

# Mosaic3

Version 3.6 revised 15 Oct 2024



## Hardware Guide

(covers Mosaic 3 and Infinity USB 3.0 models)



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## Revision History

| Version | Released    | Description  |
|---------|-------------|--|
| 1.0     | 24 Sep 2010 | Initial Release  |
| 1.1     | 15 Feb 2012 | Conversion into InDesign format  |
| 1.2     | 09 Jul 2013 | Minor updates (All sections)   |
| 2.0     | 10 Oct 2013 | Updated Laser Safety Information.<br>Updated presentation (All sections)<br>Added PDF Functionality to improve navigation  |
| 3.0     | 19 Dec 2013 | Fully revised and updated information to match latest Mosaic3 model features and functionality (all sections)  |
| 3.1     | 11 Feb 2015 | Updated to include to cover the Mosaic Infinity models   |
| 3.2     | 18 Feb 2016 | Updated to cover USB 3.0 functionality.  |
| 3.3     | 09 Mar 2016 | Updated power consumption values (Section 8.2)   |
| 3.4     | 27 Sep 2016 | Corrected DMD image diagram (Section 2.3)<br>Changed references of active illumination to Photostimulation.<br>Minor branding and address details edits.<br>Corrected document numbering (Section 6) |
| 3.5     | 8 May 2019  | Updated USA and Asia-Pacific Addresses.<br>Updated Laser Safety Information.   |

## 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 Andor, the protection provided by the equipment may be impaired.
2. Do not position this product so that it is difficult to operate the Mains disconnecting device. See SECTION 5.1, “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 Hardware Guide.
4. Keep this Hardware Guide 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 may be used with lasers, which are very hazardous, so please read the laser safety information following this section very carefully.
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 system 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. Any AC/DC Power Supply used with this product must meet the requirements of Section 8.1.
13. Only use a mains cord certified to the safety regulations for your region and suitably rated for the mains supply specified in Section 8.1.
14. 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.
15. Locate the laser source and any other connected devices within 2 m of each other so that the interconnecting fibres are not stretched, bent, or constrained.
16. While running an experiment, try to keep room temperature as stable as possible.
17. Performance of the system may be adversely affected by rapidly changing environmental conditions or operation outside of the operating conditions specified in SECTION 8 “TECHNICAL SPECIFICATIONS”
18. 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.



19. 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.
20. 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.
21. Your product is a precision scientific instrument containing fragile components. Always handle it with care.
22. 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 300mm or greater.
23. If noise patterning or optical fluctuations are seen, contact Andor Customer Support for advice.
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. Do not expose the product to extreme hot or cold temperatures.
28. Do not expose the product to open flames.
29. Do not allow objects to fall on the product.
30. See SECTION 6.1, "Cleaning and Decontamination".

## LASER SAFETY SPECIAL WARNINGS

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

This product includes lasers or is designed to be upgraded with lasers, so you must be aware of the hazards associated with the use of the powerful laser radiation that can be emitted by this product. Laser radiation differs from ordinary light primarily because its optical power can be concentrated into a narrow, low-divergence beam, whereas, for example, a standard light bulb diffuses its light in all directions and thus spreads out its power. It's a bit like the difference between walking outside on a sunny day versus having the sun's light concentrated on your skin using a magnifying glass.

Skin damage or deeper injury can be caused by lasers, but the eye is especially susceptible as laser light can be collimated into a narrow beam that can enter the eye and permanently damage the retina with life-changing consequences.

Be aware that visible laser light is dangerous as well as invisible and that this laser product is not fully safe as you usually have access to hazardous laser radiation. Laser safety for this type of product is about reducing risk, rather than being able to eliminate it because access is required for the performance of this product.

It is important to remember to beware reflections from objects such as tools or clips placed close to the laser beam emitted from the microscope objective.

Andor strongly recommend that all facilities have an established system for the safe use of lasers as per their national regulations and occupational health and safety legislation. IEC TR 60285-14 Safety of laser products – Part 14: A user's guide and the American National Standard for the Safe Use of Lasers (ANSI Z136.1) are standard references for good practice.

## LASER PRODUCT SAFETY STANDARDS

If your product contains lasers, it has been designed and manufactured to comply with the international laser product safety standard IEC 60825-1 and the U.S. CDRH Regulation 21CFR § 1040.10 to reduce risk as far as is reasonably practicable. Our Customer Support Team install the system according to the same standards, but if there has been an agreement that you should install all or part of the laser product system, then you take responsibility to install this according to the same standards.

## RECOMMENDED RESPONSIBILITIES OF A LASER SAFETY OFFICER

These include, but are not restricted to, the following. However, national and industry guidelines should also be referred to, e.g. IEC 60825-14 Section 3.3.

1. Ensure 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
2. Ensure users are familiar with the hazardous properties of lasers, especially that laser safety hazards differ from those of normal light sources as they are highly-concentrated, very low divergence beams of radiation
3. Ensure the 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

We recommend that a copy of IEC 60285-1 is purchased by the Laser Safety Officer for reference, as well as the aforementioned safe use of lasers guidelines.

## 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(s) turns off when any of the following are done:
  - The microscope ocular eyepieces are activated/engaged for viewing
  - The articulated transmitted light arm on inverted microscopes is tilted back from the functional vertical position before using the system
  - Each beam splitter is removed from the unit
  - Any other interlocks on your 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.

## 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 to 510 nm – Kentek KXP-4001 Spectacles
- 510 nm to 670 nm – Kentek KRA 6702 Spectacles

## WORKING WITH OPTICAL FIBRES

1. Only service personnel authorised by Andor should remove or inspect fibres as these are part of the installed protective housing
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, so ensure that the minimum bend radius is never exceeded when handling, which is recommended to be 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

## LASER SAFETY AND PRODUCT COMPLIANCE LABELS

### GENERAL SYMBOLS



WARNING: Laser radiation hazard



This product has been tested to the requirements of CAN/CSA-C22.2 No. 61010-1, 2nd Edition, including Amendment 1, or a later version of the same standard incorporating the same level of testing requirements. This is an old symbol and is not included on newer products tested to the 3rd Edition of the standard



This product meets the requirements of the applicable CE-marking directives of the EU

### 3RD PARTY PRODUCTS

The laser sources incorporated in this product are supplied from 3rd party suppliers. Reproductions of their labels and their positions on these laser sources are included in their manuals, which are supplied along with this user guide. These labels will include laser powers that are only output direct from these sources when used standalone.

### CLASSIFICATION INFORMATION

A number of labels have laser classification labels on them identifying the Laser Radiation Class accessible at that point together with a warning regarding exposure.

## CLASS 3B

This laser radiation can damage your eye, but will not normally damage your skin, and will be identified as follows:

### WARNING – CLASS 3B LASER RADIATION – AVOID EXPOSURE TO BEAM

These are defined by IEC 60825-1 Annex C.2 as “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 has a small diameter or is focused.”

“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 sec. 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.”

The following terms are defined as follows:

- **Intrabeam ocular exposure:** Getting your eye in the way of a laser beam
- **Nominal Ocular Hazard Distance (NOHD):** Distance from the output aperture beyond which the beam irradiance or radiant exposure remains below the appropriate corneal maximum permissible exposure (MPE)
- **Accessible Emission Limit (AEL):** Maximum accessible emission permitted within a particular class, i.e. the limit at which one class transitions into another
- **Maximum Permissible Exposure (MPE):** Level of laser radiation to which, under normal circumstances, persons may be exposed without suffering adverse effects.

