is felt to be fully enclosed e.g. uses a stage cover and / or environmental enclosure.

Assess if any of the laser emissions are open to Human Access as defined by:

1. ability of the human body to meet laser radiation emitted by the laser product, i.e. radiation that can be intercepted outside of the protective housing, or
2. ability of a cylindrical probe with a diameter of 100 mm and a length of 100 mm to intercept levels of radiation of Class 3B and below, or
3. ability of a human hand or arm to intercept levels of radiation above the AEL of Class 3B,
4. also, for levels of radiation within the protective housing that are equivalent to Class 3B or Class 4, ability of any part of the human body to meet hazardous laser radiation that can be reflected directly by any single introduced flat surface from the interior of the product through any opening in its protective housing.

The standard Ophir PD-300W sensor and power meter can be used to assess accessible power levels in conjunction with suitable Safety Glasses and applicable Safe Systems of Work. Any queries should be referred to the Andor Product Laser Safety Officer for guidance.

If Human Access is not possible then the device should be reclassified as a Class 1 device. This involves the following steps:

1. Remove all other Explanatory (Classification) Labels EXCEPT those on the Laser Sources (these count as Removable Laser Sources and need to remain labelled and classified as stand-alone products).
2. Fit a Class 1 Explanatory Label onto a permanently affixed surface which is easily visible before and during operation of the system.
3. Ensure a Laser Hazard Symbol is clearly visible before and during operation and affix a label if not.

SECTION 4: OPERATION

WARNINGS:

- **IF THE EQUIPMENT IS USED IN A MANNER NOT SPECIFIED BY SPECTRAL OR ANDOR SYSTEM DISTRIBUTORS, THE PROTECTION PROVIDED BY THE EQUIPMENT MAY BE IMPAIRED.**
- **READ THE USER GUIDES SUPPLIED WITH YOUR SYSTEM COMPONENTS AND SOFTWARE PRIOR TO USE.**

4.1 Emergency Mains Disconnection

In case of emergency, the disconnecting point of the equipment is the mains power cord connected to the external power supply, or the mains socket switch.

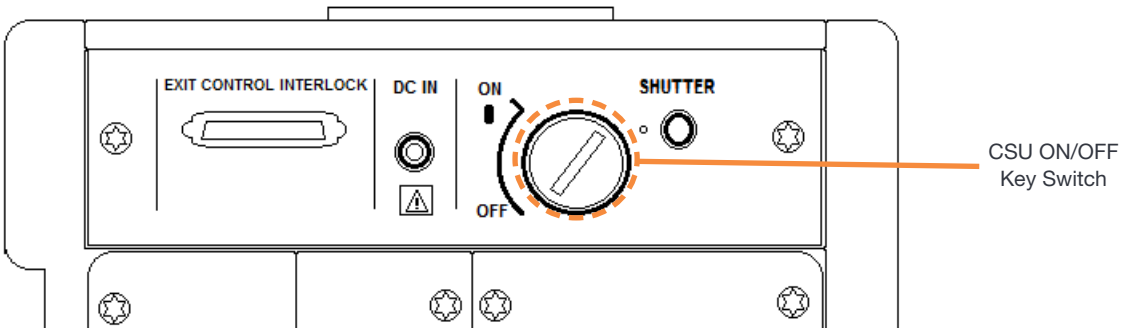
WARNING: SWITCH OFF THE POWER AT THE MAINS SOCKET AND REMOVE THE MAINS LEAD FROM THE EXTERNAL POWER SUPPLY.

4.2 Power-up Sequence

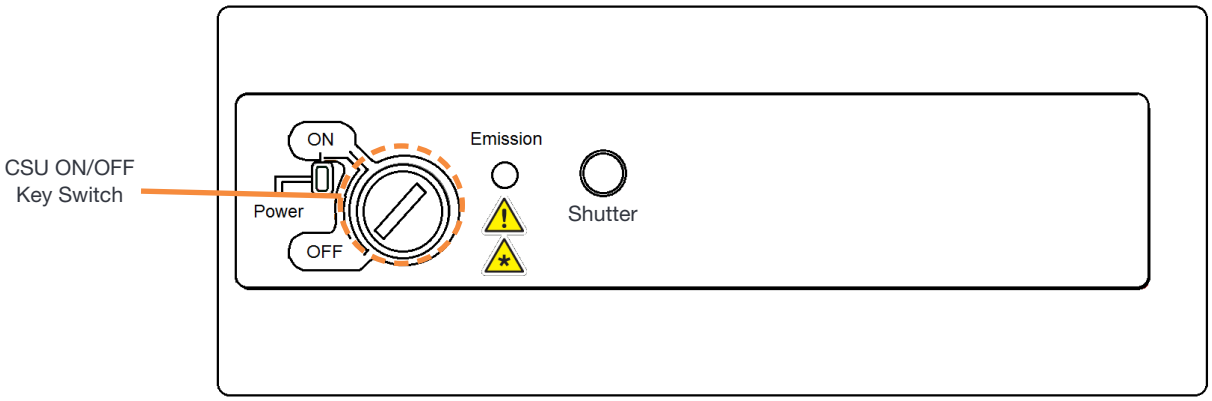
Once all system components are connected, it may be turned on as follows:

