ANDOR
an Oxford Instruments company

Integrated Laser Engine

Version 1.4 revised 10 Oct 2024

Hardware Guide

covers models ILE-400, ILE-700 and ILE-800

andor.com

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Revision History

Version	Released	Description
Rev -	02 Oct 2012	Initial Release for production
Rev A	10 Apr 2013	Update for triple output, added lasers
Rev B	11 Dec 2013	Corrections and minor updates; 400-800 nm only
Rev C	12 Dec 2013	Issued as Andor Document
1.0	30 Mar 2015	Hardware guide updated to support both ILE-400 (4 line) and ILE-700 (7 line) configurations (all sections).
1.1	21 Jan 2016	Information added to cover ILE-800 model and BCU-200 (dual input) units (all sections). Updated configuration for ILE-700 added (Section 2.6) Updated support contact information (Section 1.1)
1.2	11 Apr 2017	Made reference to requirement for systems to have dual language laser and warning labels applied (preface)
1.3	23 Feb 2018	System connection diagrams updated to match typical system configurations used for Dragonfly (Section 2.6.1) Added extra system and emission indicator LEDs image (Section 2.1.6)
1.4	15 Oct 2024	Added AI translation Disclaimer (Section 1.2)

Updates to the Manual

Changes are periodically made to the product and these will be incorporated into new editions of the manual. Please check for new releases of the manual in MyAndor: http://my.andor.com/login.aspx. If you find an issue in this manual please contact your customer support representative (Section 1.1) with a description of the issue.

Safety and Warning Information

PLEASE READ THIS INFORMATION FIRST

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

1. If the equipment is used in a manner not specified by Spectral or Andor, the protection provided by the equipment may be impaired.
2. 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 Hardware Guide.
3. Users must be authorised and trained personnel only; otherwise this may result in personal injury, and/ or equipment damage and impaired system performance.
4. There are no user-serviceable parts inside the product and the enclosure must not be opened. Only authorised service personnel may service this equipment.
5. This product will contain lasers.
6. IEC Technical Document IEC TR 60825-14 recommends the presence of a Laser Safety Officer (LSO); however, national guidelines should be referred to.
7. 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.
8. Do not position this product so that it is difficult to operate the Mains disconnecting device. See SECTION 4.1, “Emergency Mains Disconnection”.
9. 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.
10. Only the correctly specified mains supply should be used.
11. Only the AC/DC external power supply provided with the product should be used.
12. 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.
13. 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.
14. 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”
15. While running an experiment, try to keep room temperature as stable as possible.
16. This equipment has not been designed and manufactured for the medical diagnosis of patients.
17. 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.
18. 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.

19. Please note that this product is not designed to provide protection from ionising radiation. Any customer using this product in such an application should provide their own protection.
20. Your product is a precision scientific instrument containing fragile components. Always handle it with care.
21. The ILE weighs over 20 kg depending on system configuration and therefore requires due consideration during manual handling. It requires two persons to lift at all times.
22. When transporting, installing or moving the ILE, use the carry handles.
23. Ensure 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.
24. Do not wet or spill liquids on the product, and do not store or place liquids on the product.
25. If spillage occurs on the product, switch off power immediately, and wipe off with a dry, lint-free cloth.
26. If any ingress of liquids has occurred or is suspected, unplug the mains cables, do not use, and contact Andor Customer Support.
27. See SECTION 5.1, “Cleaning and Decontamination”.
28. Do not expose the product to extreme hot or cold temperatures.
29. Do not expose the product to open flames.
30. Do not allow objects to fall on the product.
31. Keep this Hardware Guide in a safe place for future reference.

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 incorporates lasers that may 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. 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 Integrated Laser Engine may be classified as Class 3B or Class 4 in accordance with the requirements of IEC 60825-1 and CDRH Title 21 CFR 1040.10. Classification depends on the laser source and configuration. Refer to the following sections.

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, including for the intended region of use e.g. French versions of the appropriate warning labels applied for use in Canada. Please refer to section 3.4 for guidance on the assessment and classification procedure.

Laser Safety and Product Compliance Labels

A label is located on the base plate or rear panel of the ILE to indicate compliance with the applicable standards (it may differ from that shown below. It also provides information on the manufacturer and identifies the model, serial number, and manufacturing date (month, year). Note that the model ILE is suffixed with /N where N is the number of lasers included within the ILE.

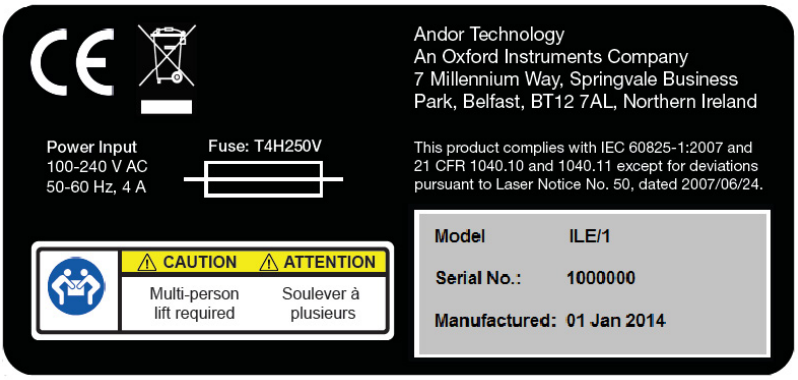


Figure 1: Compliance and Serial Identification labels on rear panel of the ILE

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

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. Note that were appropriate e.g. Canada, French versions of warning labels must also be applied. The ILE may be configured as a 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 3B

Laser products that are normally hazardous when intrabeam ocular exposure occurs (i.e. within the Nominal Ocular Hazard Distance, NOHD) including accidental short time exposure. Viewing diffuse reflections is normally safe. Class 3B lasers which approach the Accessible Emission Limits (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 Maximum Permitted Exposure (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 for which the viewing of diffuse reflections may be hazardous. These lasers also often represent a fire hazard.

Aperture

The following label is located at the fibre optic cable connections on the front panel of the ILE. 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

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

Non-interlocked Protective Housings

This label is located in two places on the ILE: on the removable cover panel on the optics section and on the baseplate inside the optics section of the unit so that it is clearly visible when the cover is removed for servicing. Note that the ILE may be Class 3B or Class 4. It is possible that the ILE itself is Class 4, but the overall system is classed as 3B as overall system classification is dependent on the AEL of the whole system.

Figure 4: Non-Interlocked Protective housing labels

Description of Emitted Radiation from Laser Products

Table 1: Description of Emiited radiation from Laser Products

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 sources integrated within the ILE. As there are multiple options available from Andor 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. Ensure that 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. Ensure equipment is used in a controlled area by trained end users in accordance with national guidelines.
4. Ensure end-users are familiar with the operation of the laser's key switch control, interlocks, emission LEDs and other safety features.
5. Ensure that all interlocks are connected and functioning correctly.
6. The laser safety officer should use IEC 60285-1 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 areas where lasers 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 either 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 system installation, 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.

ILE Laser Selection

The current laser selection for the ILE includes lasers ranging from 405 to 785 nm as shown in the table 2 below. Laser options may change as models are replaced or new models are introduced by the different laser manufacturers. Please contact your local sales representative for the latest information.

Table 2: Selection of laser options available for the ILE

Wave-length (nm)	Power Rating (mW)	Divergence (mrad)
405 ***	50, 100, 200	<1
445 ***	75	<1.1
458 **	75	<1.1
473 **	75	<1.1
488 **	50, 100, 150, 200	<1.2
514 **	40	<1.2
515 **	50, 100, 150	<1.2
532 **	50, 100	<1.1
552 **	60, 100	<1.1
561**	50, 100, 150	<1.2
594 *	50, 100 ‡	<1.2
637 ***	140	<1.3
640 ***	100	<1.3
647 ***	120	<1.3
685 ***	40	<1.1
730 ***	30	<1.3
750 ***	400	<1
785 ***	50, 120	<1.3

‡ indicates DPSS laser which is not recommended for fast switching or blanking applications.

Wavelength variation (nm) depends on laser type: * +/- 0.3, ** +/- 2, *** +/- 5

Maximum Permissible Exposure (MPE)

The **Maximum Permissible Exposure (MPE)** is computed based on criteria established in IEC 60825-1: 2007 for a duration over 100 s and for short duration (<0.25 s) exposure for visible wavelengths between 400-700 nm. The long duration calculations are a function of wavelength as indicated below while the short duration is fixed at 2.5 mW/cm^2. The MPE based on short (0.25 s) duration is used for the calculation of the **Nominal Ocular Hazard Distance (NOHD)** in table 3 given that any exposure is expected to be limited by the 0.25 s aversion response to a bright light “flash”. The MPEs based on long durations (100 s) are used for the calculation of the Optical Density (OD) of protective eye wear.