## CLASS 4

This laser radiation can damage both your eye and your skin, and potentially could cause deeper injuries, and will be identified as follows:

### DANGER – CLASS 4 LASER RADIATION – AVOID EYE OR SKIN EXPOSURE TO DIRECT OR SCATTERED RADIATION

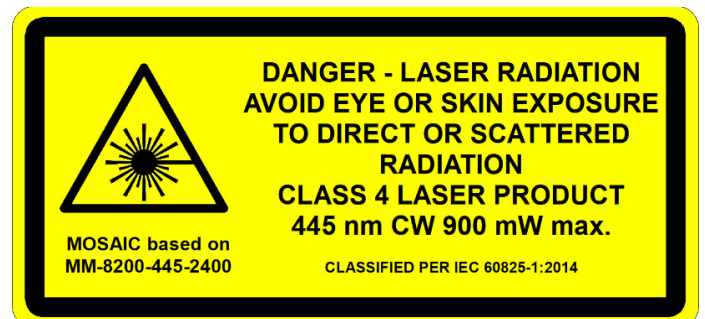
These are defined by IEC 60825-1 Annex C.2 as “laser products for which intrabeam viewing and skin exposure is hazardous and for which the viewing of diffuse reflections may be hazardous. These lasers also often represent a fire hazard.”

## EXPLANATORY LABELS WITH PRODUCT CLASSIFICATION, RADIATION OUTPUT AND STANDARDS INFORMATION

Each Mosaic laser product will have one of these labels located on the microscope as close as reasonably practicable to the laser aperture at the stage. In some older models, the same information will be located on the Fibre Collimator, where the optical fibre enters the main product.

For Adalaser products that combine the laser from two laser diodes, there is another label because in theory this combined laser source could be detached as a Removeable Laser System and so must be additionally labelled.

The maximum optical power stated is the worst-case possible and will normally be greater than the maximum actually accessible. There are many different versions of this label due to the product variants, but the following are two examples:



The acronym "CW" refers to "Continuous Wave" and means that the laser can output the power shown continuously as opposed to the case of pulsed lasers.

## MICROSCOPY OCULARS WARNING LABEL

The microscope oculars will have the following label to indicate that although interlocking is applied to protect you from laser radiation, it has been found that with some microscopes the optical switching can be so fast that delays in interlocks operating can cause brief flashes of light. This is the nature of your chosen microscope and not our product.



## LASER APERTURE LABELS

A number of these labels are located at various points where laser is emitted from an aperture either deliberately at the microscope objective or potentially as a result of disassembly during installation or servicing.

### INTERNATIONAL LASER APERTURE LABELS: MICROSCOPE OBJECTIVE OUTPUT

This is located at the nearest practical point to the actual emission.



### POTENTIAL LASER APERTURE LABEL No 1: LASER DIODE MODULE OUTPUT





POTENTIAL LASER APERTURE LABEL No 2: COVERED/UNCOVERED ADALASER OUTPUT



POTENTIAL LASER APERTURE LABEL No 3: HOMOGENISER OPTICAL FIBRE OUTPUT



## POTENTIAL LASER APERTURE LABEL No 4: COVERED/UNCOVERED FIBRE COLLIMATOR OUTPUT

This is the part that through which laser radiation from the optical fibre enters the main Mosaic unit.



## POTENTIAL LASER APERTURE LABEL No 5: STANDARD EPI-PORT ADAPTOR OUTPUT

The standard, or non-infinity, versions of Mosaic connect to the microscope via its epi-port and have a potential laser aperture if installers/ service personnel disconnect the system at this point.

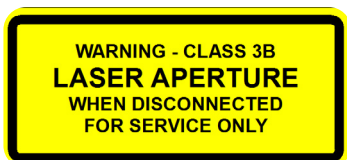
**WARNING - CLASS 3B  
LASER APERTURE  
WHEN DISCONNECTED  
FOR SERVICE ONLY**

**DANGER - CLASS 4  
LASER APERTURE  
WHEN DISCONNECTED  
FOR SERVICE ONLY**



## POTENTIAL LASER APERTURE LABEL No 6: INFINITY MICROSCOPE ADAPTOR LOWER TRANSMISSION PORT

There is a potential laser aperture where the Infinity versions of Mosaic connect to the microscope, if installers/ service personnel disconnect the system at this point.



## ACCESS PANELS

Access panels are defined in IEC 60825-1 as “part of the protective housing which provides access to laser radiation when removed or displaced.” In most cases, you should have no reason to open these and only service personnel will need to gain access, but the laser standards direct us to warn you of access using the following labels.

### ACCESS PANEL LABEL NO 1: FIBRE COLLIMATOR ADJUSTMENT SLOTS

When the cover is removed from the Fibre Collimator (where the fibre enters the main unit), the screws for illumination control are exposed. As tools could accidentally access laser light, there is a warning of laser access as follows:

**WARNING – CLASS 3B LASER  
RADIATION ACCESSIBLE  
THROUGH SLOTS  
AVOID EXPOSURE TO THE BEAM**

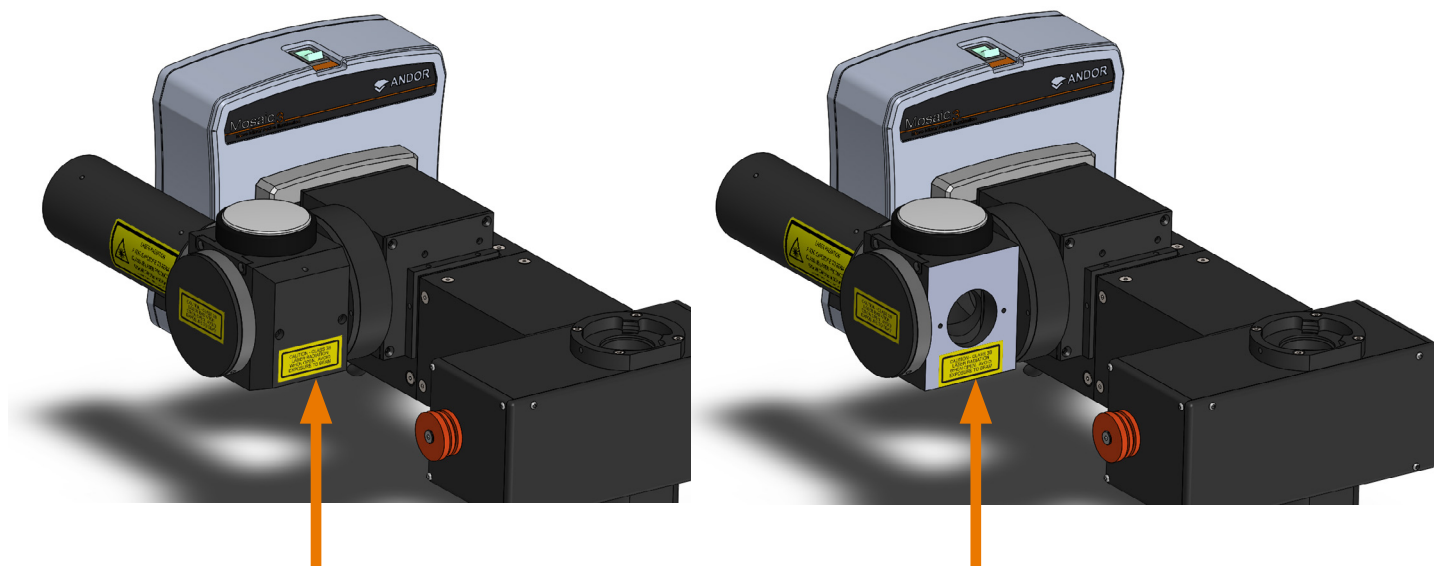
**DANGER – CLASS 4 LASER  
RADIATION ACCESSIBLE  
THROUGH SLOTS – AVOID EYE  
OR SKIN EXPOSURE TO DIRECT  
OR SCATTERED RADIATION**