1. Turn on the CSU using the key switch (refer to the manufacturer's instructions).

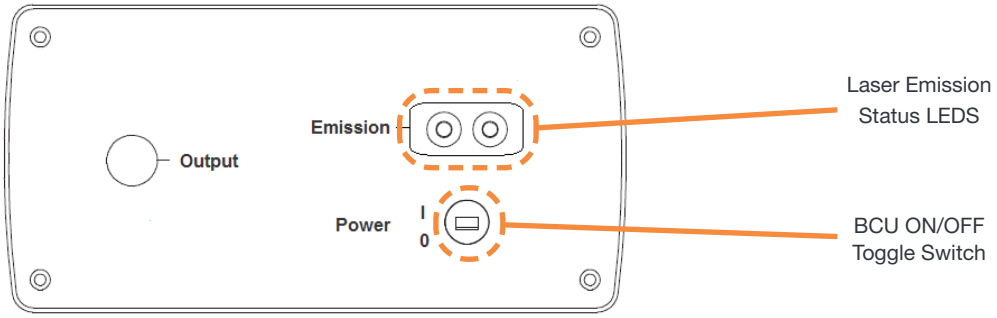
CSU-X



CSU-W



2. Turn on the BCU using the front panel toggle switch.



3. Confirm that the Emission LEDs light.
4. Turn on laser source according to manufacturer's instructions.
5. The system can now be used as outlined in the user guides for your CSU equipped Confocal system.
6. Refer also to your user guides supplied with your software e.g Andor iQ.

4.3 Power-Down Sequence

In order to turn the system off, proceed as follows:

1. Turn off the laser source.
2. Turn off the CSU using the key switch.
3. Turn off the BCU using the front panel toggle switch.

NOTE: THE BCU SHOULD BE POWERED OFF WHEN NOT IN USE TO PRESERVE MOTOR LIFE.

4.4 Risk Mitigation

4.4.1 Mechanical Housings

Once installed the BCU, CSU and the microscope form the protective housings of the product. No components, panels, connections or linkages should be loosened or removed to avoid exposure to hazardous radiation.

4.4.2 Hazards Due to Moisture or Liquids

Please do not put components including power cables or external power supply in places with high moisture or near water.

4.5 Using the Borealis

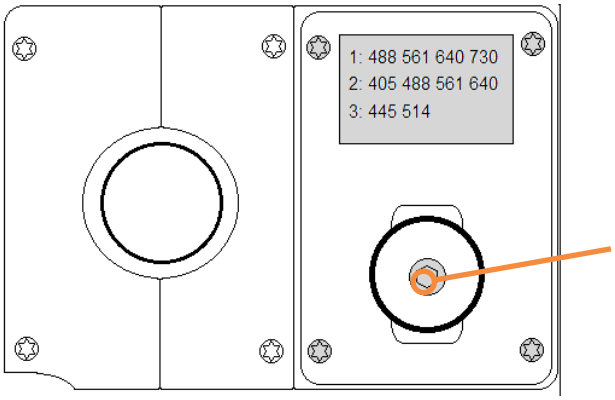
4.5.1 Useful Information

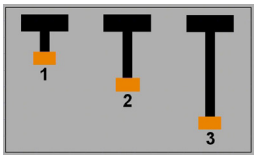
After installation and the BCU is powered on there are no settings or adjustments required.

NOTE: THE BCU SHOULD BE POWERED OFF WHEN NOT IN USE TO PRESERVE MOTOR LIFE.

4.5.2 Using the CSU Dichroic Slider (not applicable to CSU-W)

If this has been specified, select between the three dichroic positions using the selection knob as required.





WARNING: Ensure the CSU power is off when changing positions.