Table 3: Calculated MPE values for short duration (<0.25 s) exposures at wavelengths 405-785 nm.

Wavelength (nm)	MPE, mW/cm^2
405	0.1
445	0.1
458	0.1
473	0.1
488	0.575
514	1
515	1
532	1
552	1
561	1
594	1
637	1
640	1
685	1
730	1.15
750	1.26
785	1.48

Nominal Ocular Hazard Distance (NOHD)

The system's aperture is the output of the fibre coupler located on the front panel of the ILE. The NOHD is computed on the basis of the short duration (0.25 s) MPE value (2.5 mW/cm^2) given that any exposure is expected to be limited by the 0.25 s aversion response to a bright light "flash". The NOHD values for each wavelength are based on measurements of the irradiance on a 7 mm diameter aperture (representing the eye). The values are provided below in table 4. Note that the single mode output coupler full angle divergence is 60 mrad whereas the multi-mode coupler full angle divergence is 120 mrad.

Table 4: NOHD values for single and multi-mode couplers- based on short duration (0.25 s) MPE value 2.5 mW/cm^2).

Wavelength (nm)	Single Mode Max. Laser Power (mW)	Multi-mode Max. Laser Power (mW)	Single Mode NOHD, cm	Multi-mode NOHD, cm
405	200		226	n/a
445	75		139	n/a
458	75		139	n/a
473	75		139	n/a
488	200		226	n/a
514	40		101	n/a
515	150		196	n/a
532	100		160	n/a
552	100		160	n/a
561	150		196	n/a
594	50		113	n/a
637	140		189	n/a
640	110		168	n/a
685	40		101	n/a
730	30		88	n/a
750	400	400	n/a	160
785	120		113	57
multiple vis	500	500	357	179
multiple vis	2000	2000	714	357

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.

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

Information on Viewing Apertures

In order to view any of the apertures, it is necessary to use eye protection to reduce the intensity of the laser power to acceptable levels for viewing. The table below provides the appropriate OD values required for each wavelength.

WARNING: THE USER IS RESPONSIBLE FOR ACQUIRING THE APPROPRIATE GOGGLES TO MEET THESE SAFETY REQUIREMENTS IF VIEWING IS REQUIRED.

It should also be noted that since the laser selection covers many wavelengths, it may not be possible to find a single pair of goggles to provide the necessary protection.

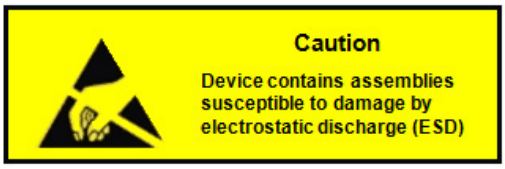
Table 5: Eye protection information for safe viewing

Wavelength (nm)	Max. Laser Power (mW)	Optical Density for Safe Viewing
405	180	4
445	67.5	4
458	67.5	4
473	67.5	4
488	180	4
514	36	3
515	135	3
532	90	3
552	90	3
561	135	3
594	45	3
637	126	3
640	126	3
685	126	3
730	27	3
750	360	4
785	108	3

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 exposure to this 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 300 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.

ESD Caution



This label is located on the cover panel of the ILE electronics section. This may be accessed only by authorised service personnel.

SECTION 1: INTRODUCTION

This manual provides an overview of the Integrated Laser Engine (ILE). This product is intended for professional scientific research applications, especially bio-imaging, photo-stimulation and spectroscopy. The ILE is a laser combiner system that utilises modern lasers that allow analog control of output power. These are more efficient and smaller than previous generations. Thus, the ILE is designed as a fully integrated instrument with only a line cord required to provide line power and a USB or serial cable to provide command and control communications.

The ILE houses control electronics, laser optics and up to 4 individual solid-state lasers per unit, and the power supply. Although the ILE is designed to accommodate small integrated lasers, there is a slot for a DPSS laser. This slot provides a shutter and neutral density filter assembly for output power control. A USB 2.0 interface is provided that allows communication with the ILE and controls each laser channel. A Master Shutter is also included to block any output when required. The ILE also supports interfaces for direct control of lasers: TTL for fast switching and analogue (0-5V) for variable intensity control.

The ILE is constructed from a robust, rigid Aluminium structure with the individual lasers mounted internally. Internal stabilization ensures that a reasonable variation in ambient temperature will not affect the system performance.

Inside ILE, the laser beams are individually focused onto a fibre output coupler. If the ILE has a dual output configuration, a second fibre output coupler is serviced by an optical switch mechanism. If the ILE has a triple output configuration, a third fibre output coupler is serviced by an optical switch mechanism that directs the laser outputs to any one of the outputs.

A single ILE-400 facilitates up to 4 lasers. The ILE-700 is configured with two ILE units (ILE-400 and an ILE-300) interconnected with a fibre so that up to seven lasers can be integrated into the system. The ILE-800 is configured with two ILE-400 units so that eight lasers can be used.

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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:

Europe

Andor Technology

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*** The latest contact details for your local representative can be found on the contact and support page of our website.**

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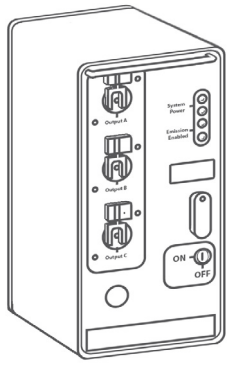
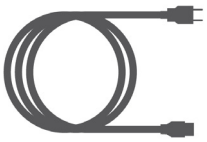
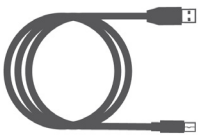
1.5 Supplied Components

Description		Quantity
	**Integrated Light Engine (ILE)**[•1,3]	see note 1

	**Keys for ILE Laser Power Switch**	1		**Country Specific Power Cable**	1
	**Fibre Optic Cable (2 metre)**	1[•2]		**USB Cable**	1
	**Test Report**	1		**RS232 Communication Cable**	1
	**Hardware Guide** (in electronic format)	1		**Triggering and Interlock Cables (BNC)**	see note[2]

1. ILE-400 is configured with up to 4 laser sources/outputs. ILE-700 supports up to 7 lasers- consisting of a “Primary” ILE (ILE-400) and “Secondary” ILE (ILE-300) unit. ILE-800 supports up to 8 lasers and consists of 2 ILE-400 units. 2. As required. Interlock, Triggering BNC and communication cables supplied will vary as required for specific system configurations. 3. For information on ILE systems that require a Beam Conditioning Unit (BCU) please refer to the Borealis Hardware Guide, and if used in a Dragonfly system, refer to the Dragonfly hardware guide.

1.5.1 Optional Components

The standard ILE system may be configured with up to 4 laser sources or co-lineated and delivered into a single or multi mode fibre. The ILE can further be equipped with one or two additional fast switched fibre outputs, thereby supporting multiple illumination methods, as is possible for example by Andor Dragonfly systems.

SECTION 2: PRODUCT OVERVIEW

This section provides an overview of the ILE. This covers ILE-400, ILE-700 and ILE-800 models.