## ACCESS PANEL LABEL No 2: OPTICAL BODY LIGHT INPUT BLOCK INTERLOCK COVER

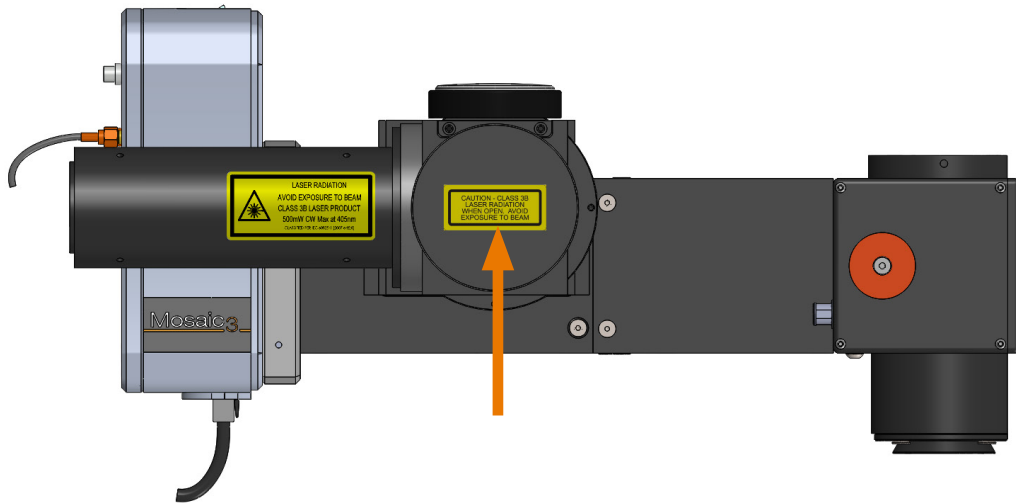
There is a tool-accessible panel to allow access to an interlock for installation/service personnel as follows:

**DANGER – CLASS 4 LASER  
RADIATION WHEN OPEN  
AVOID EYE OR SKIN  
EXPOSURE TO DIRECT OR  
SCATTERED RADIATION**



ACCESS PANEL LABEL No 3: OPTICAL BODY LIGHT INPUT BLOCK SECONDARY PORT  
BLANKING PLATE

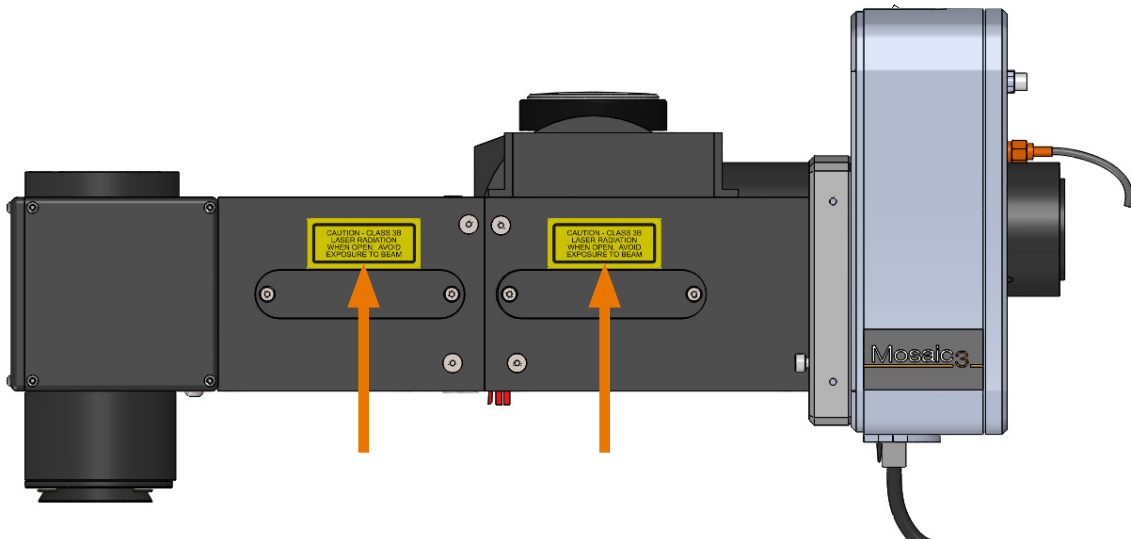
**DANGER – CLASS 4 LASER  
RADIATION WHEN OPEN  
AVOID EYE OR SKIN  
EXPOSURE TO DIRECT OR  
SCATTERED RADIATION**



ACCESS PANEL LABEL No 4: OPTICAL BODY FOCUS ADJUSTMENT

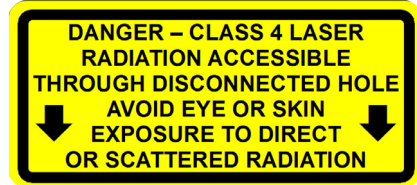
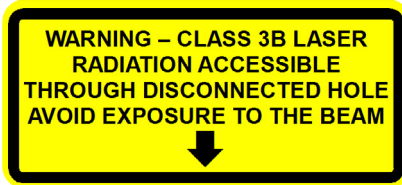
**CAUTION – CLASS 3B  
LASER RADIATION  
WHEN OPEN. AVOID  
EXPOSURE TO BEAM**

**DANGER – CLASS 4 LASER  
RADIATION WHEN OPEN  
AVOID EYE OR SKIN  
EXPOSURE TO DIRECT OR  
SCATTERED RADIATION**



## ACCESS PANEL LABEL No 5: INFINITY MICROSCOPE ADAPTOR UPPER EMISSION PORT

There is a potential access point where the Infinity versions of Mosaic connect to the microscope, if installers/ service personnel disconnect the system at this point.



## CDRH CERTIFICATION LABEL

This self-certifies that we comply with the U.S. CDRH laser regulations.

Complies with 21 CFR 1040.10 and 1040.11 except for conformance with IEC 60825-1 Ed. 3., as described in Laser Notice No. 56, dated May 8, 2019

U.S. Patent 6,885,492  
Other patents issued  
and pending

Manufactured by  
Andor Technology Ltd  
Belfast BT12 7AL U.K.

MSC-07219 Issue 03



## SECTION 1: INTRODUCTION

Built around MEMS Digital Micromirror Devices (DMD), the Mosaic family (Mosaic 3 and Mosaic Infinity) is a patented instrument for targeted illumination (photostimulation) on microscopy systems. High speed frame switching (5,000 fps) makes the Mosaic suitable for many dynamic applications including optogenetics, bleaching, uncaging, photo-switching and constrained illumination. Mosaic exploits DMD in a proprietary programmable platform, integrated with scientific light sources including lasers, LEDs and arc lamps, and operates from 360 to 800 nm. It is offered with a range of high performance microscope adapter optics and can be integrated with CLSM (Confocal Laser Scanning Microscopy), spinning disk and wide field imaging modalities.