Slide the selection knob in/out to select the required dichroic position (you will feel a "click" for each position).

Wavelengths (as selected at time of ordering) are indicated on the label.

Figure 11: Selection of dichroic position

SECTION 5: MAINTENANCE

WARNINGS:

- **THERE ARE NO USER MAINTENANCE PROCEDURES REQUIRED FOR THE BCU OR CSU.**
- **THE SYSTEM SHOULD BE POWERED-DOWN PRIOR TO USER PERFORMING ANY MAINTENANCE CHECKS.**
- **DO NOT USE EQUIPMENT THAT IS DAMAGED.**
- **CONTACT YOUR ANDOR REPRESENTATIVE IF THERE ARE ANY QUERIES OR ISSUES WITH YOUR BOREALIS SYSTEM.**

5.1 Cleaning and Decontamination

The most critical aspect of maintenance by the user is to ensure that the system is in a clean environment that is suitable for sensitive electro-optical equipment. The laboratory should be free of dust, fumes and other materials that could affect the system.

- To clean the product, only use a damp, lint-free cloth on the external housing of the unit. Do not wet the connectors.
- Use water only- do not use solvents, cleaning agents, or aerosols.

5.2 Regular Checks

The state of the product should be checked regularly, especially the integrity of the enclosure and the mains cable.

On a Daily Basis:

- Visually inspect the system.
- Perform any maintenance activities suggested by the microscope and camera manufacturer(s).

On a Weekly Basis:

- Ensure that all power cables are firmly in place.
- Check the optical cables, connections and interlocks to ensure that the fibre shroud locksare in place and no damage has occurred to the optical fibres connecting the various elements of the system.

5.3 Annual Electrical Safety Checks

It is advisable to check the integrity of the insulation and protective earth of the product on an annual basis, e.g. U.K. PAT testing.

SECTION 6: TROUBLESHOOTING

6.1 Troubleshooting Examples

The following examples provide guidance for some possible troubleshooting scenarios. Refer also to the operation and troubleshooting information provided with your other system components.

6.1.1 No Laser Power at CSU

Fault	Action
No laser power at CSU	1. If the Emission LEDs are not lit, check BCU power supply. 2. If the Emission LEDs are lit: • Check the laser source (refer to manufacturers service information). • Check the light path settings e.g. filter cubes in the microscope filter turret. • Check all interlocked panels are present and fixed securely. • Check that the software has successfully connected to the Hardware and all required shutters are open

6.1.2 Low Laser Power at CSU

Fault	Action
Low laser power at CSU	1. Contact your customer support representative.

6.1.3 Poor Uniformity over CSU FOV

Fault	Action
Poor uniformity over CSU FOV	1. Contact your customer support representative.

6.2 Problem Reporting Form

Please have the following information when connecting customer support:

Owner Information			
Institution		Name	
Vendor Information			
Vendor		Contact	
Equipment Information			
Model		Serial No.	
Check List			
Cable Connections		Emission LEDs	
Mains Power			
Summary			
What is the nature of the problem?			
Any other observations?			

SECTION 7: TECHNICAL SPECIFICATIONS

7.1 Beam Conditioning Unit (BCU)

Laser source fibre coupler	FC/APC
Input power	<10 W (combined wavelengths)
Fibre length from laser source	2 m
Fibre length to CSU	2 m
Weight	7 kg
Dimensions (L x W x H)	400 x 200 x 95 mm
Power supply	100-240 V, 50-60 Hz, 0.8 A, 2.1mm, centre positive

7.2 Borealis Enhanced CSU

	CSU-10, -21, -22 and -X	**CSU-W**
Input wavelength range	400-750 nm	400-800 nm
Input power	<500 mW (combined wavelengths)	<500 mW (combined wavelengths)
Uniformity (for single dichroic systems @488nm using FRAPPA calibration slide)	5% rms	10% rms
Maximum frame rate (fps)	1000	200

7.3 Field Lens Tubes

	CSU-10, -21, -22 and -X	**CSU-W**
Magnification options (S=short, L=long)	1.0 (S), 0.9x (L), 1.5x (S)	1.0x
Tube lengths (mm)	37.6, 109.3, 187	N/A