2.1 ILE Front Panel

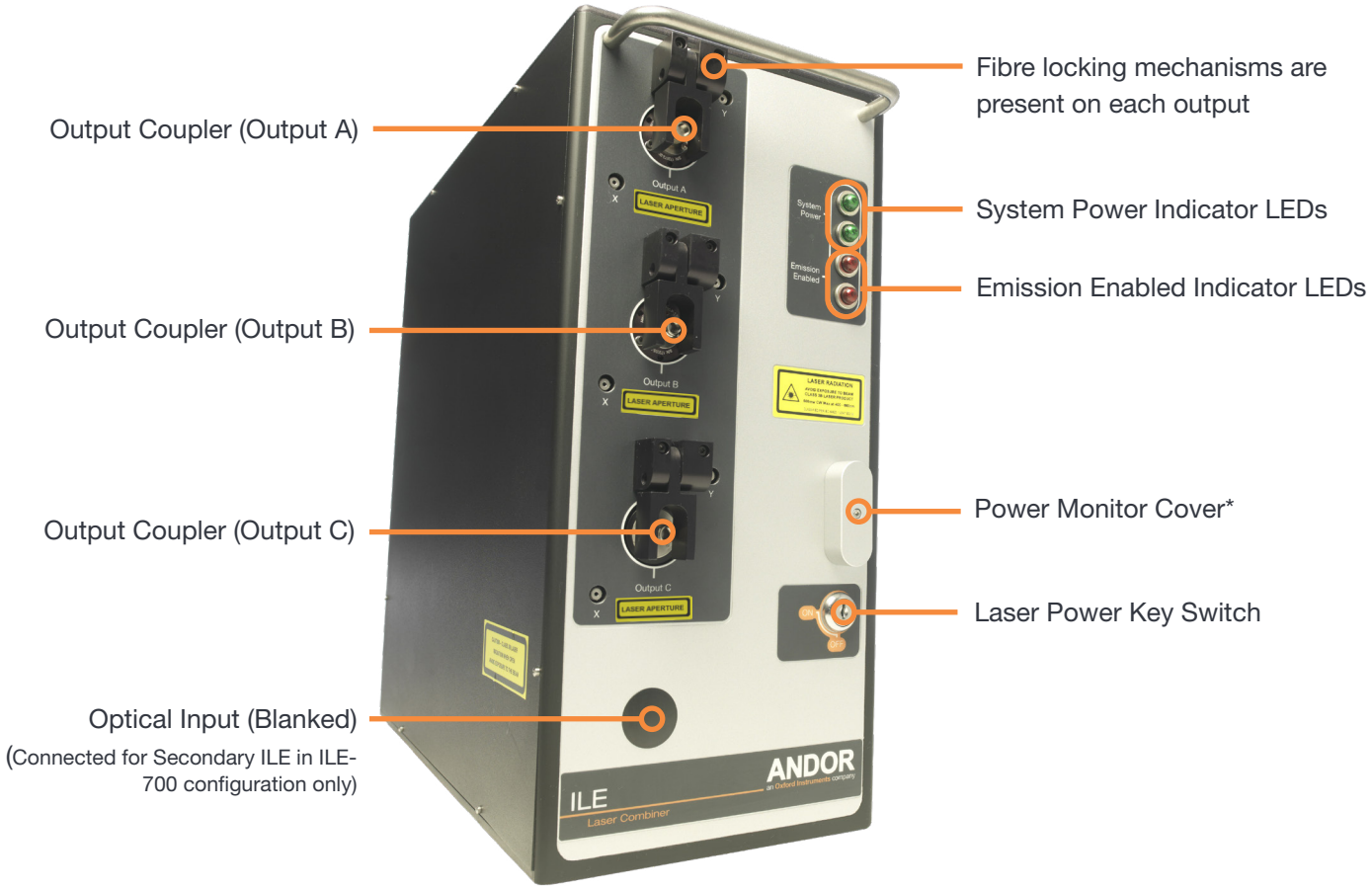


Figure 5: ILE Front Panel

* Power monitor connection is not accessible to user

2.1.1 Output Couplers

The output couplers are the laser apertures for the ILE. A single output is standard but dual output and triple outputs are available. They couple the internal laser outputs into the SM and/or MM fibre(s) attached depending on the requirements for the specific system configuration. The couplers can be adjusted in two rotational axes using differential tools (provided with the system or 1/16" Allen key) via the two access holes labelled "X" and "Y".

2.1.2 Fibre Locking Mechanism

A locking mechanism is provided for each of the outputs. This protects each fibre from disconnection from its output coupler.

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.**

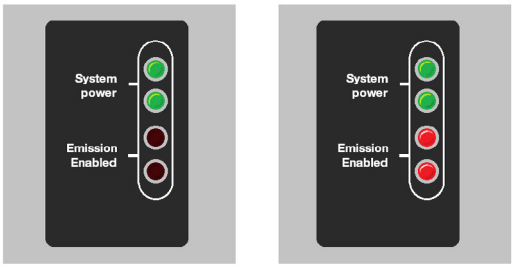
2.1.3 Laser Power Key Switch

The Laser Power Key Switch is present on the front panel of the ILE. This switch controls the power to all the lasers acts as the manual reset in a Class 4 system. The key can be removed when the switch is OFF but cannot be removed when the switch is ON (Refer also to Section 2.2.3).

2.1.4 Power Indicator LEDs

The green LED indicators light when the rear panel mains rocker switch is turned ON. The internal AC/DC power supply is receiving power from the mains power supply. Note that the two power indicator LEDs operate as a redundant pair.

2.1.5 Emission Indicator LEDs



The upper green LED are turned ON a few moments after the Laser Power Key Switch is turned on.

The lower red LEDs are turned ON when the Master Shutter is opened a few seconds after the laser power is turned on. This indicates that laser emission is possible and could be imminent.

2.1.6 Power Monitor

The power monitor is only accessible to service personnel and not accessible to users.

2.1.7 Optical Input

The front optical input is only present in a "Secondary" ILE unit as part of an ILE-700 system (refer to Section 2.6).

2.2 ILE Rear Panel

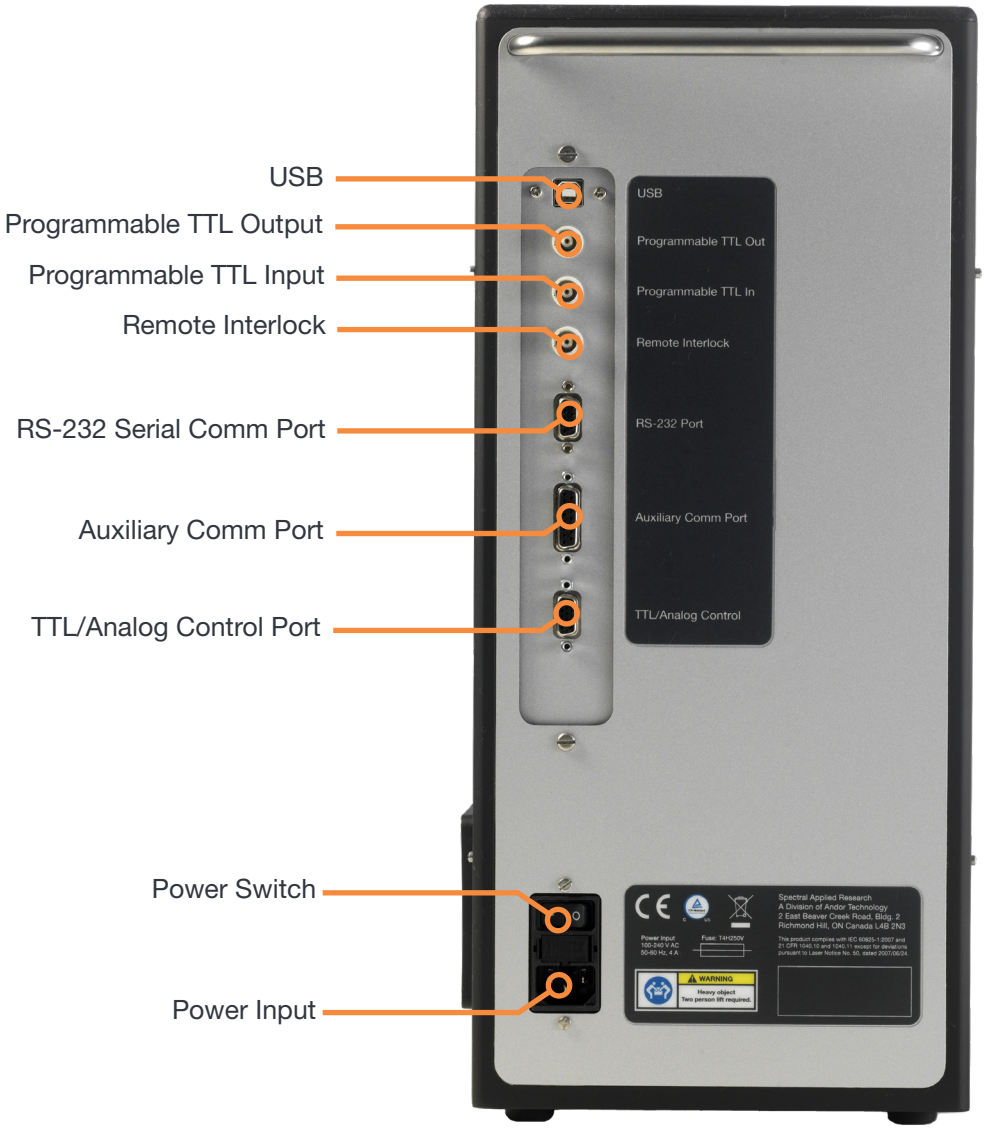


Figure 6: ILE Rear Panel

Connection	Description
USB	USB 2.0 Standard Series B Receptacle
Programmable TTL Output	BNC socket
Programmable TTL Input	BNC socket
Remote Interlock	BNC socket
RS-232 Serial Comm Port	Standard 9-pin D-sub (DE-9) female socket
Auxiliary Comm Port	Reserved (not available to the user)
TTL/Analog Control Port	High-density 15-pin D-sub (DE-15) female socket

2.2.1 USB/RS-232

Either of the USB or the RS-232 connections may be used to communicate with the ILE to control and monitor the lasers and other functions. The RS-232 uses the following settings: 19200 bps, 8 data bits, 1 stop bit, no parity, no hardware flow control. The USB connection uses the human interface device (HID) protocol and is automatically detected by compatible software programs.

2.2.2 Programmable TTL Input/Output

Two BNC connectors are provided on the rear panel to allow the user to synchronize external equipment with the ILE. Any common type of coaxial cable may be connected the BNC connector including 50 Ω and 75 Ω types. Wire leads may also be used with an appropriate BNC coaxial to wire adapter.