The on-board memory allows for sequences of masks to be defined and executed with Hard Real-Time accuracy under software control or following external Trigger signals for complete experimental flexibility.



Figure 1: The Mosaic (Mosaic 3)

It has the following features:

- Supports a range of light sources such as LED, laser and arc to match a wide range of techniques from optogenetics to photobleaching.
- Unlimited flexibility in shape, size and complexity within the 800 x 600 illumination mask.
- Simultaneous illumination of multiple regions of interest.
- Precise, diffraction-limited illumination of areas of interest that protects target specimens and fluorophores.
- Zero delta acquisition time for true digital excitation/illumination of all regions of interest.
- On-board mask storage for high-speed sequencing, which is ideal for high speed physiological studies (e.g. electro/opto-physiology).
- Software independent triggering for use with independent hardware (e.g. electrophysiology).
- Greyscale functionality for light-source independent, region-specific illumination intensity control.
- Long lifetime and low maintenance with rugged semiconductor device.

## 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 Ltd.  
7 Millennium Way  
Springvale Business Park  
Belfast  
BT12 7AL  
Northern Ireland  
Tel. +44 (0) 28 9023 7126  
Fax. +44 (0) 28 9031 0792

### USA

Andor Technology  
300 Baker Avenue  
Suite # 150  
Concord  
MA 01742  
USA  
Tel. +1 (860) 290-9211  
Fax. +1 (860) 290-9566

### Asia-Pacific

Andor Technology (Japan)  
5F IS Building  
3-32-42 Higashi-Shinagawa  
Tokyo 140-0002  
Japan  
Tel: +81 (0) 3 6732-8968  
Fax: +81 (0) 3 6732-8939

### China

Andor Technology  
Unit 1, Building A,  
66 Zhufang Rd,  
Haidian Dist.  
Beijing 100085  
China  
Tel: +86 (0) 10 8271 9066  
Fax. +86 (0) 10 8271 9055

\* The latest contact details for your local representative can be found on the [Contact and Support](#) page of our website.

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Changes are periodically made to the product and these will be incorporated into new editions of the manual. New releases of the manual are available through MyAndor: <http://my.andor.com/login.aspx>.

### 1.5 SUPPLIED COMPONENTS

Refer to the packing list supplied with your system and inspect against the components specified at time of ordering.

### 1.6 OPTIONAL COMPONENTS

There are a range of optional components available for the Mosaic 3. Please contact your nearest Andor Sales Representative for further information on these and other system components available.

## SECTION 2: PRODUCT OVERVIEW

### 2.1 GENERAL

The Mosaic is highly configurable so the exact configuration of your product will depend on the options specified at the time of purchase.

The main components are described in the following sections:

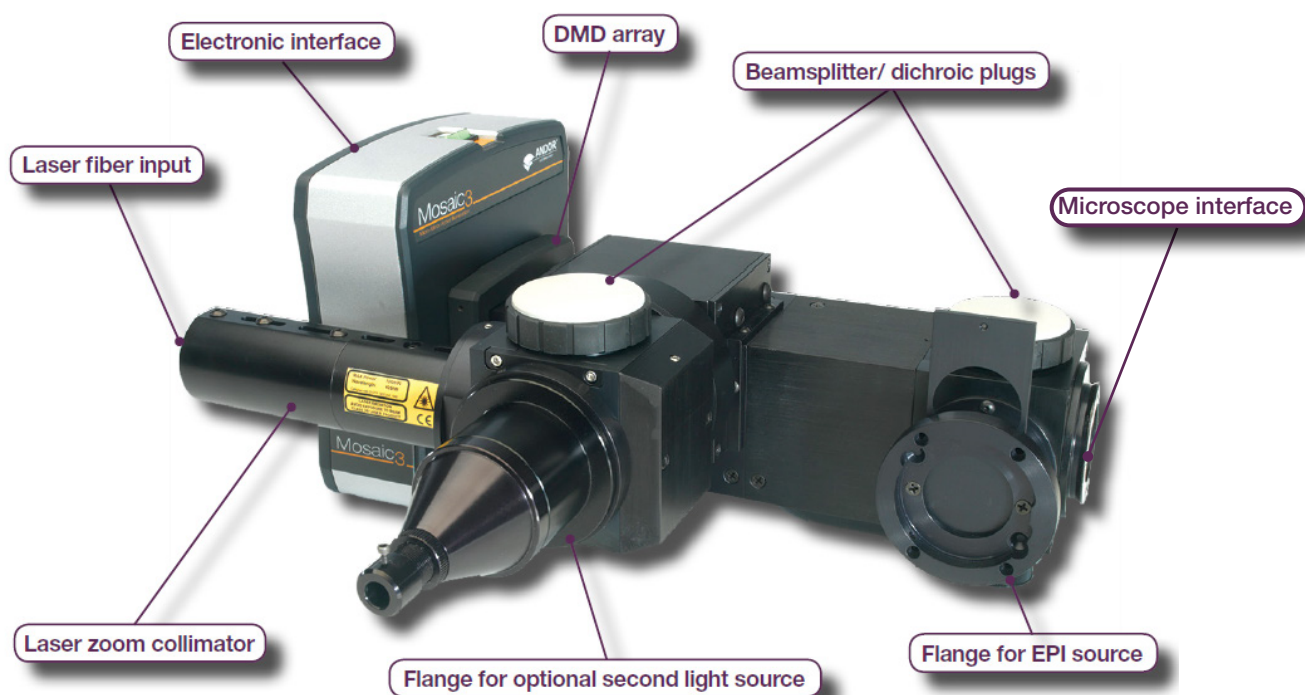


Figure 2: Mosaic Components (Mosaic 3 shown)

|                                       |  |
|---------------------------------------|--|
| <b>Electronic Interface</b>           | This houses all of the control electronics and the DMD Array and provides all of the electrical and control interfaces to the device on the rear face.   |
| <b>DMD Array</b>                      | The Digital Micro-mirror Device is an electronic/micro-mechanical chip at the core of the device which ‘draws’ the required illumination patterns by individually controlling an array of Micro-mirrors.                                   |
| <b>Laser Fibre Input</b>              | Connection for the Fibre Optic from the laser source if one is present.  |
| <b>Laser Zoom Collimator</b>          | This expands and collimates the input laser beam to match it to the DMD Array.   |
| <b>Flange for Second Light Source</b> | An optional second light source may be connected e.g. LED source, second laser source, halogen lamp. This can allow illumination with two different wavelengths simultaneously or fast switching by hardware control of the light sources. |
| <b>Flange for EPI Source</b>          | Allows the use of a standard EPI illumination source when photostimulation isn’t required or simultaneous use for widefield imaging with targeted excitation in the Regions of Interest.   |
| <b>Beam Splitter/ Dichroic Plugs</b>  | These plugs hold either mirrors or dichroics which allow the manual selection of the required input light source or the selective combination of different input sources depending on wavelength.  |
| <b>Microscope Interface</b>           | Connection to the microscope- either upright for Mosaic Infinity, or inverted for Mosaic 3 (as shown above)  |

## 2.2 MOSAIC INFINITY CONFIGURATION

The Mosaic Infinity version enables the mosaic to be integrated into an upright microscopy set-up. The features and functionality of the infinity version are the same as the Mosaic 3 (Section 2.1 ) apart from as detailed in the following sections.