7.4 Bellows Adapter

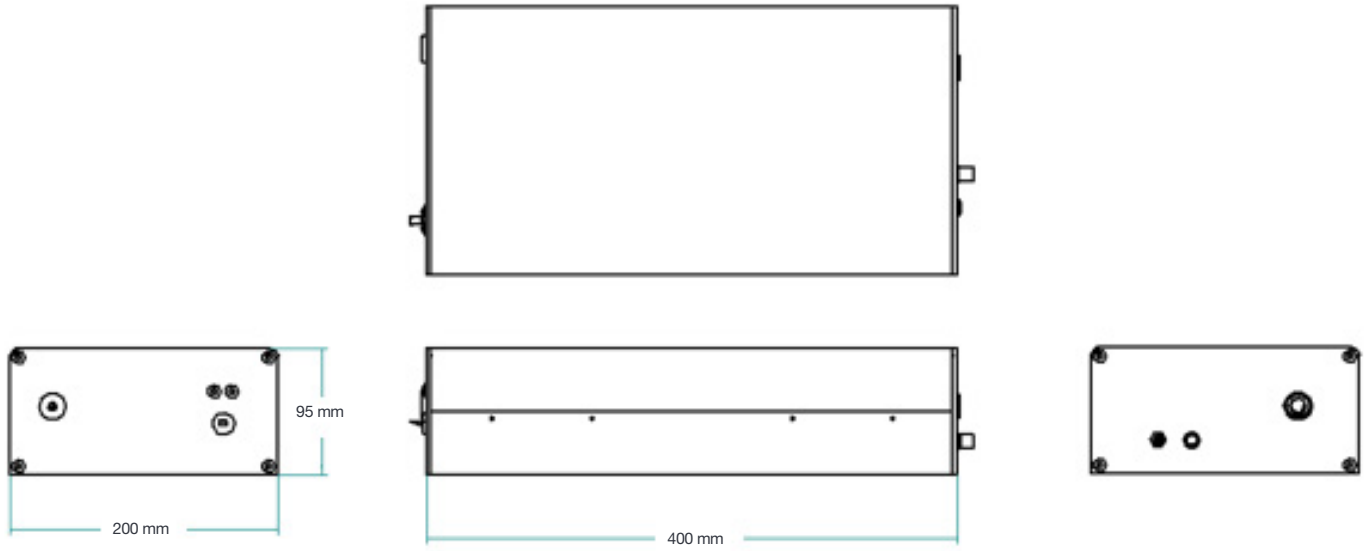
Length range, nominal (mm)	54 +/-5	43 +/-10
Tubes and bellows diameter (mm)	66, 85	61

7.5 Environmental

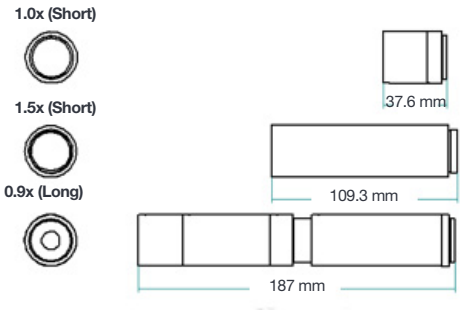
Usage	Indoor use only
Altitude	Up to 2000 m
Operating Temperature	18°C to 28 °C ambient
Storage Temperature	0°C to 50 °C
Operating Relative Humidity	<70% (non-condensing)
Overvoltage Category	CAT II. An overvoltage category of CAT II means that the equipment is designed to cope with transient voltages above the rated supply that would be experienced by any product connected to a mains socket in a building.
Rated Pollution	Pollution Degree 2. Normally only non-conductive pollution occurs. Occasionally, however, a temporary conductivity caused by condensation must be expected.
Ventilation Requirements	Do not cover during operation.

APPENDIX A: MECHANICAL DRAWINGS

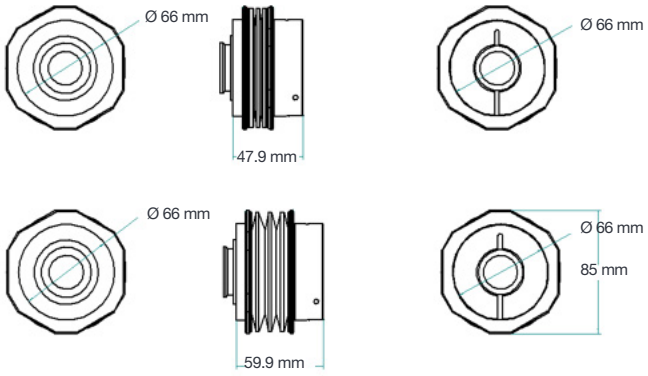
Borealis Conditioning Unit
(BCU)