Programmable TTL Input: is by default configured to provide synchronization to an external camera fire signal. A high TTL level turns on any selected lasers and a low level blanks the ILE output. Synchronization is initiated by turning on the desired laser through the ILE software interface, and then the selected lines will automatically be blanked when the TTL signal goes low, and restored when the signal goes high.

The TTL input is capable of driving lasers with less than one microsecond response time although the exact response time may be limited by the laser. Contact your sales representative for information specific to the lasers in the system.

- In general, diode lasers have sub microsecond response times.
- Optically pumped semiconductor lasers (OPSL) have response times of around ten microseconds.
- Lasers that use a mechanical shutter, typically diode pumped solid state lasers (DPSS), have response time typically around two milliseconds.
- The mechanical shutters should be limited to 50 Hz repetition rates with short bursts of a few seconds of no more than 100 Hz.

The TTL output can optionally be used to provide spinning disk speed control on some confocal systems.

Table 6: TTL Input/Output Specifications

	Description
Input	Low: 0-0.8 V High: 2.0-5.0 V 100 kΩ internal pull up resistor to 5 V so that the lasers will operate when no cable is attached.
Output	+/-4 mA up to 5 V

2.2.3 Remote Interlock/Manual Reset

A BNC connector is provided so that the user can interlock the ILE lasers with external equipment such as a microscope or warning lights. The contacts must be shorted for the lasers to operate. When the interlock contacts are open, the Master Shutter closes and all the lasers are disabled.

For Class 3B: the laser configuration is re-established to what is was, once the interlock is closed again.

For Class 4: the shutters must be re-opened to regain the previous laser configuration. Alternatively, the Key Switch may be cycled OFF and then ON again to restart the ILE. However, in this case, the laser configuration must be re-established entirely.

ILE-700 and 800 configurations: Where this is present, the Interlocks between the two units must be connected with BNC cables using a T-connector on one of the ILE connectors so that external interlocks can be accommodated (see Section 2.6). The output of the primary (ILE-400) unit is connected to the secondary ILE unit. For the ILE-700 this is an ILE-300, for the ILE-800 this is a second ILE-400 unit. The output of the both units in the ILE-700 is directed out of the secondary output(s). Special firmware is required to allow this special configuration. If the combined output of both units in a ILE-700 or ILE-800 system exceeds 500 mW, then the entire system will be treated as Class 4.

2.2.4 Auxiliary Comm Port

This connection is used to communicate with a secondary unit (ILE-700 and ILE-800) or provide speed control to compatible confocal units. It is not available to the user.

2.2.5 TTL/Analog Control

The HD15 D-sub connector provides the user with the capability of controlling the lasers via TTL and analog control. The pin-outs for this connector are provided below. Pins 4-6 are auxiliary inputs for the camera fire on multiple camera systems. These inputs are logically OR'd with the main signal on the TTL Programmable Input. The fire signal on a single camera system should be connected to the TTL Input (Section 2.2.2). Additional cameras may be connected to the pins on the HD15 connector. Refer also to Section 2.3.3.

Table 7: TTL/Ananlog Pin out Information

Pin	Function	Pin	Function	Pin	Function
1	+5V Output [1]	6	Aux 3 Input [2]	11	TTL In 4 [2]
2	Dual Output Switch [2]	7	Control Input [2] (for Triple output system)	12	Intensity Control In 1 [3]
3	Ground	8	TTL In 1 [2]	13	Intensity Control In 2 [3]
4	Aux 1 Input [2]	9	TTL In 2 [2]	14	Intensity Control In 3 [3]
5	Aux 2 Input [2]	10	TTL In 3 [2]	15	Intensity Control In 4 [3]

[1] 150 mA output maximum

[2] TTL logic, (0-0.8 V low, 2.0-5.0 V high) 5.5 V max, 100k Ohm pull-down

[3] 10k Ohm pull-down, 0.5 V = 0 %, 4.5 V = 100%, 5.5 V max

2.2.6 Power Switch/Power Input

A power switch is located above the power input socket (IEC 60320 C14 mains inlet) on the rear panel of the ILE.

2.3 Internal Features of the ILE

2.3.1 Laser Shutters

The lasers are controlled via the USB, serial communications ports or the TTL/Analog interface. These interfaces can be used for both shutter and intensity control from application software or appropriate hardware and performance is specified in the table below. Diode and OPSL lasers can be directly controlled, but DPSS lasers have opto-mechanical support within the ILE. A mechanical shutter is provided for DPSS lasers; one DPSS laser can be installed per ILE enclosure; variable intensity control of the DPSS laser is provided via motorized ND filters. Note that this limits the gating and modulation rates which can be achieved.

2.3.2 Master Shutter

A Master Shutter is incorporated that interrupts the output beam prior to the output coupler(s). This mechanism blocks the beam when the Interlock circuit is opened. The master shutter is restored to unblock the beam when the interlock is restored as described in section 2.2.3.

2.3.3 Laser Blanking

The standard configuration of the ILE allows the lasers to be blanked according to a fire signal from one or more cameras. The blanking inputs on the ILE use the Programmable TTL In (Section 2.2.2) or for additional cameras, the TTL/Analog control HD15 connection using pins 4-6 and breakout cables (see Section 2.6.4).

The blanking inputs require the fire signal from the cameras to be a TTL high when the camera is exposing and a TTL low during readout. The ILE will turn on any selected lasers when the input is high and blank the laser outputs when the signal is low. The BNC input and the three HD15 inputs are logically OR'd together so that the ILE will be in expose mode if any input is high. The BNC input is internally pulled high in the absence of a signal input so that the ILE will always be in expose mode if no camera fire signal is connected. A single camera system must be connected to the Programmable TTL Input on the BNC, and additional cameras may be connected to the HD15 pins.

The laser blanking is implemented by turning on the desired laser through the ILE software interface, and then the selected lines will automatically be blanked when the TTL signal goes low, and restored when the signal goes high.

Table 8: Shutter Speed Restrictions for a range of laser types

Laser	Description
OBIS Diode	System limited rise and fall times no worse than 500 ns.
OBIS OPSL	Limited by the laser rise and fall times no worse than 10 microseconds.
Pavilion (Multi-mode)	Response times are limited to about 100 microseconds.
Cobolt	Cobolt 561 laser: Maximum recommended shutter speed 50 Hz continuous operation, 100 Hz for short burst operation up to 10 seconds.

Note: For all OBIS lasers there is no risk of laser damage if they are driven faster than their capability.

2.4 Lasers

Refer to Section 7.3 and the laser safety sections in the preface of this manual for further information.

2.5 System Overview

The ILE-400 may be configured for up to 4 lasers. An system overview is provided below for a typical system with single output with a Borealis enhanced CSU and confocal system.