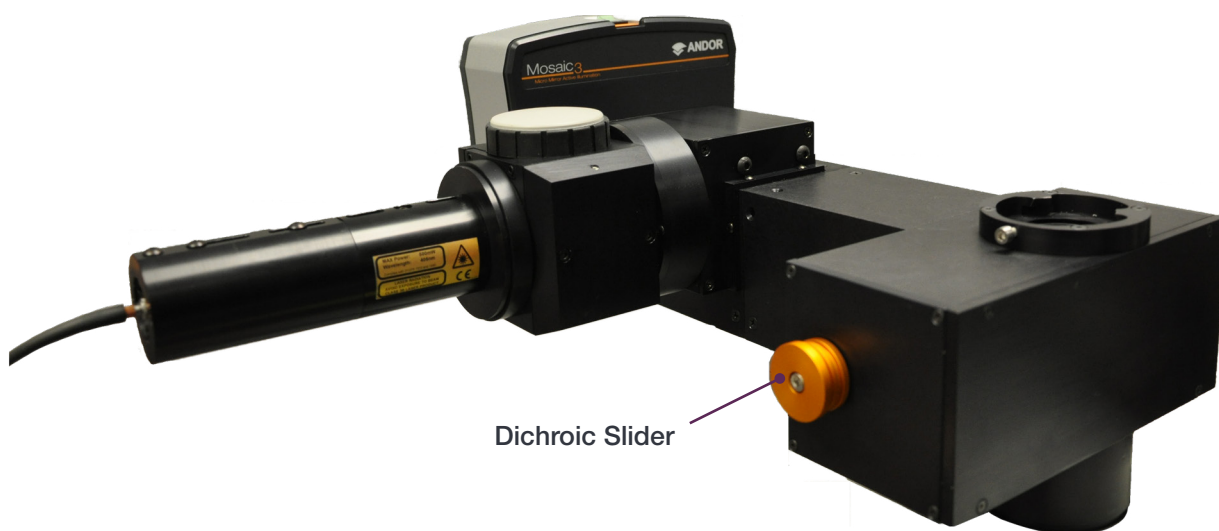


Figure 3: The Mosaic Infinity- for upright microscopes

|                        |   |
|------------------------|---|
| <b>Dichroic Slider</b> | Enables selection between three positions |
|------------------------|---|

## 2.3 OVERVIEW OF DMD ARRAY TECHNOLOGY

The core of Mosaic is the Digital Micro Mirror Device (DMD), a high speed and highly efficient semiconductor-based “light switch” array (800 x 600), of hinge-mounted, addressable, tiltable, microscopic mirrors. When a DMD chip is coordinated with a digital video or graphic signal, a light source, and beam delivery optics, its mirrors reflect a digital image of the illumination mask onto the sample. The pixel mirrors of the DMD are an array of squares that tilt at the corners as illustrated below:

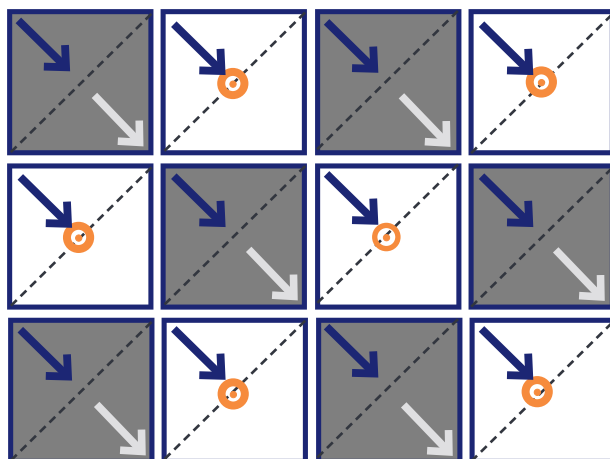


Figure 4: A representation of a small area of a DMD Mirror array (face-on view)



In the DMD power-off state the mirrors lie flat at 0° to the beam direction. When any mirror is switched ON, the tilt angle is +10° to this flat state, and -10° in the OFF (powered-on) state. DMD pixels are tilted to either the ON or OFF state, and held in place by electrostatic attraction. The light from the standard illumination source is shone at 90° to the tilt axes of the DMD (as shown above) and 20° to the “flat normal”.

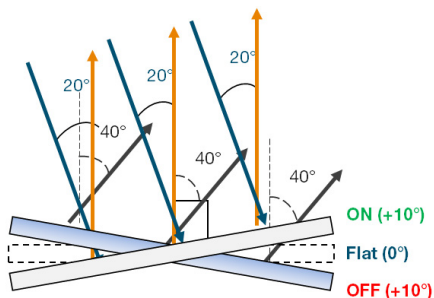


Figure 5: Cross-sectional View of a DMD Mirror

By controlling which mirrors are in the ON state the user can control which areas of the sample are illuminated at the microscope.

## 2.4 SYSTEM COMPONENTS

### 2.4.1 USB 405 NM LASER CONTROLLER

If the Mosaic is supplied with a 405 nm Laser, then this interface allows manual power control of the 405 nm Diode Laser or selection of USB control to allow the control software interface to set the laser's output power level.

### 2.4.2 LASER HOMOGENIZER

The Laser Homogenizer randomises the light in the fibre optic to produce a more uniform field of illumination. It is a passive device and has no controllable elements.

### 2.4.3 LIGHT SOURCES

The Mosaic is compatible with a wide variety of light sources including metal-halide lamps, LED sources and lasers. Please refer to the User Manuals supplied with each source for further information. Please contact your local Andor Sales Representative for any compatibility queries.

### 2.4.4 INPUT SHUTTERS

The Mosaic may be supplied with one or more fast mechanical shutters on the light source inputs which are used to blank the light input for increased extinction ratio. Please refer to the User Manual supplied with the device for operation of the Shutter Driver unit.

A shutter will be supplied with any laser based system and acts as a User Controllable Beam Stop. The Shutters self-close when power is removed so the fastest means of activating the beam stop is to turn the Power Key off on the Shutter Driver.

### 2.4.5 USB 3.0 CABLE

The Mosaic DMD Head interfaces to the PC via a USB 3.0 cable that is compatible with both USB 2.0 and USB 3.0 Standard A Receptacle ports. USB 2.0 operates slower than USB 3.0.

### 2.4.6 USB 3.0 INTERFACE PCI EXPRESS (PCIe) CARD (OPTIONAL)

In case your PC doesn't have a USB 3.0 port, a PCI Express x1 card is provided for inserting in a compatible PCIe desktop PC add-in slot to give you at least 1 off USB 3.0 port.