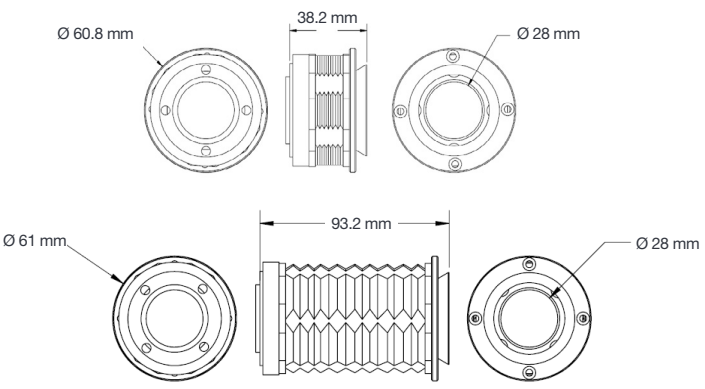
Field lens tubes



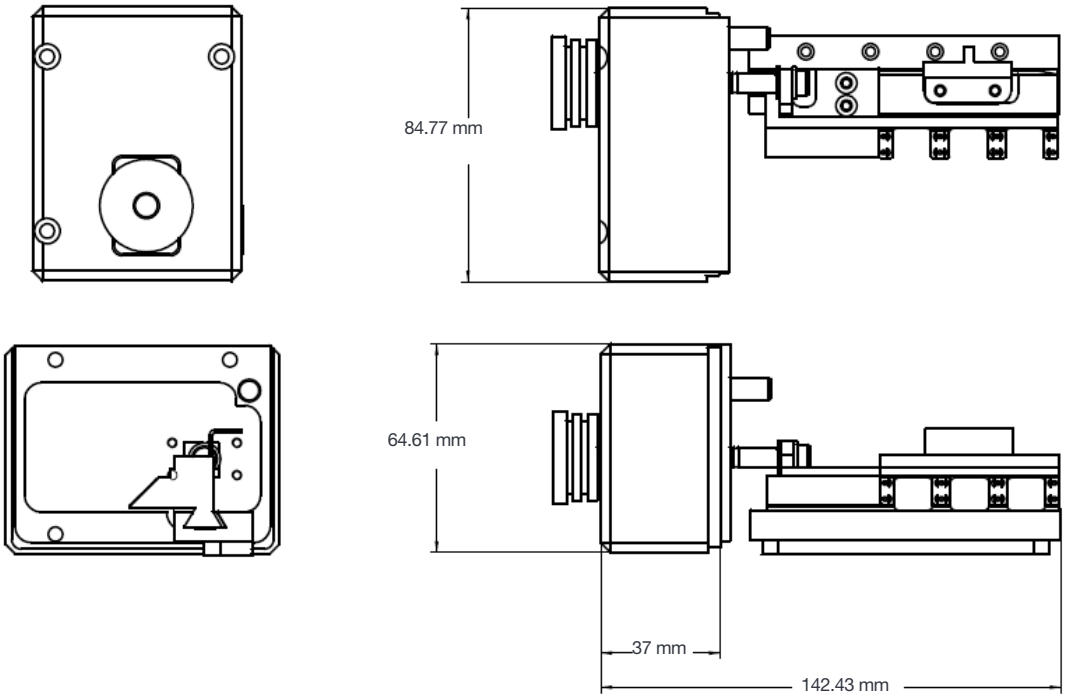
Bellows coupling adaptor (CSU-X)