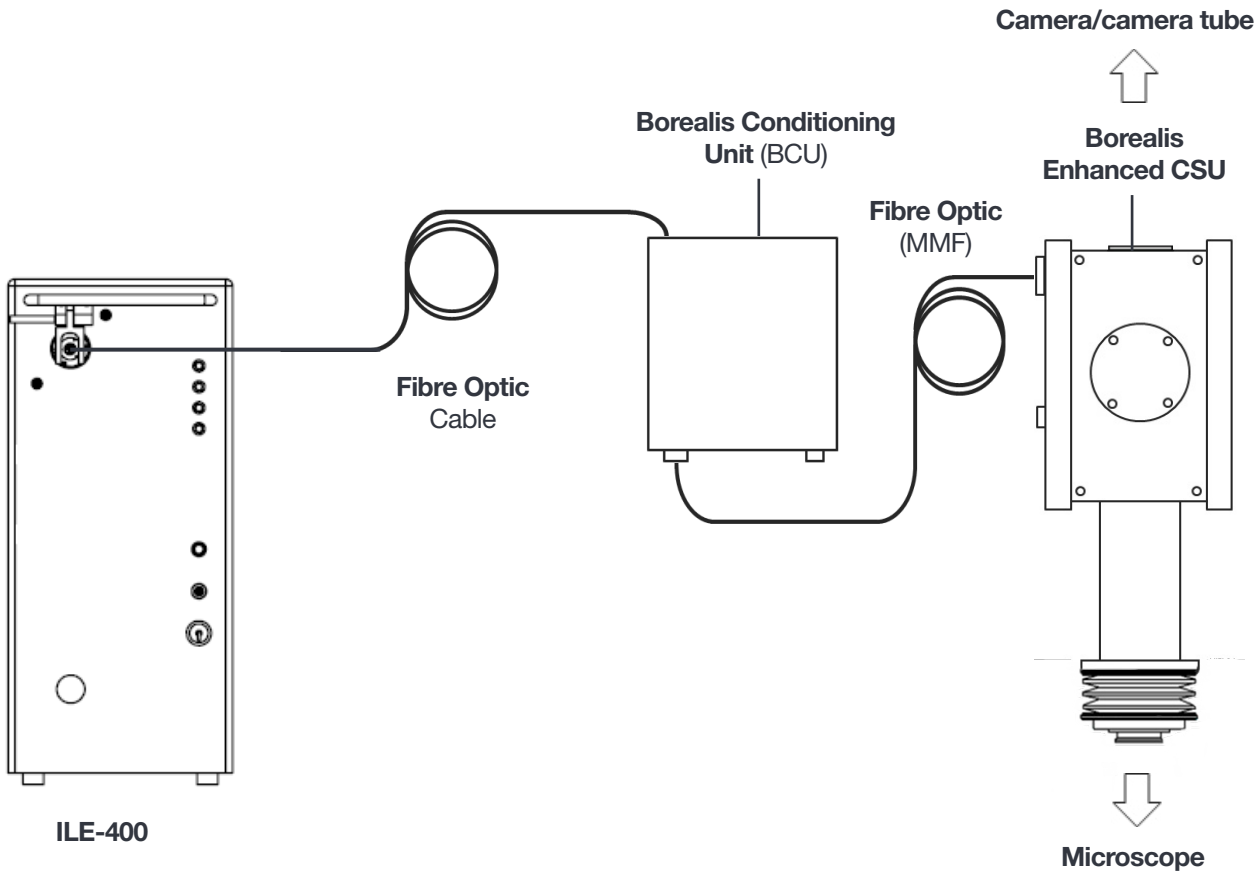


Figure 7: Overview of standard ILE as part of an overall system

2.6 ILE-700 and ILE-800 Configurations

The ILE-700 and ILE-800 systems appear to user through the software as a single ILE, but enables additional lasers to be connected up to a total of 7 (ILE-700) or 8 (ILE-800). The computer connects to the primary ILE through either a USB, or Serial RS-232 connection. The primary ILE then relays any necessary commands through to the secondary ILE unit- or for some software packages, a USB connection is made directly from the computer to both the primary and the secondary ILE units.

An overview of the connections are shown in this section for your reference. The ILE systems consist of the optical connection, interlock setup and the communication connections. With the exception of Section 2.6.3, the following connection information may also be applied to the ILE-400 system.

WARNING: The ILE system must be installed by an authorized installation engineer.

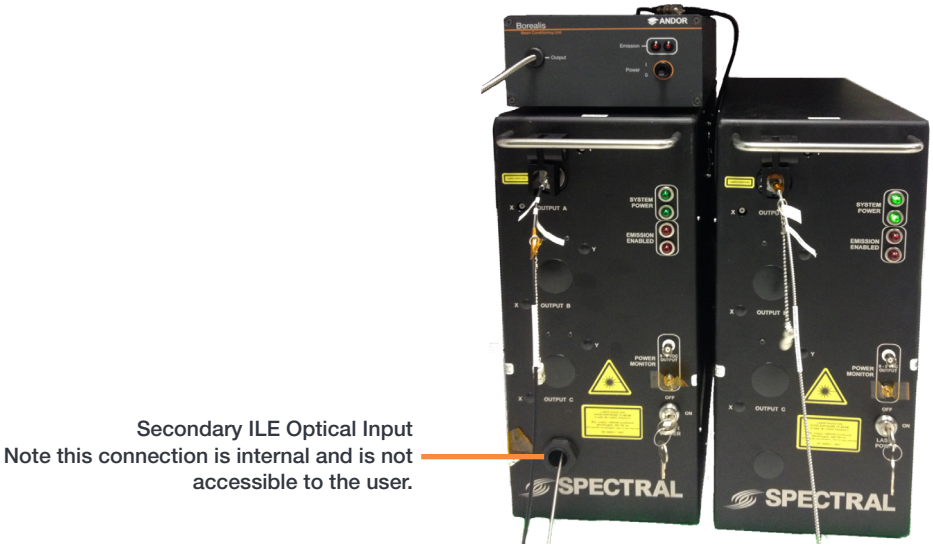


Figure 8: Secondary ILE (left), Primary ILE (right) shown with Borealis BCU

2.6.1 Optical Setup

In the case of the ILE-700 the optical setup may differ depending on the application. In this section two configuration examples are shown. Output A is single mode (SM) and goes to the secondary ILE Unit. Output B is multimode (MM) and goes to input 2 (side) of the BCU-200. On the secondary ILE unit, outputs A and B are single mode and typically connected to TIRF. Output C is multimode and is connected to input 1 of the BCU-200.

The fibre connection of the Secondary ILE Optical Input is internal and cannot be accessed by the user.

ILE-700: LC-ILE-700-M2S2 configuration

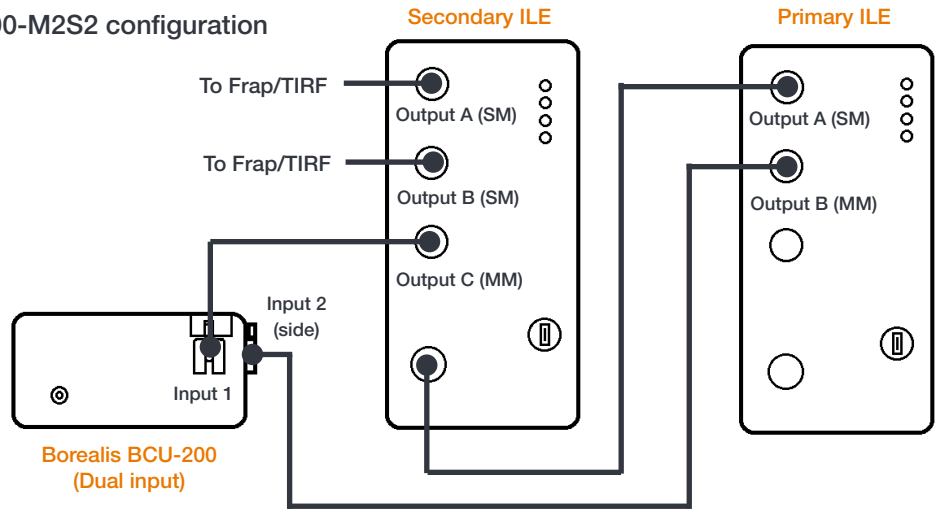


Figure 9: LC-ILE-700-M2S2 Configuration: Fibre Connections (front panel) BCU (rear panel)

ILE-700: LC-ILE-700-M2S1 configuration

This is most common configuration of the ILE-700. The primary ILE unit uses 2 outputs. Output A is single mode (SM) and goes to the secondary ILE Unit. Output B is multimode (MM) and goes to input 2 (side) of the BCU-200. On the secondary ILE unit, output A is single mode and is typically connected to TIRF. Output B is multimode and is connected to input 1 of the BCU-200.

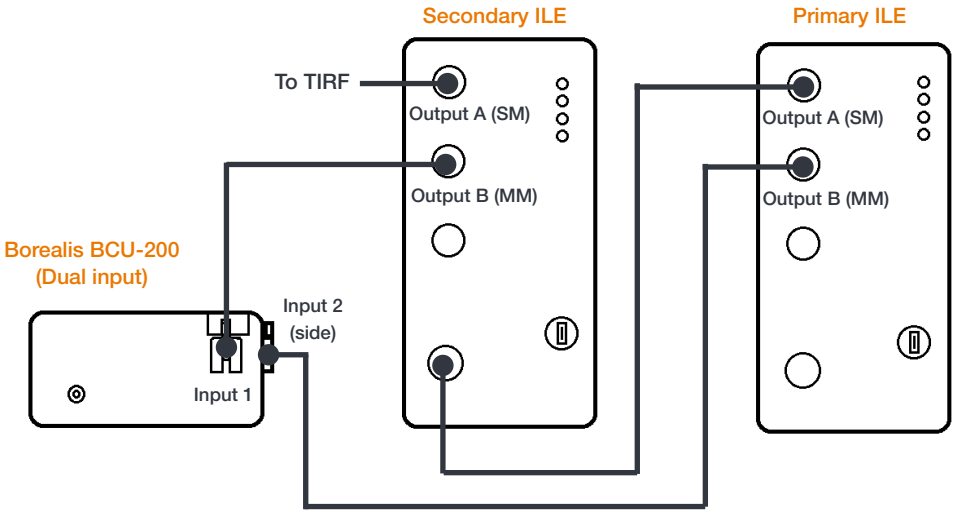


Figure 10: LC-ILE-700-M2S1 - Fibre Connections (front panel) BCU (rear panel)

ILE-800 Configurations

For the ILE-800, there are also several configurations available with combinations of both single and multi-mode options. The multi-mode (MM) optical outputs of both ILE-400 units are always connected to the dual input BCU (BCU-200). As shown in the example below for the LC-ILE-800-M configuration.

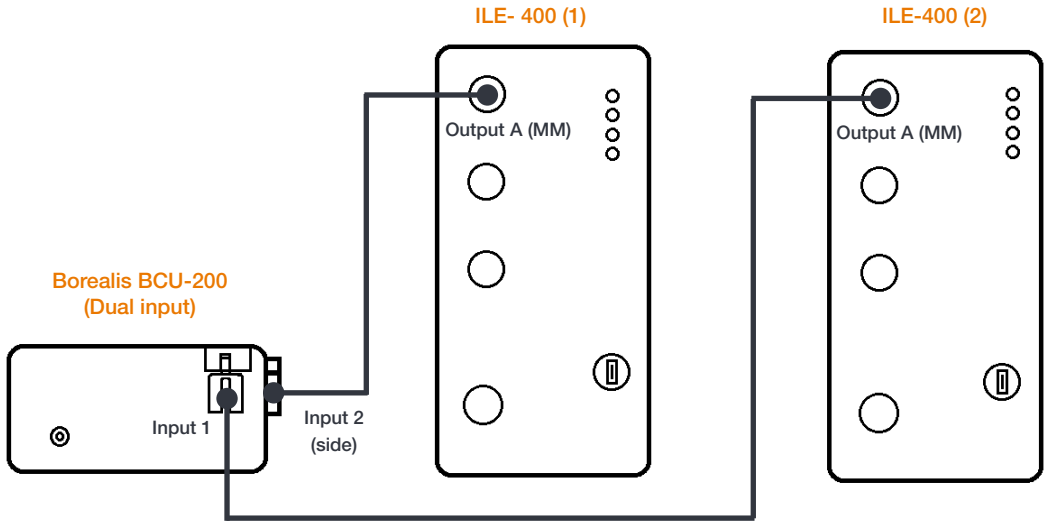


Figure 11: LC-ILE-800-M Configuration - Fibre Connections (front panel) BCU (rear panel)

2.6.2 Interlock Setup

- For the purpose of safety interlocking, both ILEs within the ILE-700 and ILE-800 systems behave as two separate laser systems. Refer also to the Dragonfly hardware guide for further system interlock information.
- If the interlock is triggered *all* lasers will be deactivated.
- The interlocks of each unit are coupled by a BNC Tee connection to the external interlock source during installation by an authorized engineer as shown in Figure 12.

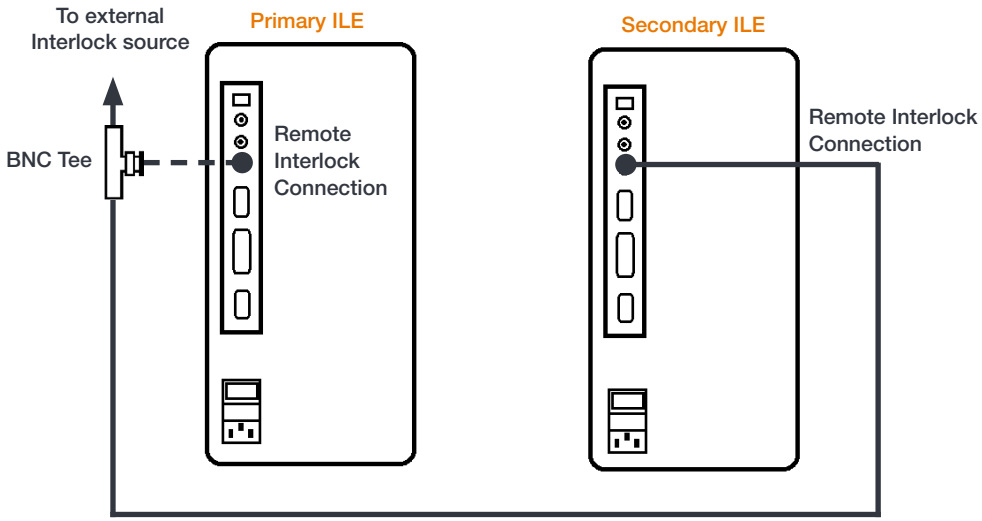


Figure 12: ILE-700 and ILE-800 Configuration Interlock Connection (rear view)

2.6.3 Communication setup*

- The Primary ILE communicates with the Secondary ILE through the ILE-700/800 communication cable. The cable is connected from the Auxiliary Comm Port (15 pin D-sub) on the rear panel of the Primary ILE to the RS-232 port (9-pin D-sub) on the rear of the Secondary ILE.
- The Secondary ILE communicates with the PC through either the RS-232 or USB connection.

***Note: For some software packages both ILE units may be connected to the control PC via USB and the communication cable is not used.**

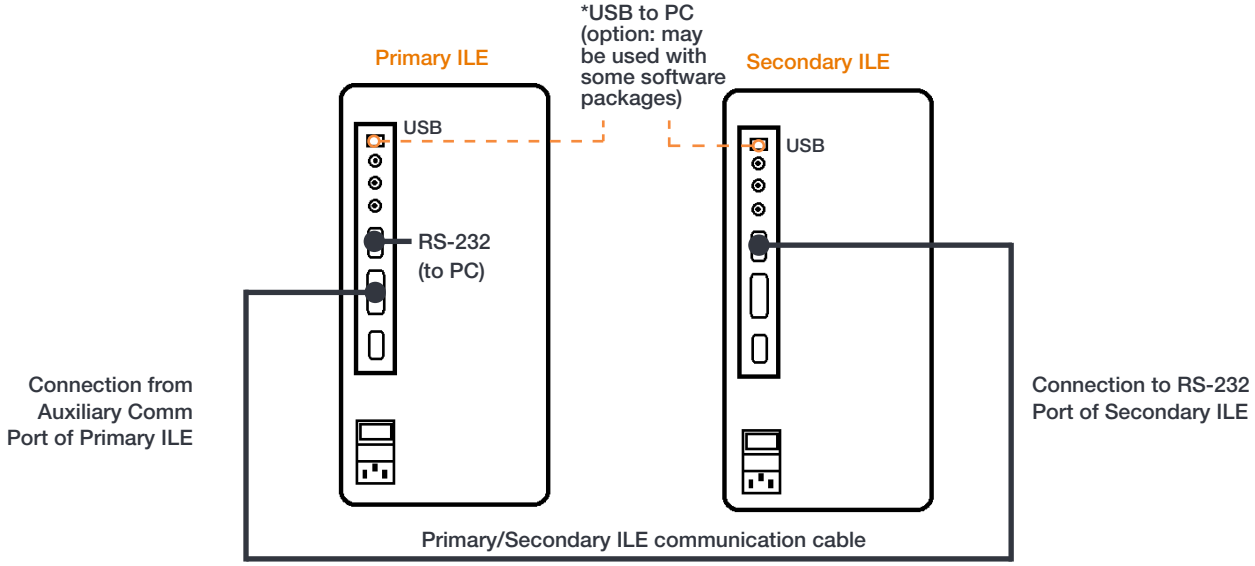


Figure 13: ILE-700/800 Configuration showing the PC and Camera Communication Connections

2.6.4 Active Blanking Connections

- An outline of the connections required for active laser blanking are shown below (refer also to Section 2.3.3).
- The Primary and Secondary ILE are coupled to the Fire Output of the first camera via the Programmable TTL In ports. A BNC Tee is connected to the Programmable TTL In port of the Primary ILE, with the other ends being connected to the Programmable TTL In port of the Secondary ILE, and the Camera Fire Output Connection.
- Blanking for additional cameras is done using the TTL/Analog control HD15 connector. The TTL/Analog control HD15 connector pins 4-6 (Section 2.2.5) are connected between the primary and Secondary ILE. A breakout cable is used as shown below to convert pins 4-6 of the HD15 connector to individual BNC connectors.
- Pin 3 of the HD15 connector is used as a common ground for pins 4-6.
- BNC Tees are used to link up to 3 additional cameras or other devices such as FRAPPA.