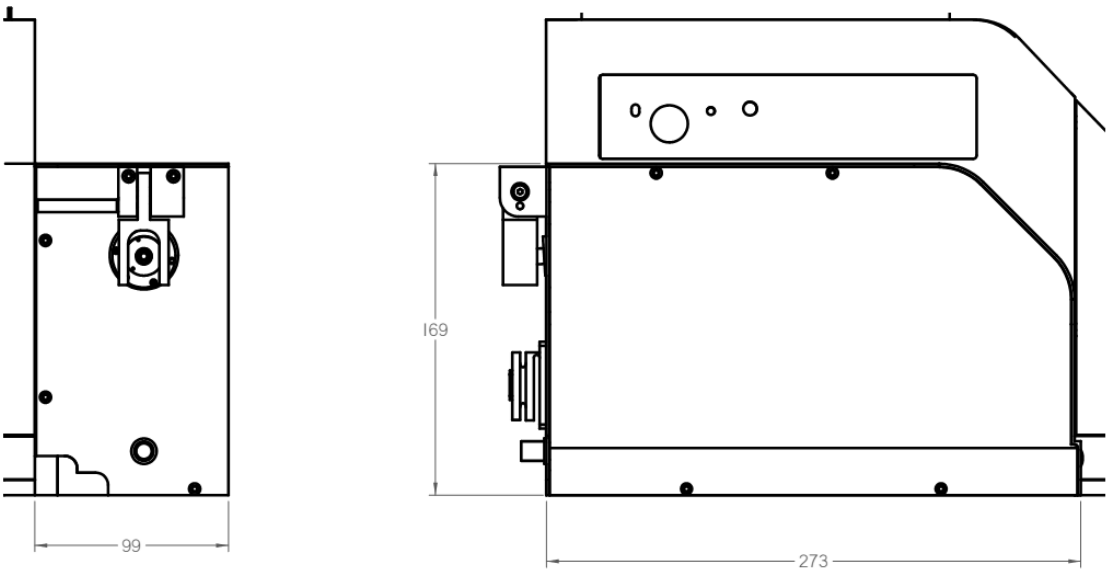
Bellows coupling adaptor (CSU-W)



3-position dichroic module for manual CSU models



Borealis enhanced CSU-W : Borealis components- dimensional information



Note: refer to the Yokogawa CSU-X1 and CSU-W1 manuals for further dimensional information on the standard units.

APPENDIX B: GLOSSARY

AC	Alternating Current (Mains)
AC/DC	An electronic device that converts AC electricity (usually mains) into a DC voltage (usually a safe low voltage)
ADC	Analogue-to-Digital Converter: Converts an analogue voltage to a digital signal.
AEL	Accessible Emission Limit: The maximum accessible emission permitted within a particular class. Wherever the text refers to “emission level not exceeding the AEL” or similar wording, it is implicit that the accessible emission is determined following the measurement criteria specified in Clause 9 of IEC 60825-1.
BCU	Beam Conditioning Unit: Homogenizes the light from the laser source to permit uniform illumination across the image
CSU	Confocal Spinning Disk
CLSM	Confocal Laser Scanning Microscopy
DC	Direct Current
Diffuse Reflection	Change of the spatial distribution of a beam of radiation by scattering in many directions by a surface or medium.
EMC	Electromagnetic Compatibility
ESD	Electrostatic Discharge
EU	European Union
FC/APC	Fibre Optic connector (Angled Physical Contact)
IO	Input/Output: Generic input and output electrical signal connections
ILE	Integrated Laser Engine: Control for up to 4 individual lasers.
Intrabeam Viewing	All viewing conditions whereby the eye is exposed to the direct or specularly reflected laser beam in contrast to viewing of, for example, diffuse reflections.
LED	Light Emitting Diode
LMM	Laser Merge Module: Combines multiple laser wavelengths into a single fibre optic cable output.
MM	Multi-mode fibre: Multi-mode fibres have a much larger core diameter than single mode fibres. This enables improved transmission of longer wavelengths.
NOHD	Nominal Ocular Hazard Distance: Distance from the output aperture at which the beam irradiance or radiant exposure equals the appropriate corneal maximum permissible exposure (MPE)
MPE	Maximum Permissible Exposure: Level of laser radiation to which, under normal circumstances, persons may be exposed without suffering adverse effects. The MPE levels represent the maximum level to which the eye or skin can be exposed without consequential injury immediately or after a long time and are related to the wavelength of the laser radiation, the pulse duration or exposure duration, the tissue at risk and, for visible and near infra-red laser radiation in the range 400 nm to 1 400 nm, the size of the retinal image. Maximum permissible exposure levels are (in the existing state of knowledge) specified in Annex A of IEC 60825-1.
Parfocal	When optical components- such as the objective lenses or camera ports of a microscope are described as parfocal this means that they may be interchanged without affecting the focus on the image.
Specular Reflection	Reflection from a surface that can be considered a beam, including reflections from mirrored surfaces.

APPENDIX C: OTHER INFORMATION

Terms and Conditions of Sale and Warranty Information

The terms and conditions of sale, including warranty conditions, will have been made available during the ordering process. The current version may be viewed at: http://www.andor.com/pdfs/literature/Andor_Standard_Warranty.pdf

Waste Electronic and Electrical Equipment Regulations 2006 (WEEE)

The company's statement on the disposal of WEEE can be found in the Terms and Conditions