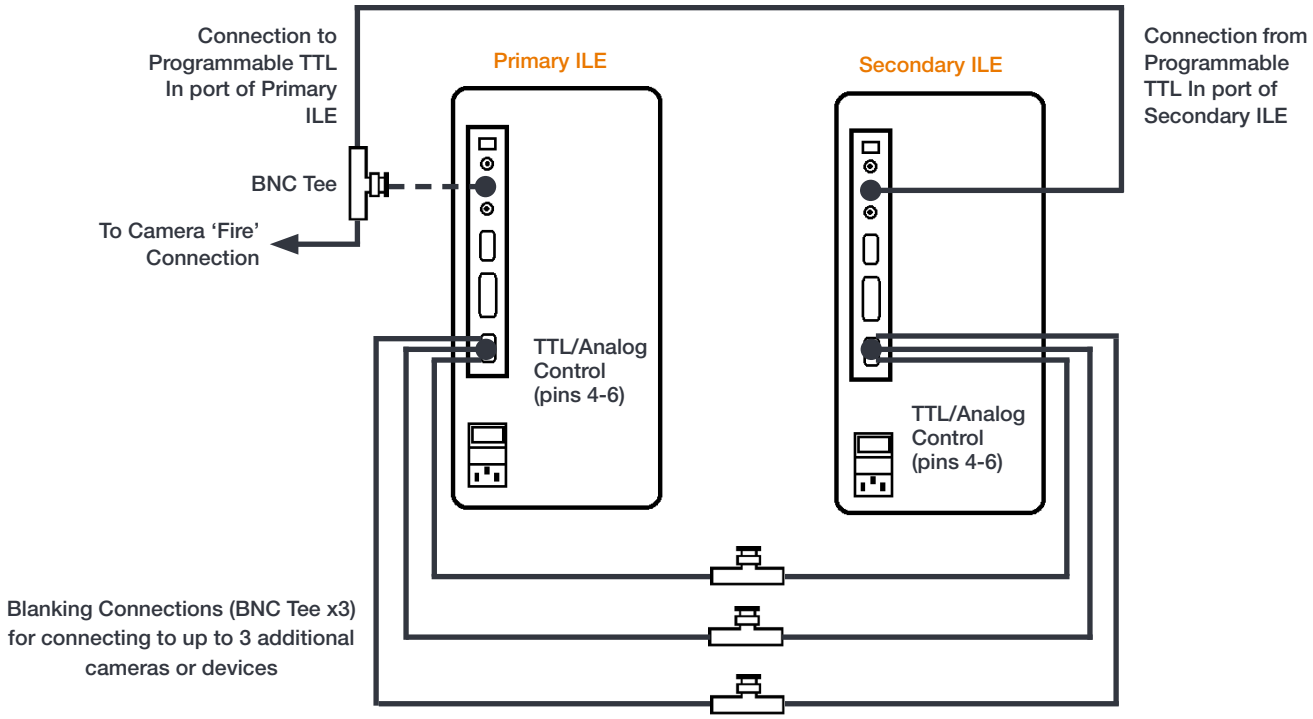


Figure 14: Active Blanking connections (shown for ILE-700/ILE-800 Configuration).

SECTION 3: INSTALLATION

WARNINGS:

- **THE ILE 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.**

- **THE ILE REQUIRES TWO PERSON LIFT AT ALL TIMES. ENSURE THAT DUE CARE IS TAKEN WHEN HANDLING THE ILE AND THAT SUFFICIENT SPACE IS AVAILABLE AND THE ILE IS LOCATED ON A PLATFORM OR TABLE CAPABLE OF SUPPORTING ITS WEIGHT (>20 KG, DEPENDING ON SYSTEM CONFIGURATION).**

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- allow 100 mm space around the ILE for ventilation

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 Classification of an Installed System

The following information provides a reference on how Andor classify a system which is configured with a number of system components, one of which is a laser a source, prior to installation.

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 5 W. 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 would 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.
4. Note that were appropriate e.g. Canada, French versions of classification and other warning labels must be applied in a suitable visible location.

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 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 (ILE-400)

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

1. Turn ON the rocker switch on the rear panel of the ILE. The green Power indicators on the ILE front panel light.
2. Turn ON the Master Key Switch on the ILE front panel. The red Emission Enabled indicators on the ILE front panel light after a few seconds (ILE initializing). Note: The ILE will operate properly if the above sequence is reversed.
3. Allow the temperature within the ILE to stabilize for 30 minutes for optimum stability. The lasers will generally be operational within 1 minute.
4. Use the appropriate applications program on the control computer to configure the ILE as required.

4.3 Power-down Sequence (ILE-400)

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

1. Close all laser shutters.
2. Turn master key to OFF on the ILE front panel.
3. Turn OFF the rocker switch on the ILE rear panel.

4.4 Power-up Sequence (ILE-700 & ILE-800)

When starting the system in ILE-700 and ILE-800 configurations it is recommended to turn on the Secondary ILE before the Primary ILE to make sure that the Secondary ILE functions are available, although it will not harm the system to turn on the Primary ILE first. The power-up procedure is as follows:

1. Turn ON the back panel rocker switch on the Secondary ILE unit. The green Power indicators on the ILE front panel light.
2. Turn ON the keyswitch on the front panel of the Secondary ILE. The red Emission Enabled indicators on the ILE front panel light after a few seconds (ILE initializing).
3. Turn ON the back panel rocker switch on the Primary ILE unit. The green Power indicators on the ILE front panel light.
4. Turn on keyswitch on the front panel of the Primary ILE unit. The red Emission Enabled indicators on the ILE front panel light after a few seconds (ILE initializing).
5. Allow the temperature within the ILE to stabilize for 30 minutes for optimum stability. The lasers will generally be operational within 1 minute.
6. Use the appropriate applications program on the control computer to configure the ILE as required.

4.5 Power-down Sequence (ILE-700 & ILE-800)

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

1. Close all laser shutters.
2. Turn master key to OFF on the Primary ILE front panel.
3. Turn OFF the rocker switch on the Primary ILE rear panel.
4. Turn master key to OFF on the Secondary ILE front panel.
5. Turn OFF the rocker switch on the Secondary ILE rear panel.

4.6 Risk Mitigation

4.6.1 Mechanical Housings

Once installed, the ILE and other system components including Borealis, 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.

4.6.2 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.

4.7 Using the ILE

Please refer to your software guide supplied with the control software, e.g. iQ, for a full description on the functionality available.

4.7.1 Pulse Width Modulation (PWM) Laser Control

Pulse Width Modulation (PWM) can be selectively enabled to support lower power levels and finer control than is possible by direct modulation alone. When active, PWM typically delivers power settings from 5% down to 0.01% in 0.01% increments and provides significant benefit to TIRF and localization microscopy using photo-activation. Spinning disk microscopy will operate at higher power levels (typically ≥10%) and does not benefit from PWM. It is recommended to deactivate the PWM feature for spinning disk microscopy.

The PWM control on the ILE applies a high frequency digital modulation to a laser in the ILE. When this mode is activated, the laser is pulsed on and off so that the average laser power from the ILE is reduced. Typically the laser is pulsed on for 250 ns, and then turned off for a period of time that determines the intensity reduction.

Note: PWM control functionality is software dependant. The software may automatically apply PWM control as appropriate, or it may be implemented when specifically activated by the user. Refer to your control software for further information.

For example, the intensity of a laser in the ILE may be controlled by a slider and/or a numeric control which sets the intensity from 0 to 100% (The appearance will vary depending on your control software). The ILE commands let the laser intensity be set in 0.1% increments. When the PWM control is available an additional drop down is displayed beside the slider that lets the user select the PWM intensity value. The PWM drop down menu allows the user to select the order of magnitude of the PWM intensity control at the following intensity levels: 100%, 10%, 1% and 0.1% and 0.01% intensity.

This allows the user to select the order of magnitude of the maximum laser power. Power within each order of magnitude can then be precisely controlled- an example is shown below:

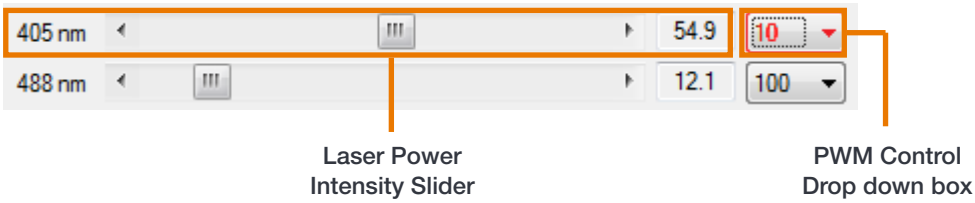


Figure 15: An example of control of laser intensity through the PWM function.

Notes:

- **Do not use PWM mode with Spinning Disk Confocal.**
- **It is not recommended to reduce the PWM option to lower than 0.01%.**

4.8 ILE-700 & 800 Configurations

The ILE-700 and ILE-800 configurations, consisting of Primary and Secondary ILE units, functions in the same way in the software as the standard ILE system, but it is possible to select and configure up to 7 lasers or 8 lasers respectively.

SECTION 5: MAINTENANCE

WARNINGS:

- **THE SYSTEM SHOULD BE POWERED-DOWN PRIOR TO USER PERFORMING ANY MAINTENANCE PROCEDURES.**
- **DO NOT USE EQUIPMENT THAT IS DAMAGED.**
- **CONTACT YOUR ANDOR REPRESENTATIVE IF THERE ARE ANY QUERIES OR ISSUES WITH YOUR ILE.**

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 Replacing/Cleaning the Air Filter

Check the air filter on the ILE monthly to ensure that it is clean.

The air filter can be removed as follows:

1. Snap off the cover to access the filter.
2. The filter is reuseable- it can be easily cleaned by vacuuming or washing with a mild detergent.
3. Ensure the filter is dry before reinstalling it in the ILE.
4. Replace the cover.

5.3 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 and connections to ensure that the locks are in place and no damage has occurred to the optical fibres connecting the various elements of the system.

5.4 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.

5.5 Replacing the Fuse

A fuse is located in the power inlet on the rear of the ILE (see Section 2.2.6). If this requires replacement, replace with fuse of same type and rating: T4H250V 5 x 20 mm, 250 V 4 A slow-blow/time delay Littelfuse 0215004.MXP or equivalent.

SECTION 6: TROUBLESHOOTING

6.1 Troubleshooting Examples

The following examples provide guidance for some basic troubleshooting scenarios. Refer also to the operation and troubleshooting information provided with your other system components. Contact your Spectral or Andor customer support representative if you require further assistance.

6.1.1 Green Power LEDs do not light

Fault	Action
Unit not receiving power	Check the power cables are connected and power switched on. Check that fuse is not blown. Replace fuse if necessary with same type and rating.

6.1.2 No Laser Output

Fault	Action
Interlock contacts open	All laser safety interlocks must be closed for lasers to operate. Check the interlock system is connected. Confirm that Red LED Emission indicators light. The lower red LED is ON when the Laser Power Key Switch is turned on. The upper red LED is ON when the Master Shutter is open a few seconds after the laser power is turned on. Note that for Class 4 systems, it might be necessary to turn the key switch off then on again.

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		Remote Interlock	
Mains Power		Emission LEDs	
laser power levels			
Computer controls			
Summary			
What channels are affected?			
What is the nature of the problem?			
Is the problem limited to either manual or computer control? Which?			
Any other observations			

SECTION 7: TECHNICAL SPECIFICATIONS

7.1 Laser Engine

Dimensions (L x W x H)	Single ILE unit: 18 x 18 x 8 inches [46 x 46 x 20 cm] approx.
Weight	ILE-400: ~44 lbs [20 kg] max ILE-700/ILE-800: ~88 lbs [40 kg] max (typical weight including lasers, weight will depend on system configuration)
Power Requirements	100-240 VAC, 50-60 Hz
Power consumption (max)	ILE-400: 300 W ILE-700/ILE-800: 600 W
Power consumption (typ)	ILE-400: 60 W ILE-700/ILE-800: 120 W
Fuse	T4H250V 5 x 20 mm, 250 V 4A slow-blow/time delay Littelfuse 0215004.MXP or equivalent
Interlock Max. Output	0 to 5.5 VDC

7.2 ILE Environmental

Usage	Indoor use only
Altitude	Up to 2000 m
Operating Temperature	18°C to 28°C ambient
Storage Temperature	-20°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 - allow 100 mm clearance for air flow at inlet and outlet

7.3 ILE Output Specifications

Maximum Output power, Class 3B	Up to 500 mW
Maximum Output power, Class 4	Up to 2000 mW
Operating wavelength range	400 to 800 nm

7.4 Output Fibre

Fibre type	Polarization maintaining single mode (SM) or Multi-mode (MM)
Coupler divergence	60 mrad (SM), 120 mrad (MM)
Connector type	FC/APC, FC

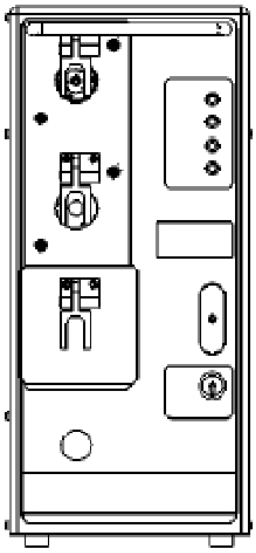
7.5 Neutral Density Filter Wheel Specifications

Attenuation	0-99%
Max. time to scan full range	<2s

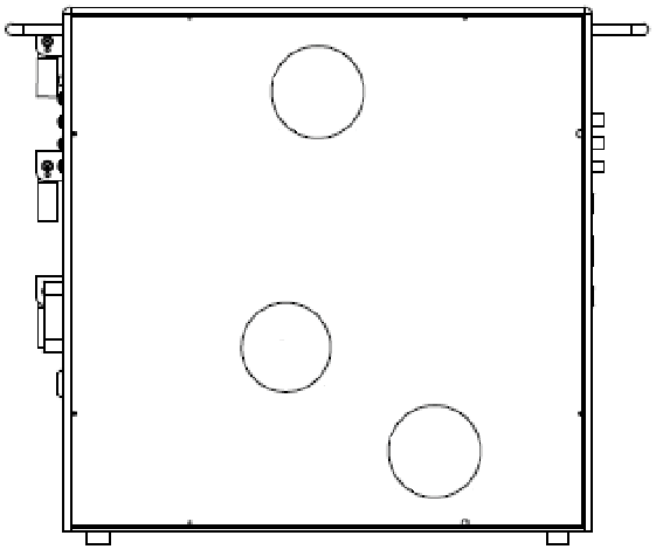
APPENDIX A: MECHANICAL DRAWINGS

Dimensions: inches [mm]

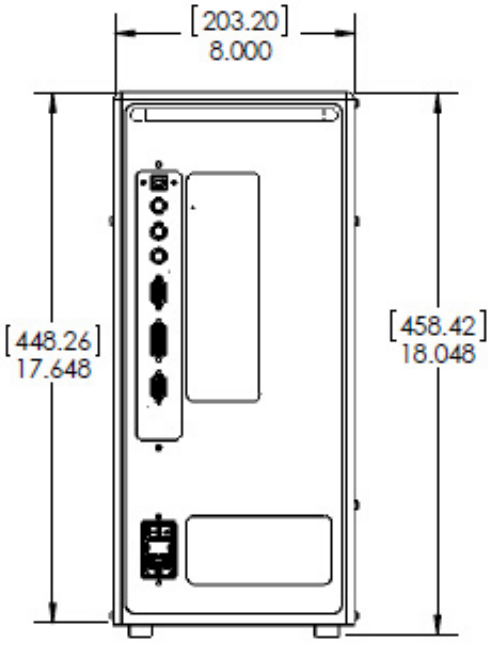
(ILE shown with triple output)



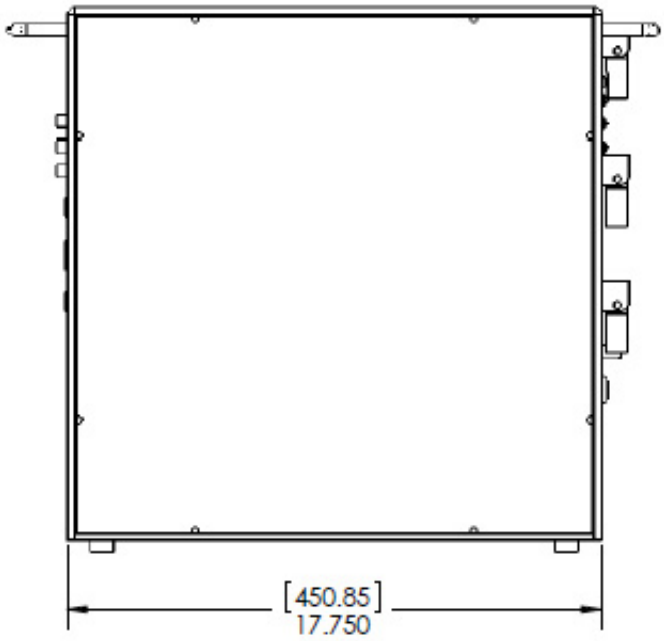
Rear Panel



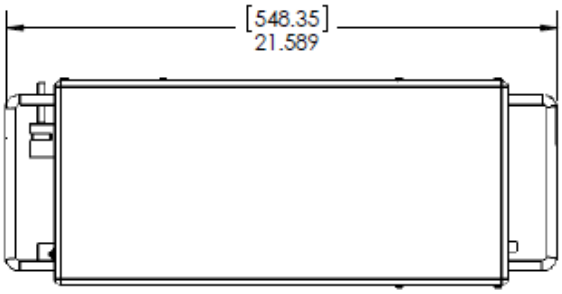
Left Side Panel



Front Panel



Right Side Panel



Top Panel

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
DPSS	Diode Pumped Solid State laser
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)
HID	Human Interface Device: device or connection conforming to the HID standard.
IO	Input/Output: Generic input and output electrical signal connections
ILE	Integrated Laser Engine: Control for up to 4 individual lasers per unit.
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
MM	Multi-mode fibre: Multi-mode fibres have a much larger core diameter than single mode (SM) 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.
OPSL	Optically Pumped Semi-conductor Laser
Specular Reflection	Beam of radiation reflected from mirrored, and other surfaces. Differs from diffuse reflections as a single incident beam/ray is reflected by a surface, into a single reflected ray (the angle of incidence is equal to the angle of reflection, with respect to the normal).

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