### 2.5 SYSTEM OVERVIEW

An example of a typical system configuration is shown below:

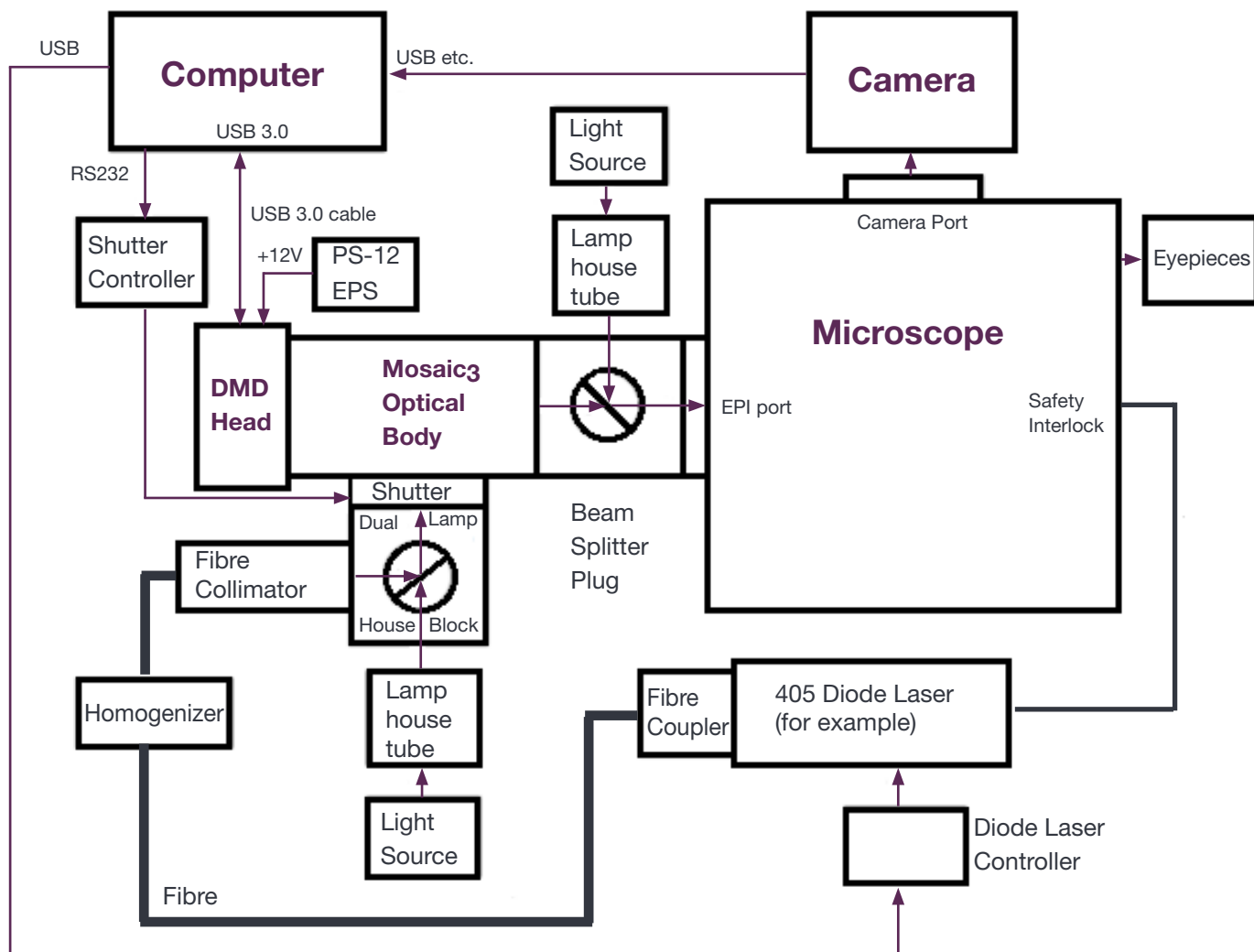


Figure 6: System overview- this example shows a representation for a Mosaic 3 system.

## 2.6 Optical Layout

### 2.6.1 MOSAIC INTERNAL LIGHT PATHS

There are two main variants of the Mosaic device.

1. **Standard (Single Input Block).**
2. **Duet (Dual Input Blocks).**

The Internal Light Paths, in this example for Mosaic 3, are shown below:

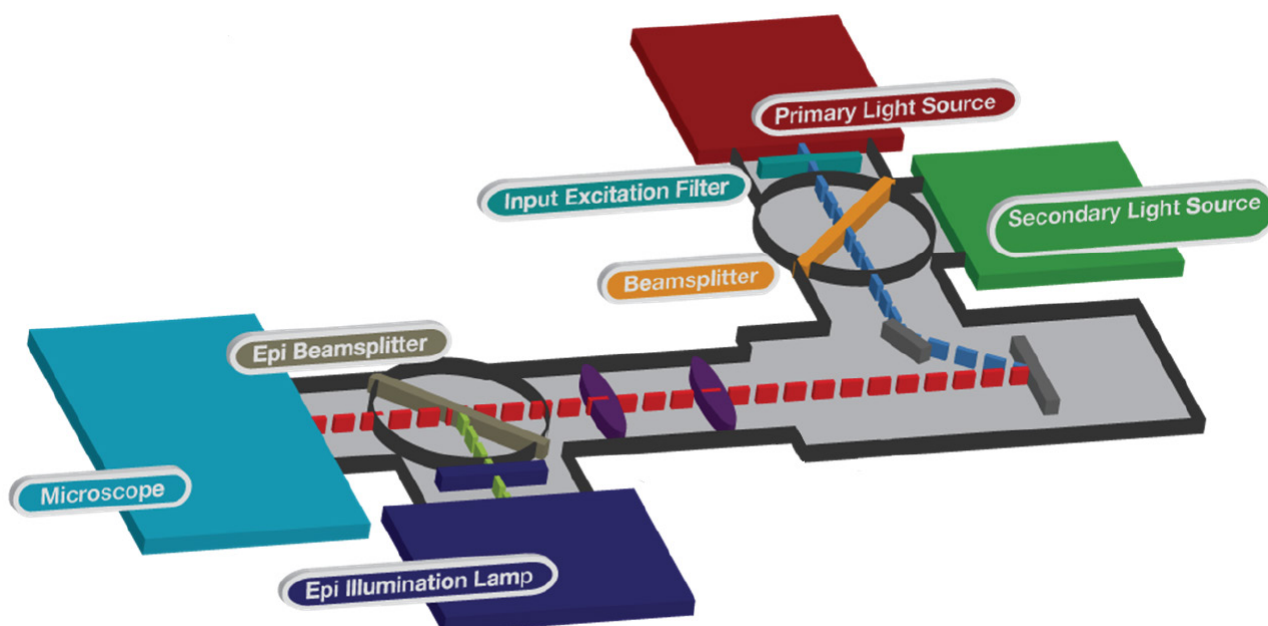


Figure 7: Internal light path of Mosaic 3 Standard version

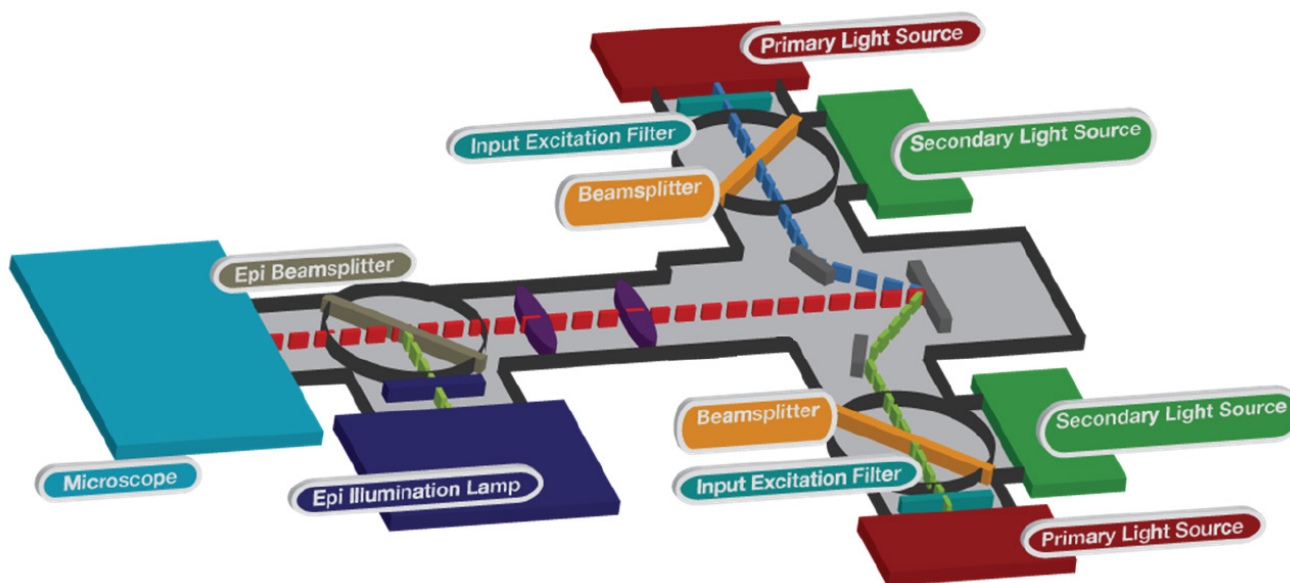


Figure 8: Internal light path of Mosaic 3 Duet version

## 2.6.2 SYSTEM LIGHT PATH: UPRIGHT MICROSCOPE

An example for an upright microscope is shown below:

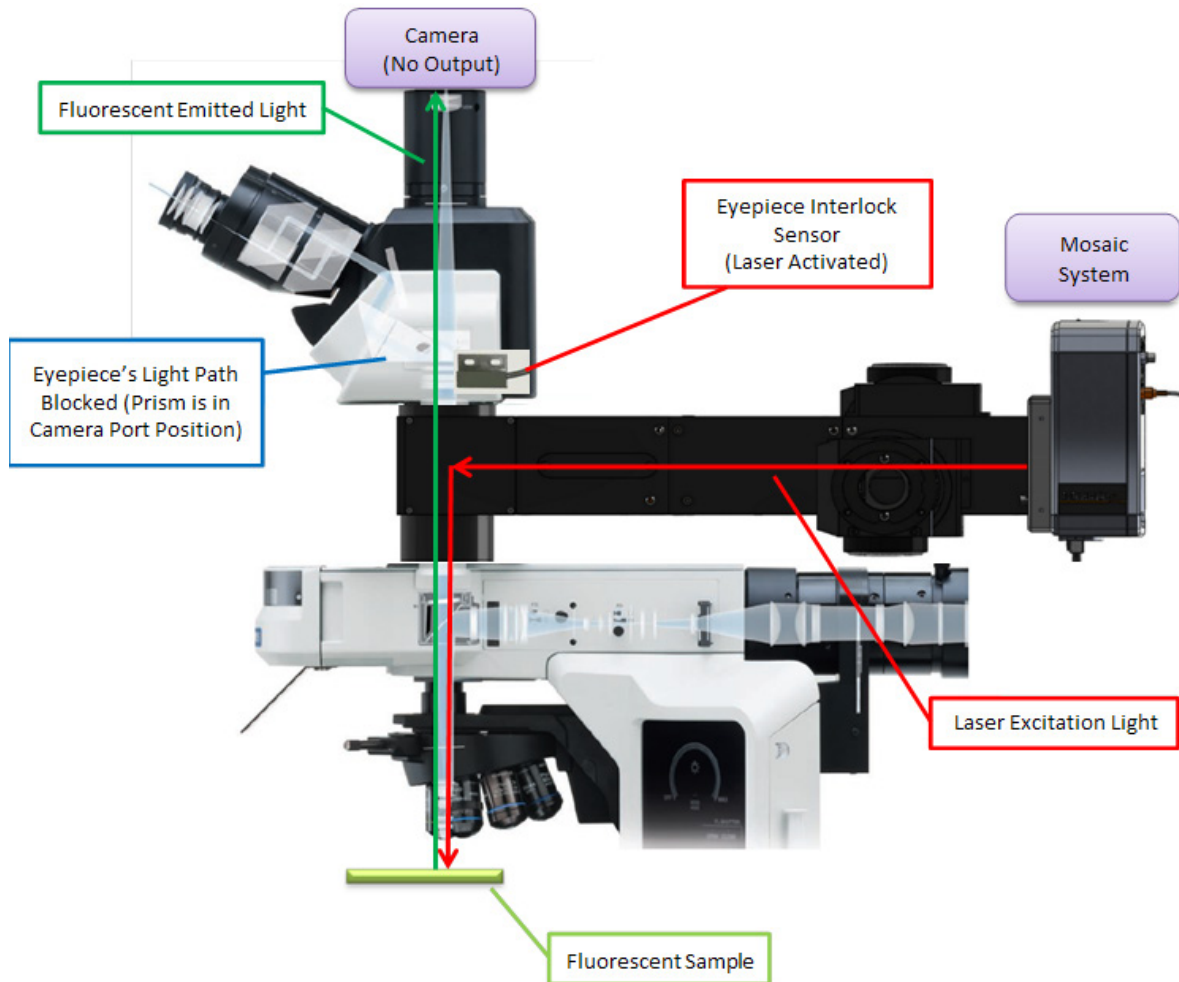


Figure 9: Upright Microscope light path (Mosaic Infinity)

## 2.6.3 SYSTEM LIGHT PATH - INVERTED MICROSCOPE

An example for an inverted microscope system is shown below:

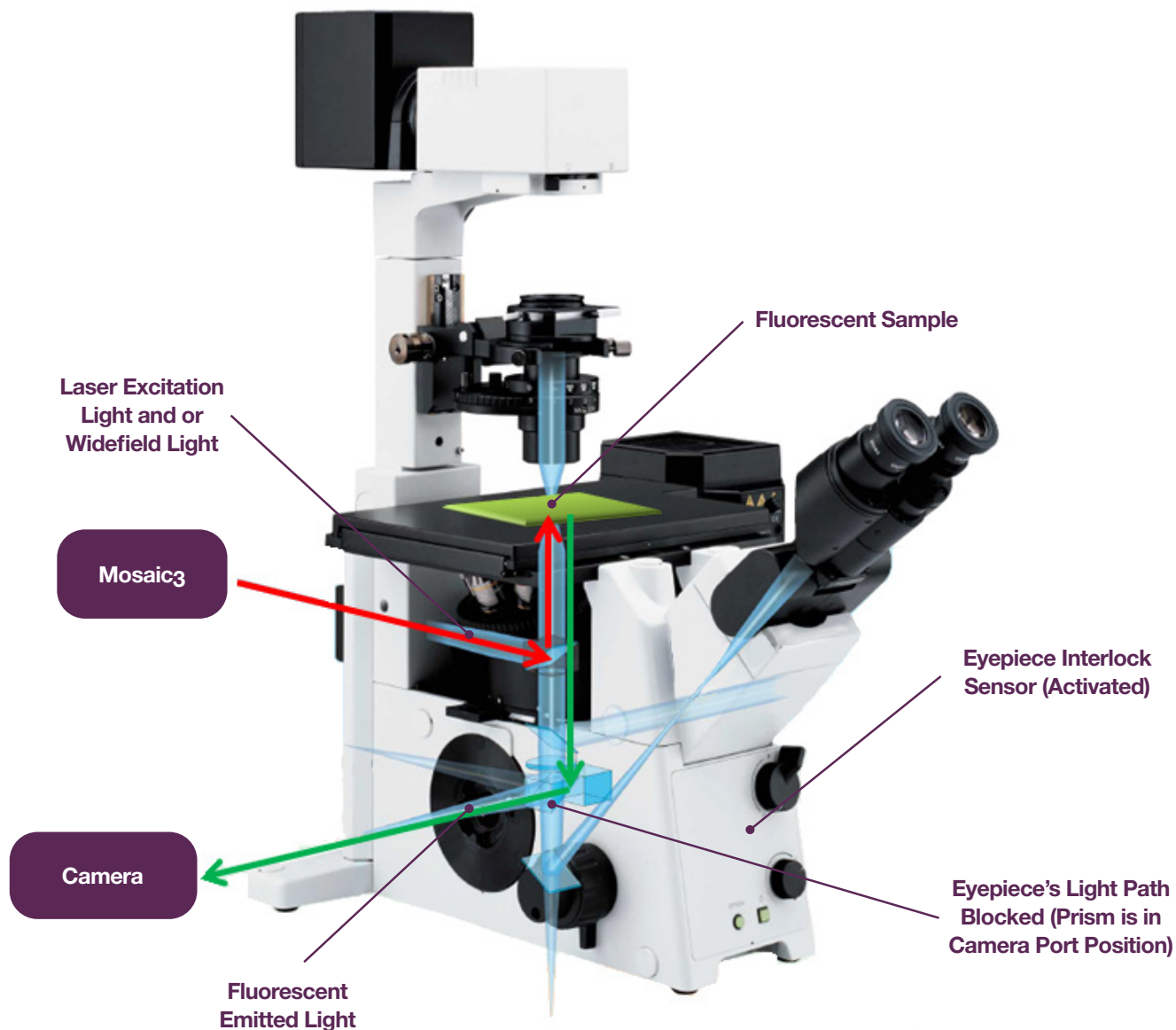


Figure 10: Inverted Microscope light path

## 2.6.4 NOTES

- The beam path is fully enclosed to prevent user access to laser radiation except at the designated aperture.
- The laser is coupled into the Mosaic via an armoured fibre optic cable.
- This fibre optic forms part of the protective housing and care should be taken not to pull or damage the fibre.
- The fibre uses FC couplings, the connection points are shielded as the fibre is not user removable.

## 2.7 SYSTEM CONTROL

1. The Mosaic must be interfaced to a workstation to allow control.
2. The workstation communicates with the Mosaic via a USB 3.0 connection.
3. Control software is required to interface with and control the device\*.

\*(an SDK is available for system integrators or advanced users, please contact your Andor Sales Representative to apply for access).

## 2.8 SOFTWARE REQUIREMENTS

To control the Mosaic you will need one of the following software packages and a Windows based PC:

- Andor iQ 3.0 onwards (previous versions compatible, but offer limited functionality)
- Molecular Devices MetaMorph 7.7.1 onwards and NX 2.5.275.0 - (In Single Shot Mode Only)
- $\mu$ Manager
- NIS Elements 4.20 onwards - (In Single Shot Mode Only)

## 2.9 INTERLOCK SAFETY SYSTEM

If the Mosaic is supplied with a laser source it will incorporate an interlock safety system to protect the users of the system.

The Mosaic contains no user serviceable parts- do not attempt to disassemble the system or the enclosure. Disassembly is only to be performed by trained and certified Andor Service Personnel. Removal of any housing component or panel may result in exposure to hazardous radiation. As the housing is not to be accessed for operation or user maintenance the panels are not interlocked. The only exception is the Mosaic Infinity which allows the User to change the loaded Filter Cubes. The Filter Cube Access Panel is interlocked with a redundant, failsafe sensor system. Please refer to Section 6.5 for the correct procedure to change Filter Cubes.

The User Interlock System comprises of a set of sensors which are used to detect the state and configuration of the Microscopy System including the Microscope Eyepiece prism, the transmitted light arm on inverted microscopes and the presence of a stage cover if one is installed. Additionally the Beam Splitter/Dichroic plugs are interlocked. This is designed to prevent the user from being accidentally exposed to the potentially high level of laser radiation emitted by the Mosaic into the microscopy system. The system is directly linked to the laser source to cease emission of any laser light if any of the following conditions exist:

- The eyepiece prism is in any position other than 100 % camera port
- If the transmitted light arm is not in the upright position
- If an installed stage cover is not present
- if any Beam Splitter plug is removed or if the Infinity's Filter Cube access panel is open

The Interlock Loom provides an additional connection point to allow a Remote Interlock (e.g. a Laboratory Door) to be interfaced directly to the safety system.

The laser source monitors the interlock loom for continuity with a low voltage signal and ceases laser emission if the circuit is broken at any point.

## SECTION 3: HARDWARE DESCRIPTION

### 3.1 MOSAIC DMD HEAD

This section describes the connectors, controls and indicators on the Mosaic DMD Head and relevant signal specifications. (This is common between Mosaic 3 and Mosaic Infinity models).

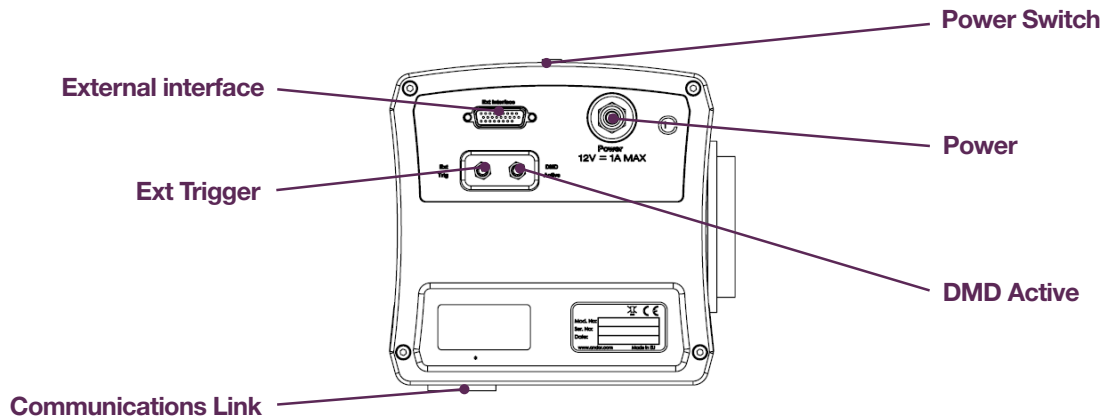


Figure 11: Mosaic<sub>3</sub> DMD Head

#### 3.1.1 POWER SWITCH

This turns the power on and off to the Mosaic DMD Head. When the power is on, the switch will be illuminated.

#### 3.1.2 POWER

The AC/DC external power supply input supplies the Head with +12V power.

#### 3.1.3 DMD ACTIVE

This output is asserted high when the Mosaic is displaying an image on its mirrors and not global dark (all mirrors off), and is supplied via an SMA coaxial connector. This may be asserted, but an image may not be displayed if no light source is illuminating the DMD mirrors.

#### 3.1.4 EXT TRIGGER

This is an active-high input used with the two external triggering modes and is supplied via an SMA coaxial connector.

### 3.1.5 EXTERNAL INTERFACE

The following is a description of the 26-way High Density Female D-type (all other pins are not connected):

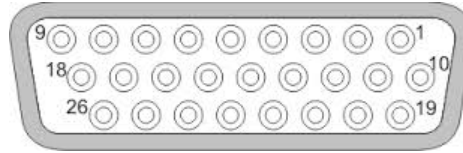


Figure 12: 26-way High Density Female D-type

| Pin                  | Signal              |
|----------------------|---------------------|
| 1                    | Ext Trigger         |
| 8                    | DMD Active          |
| 17 - 10              | Frame Address [7:0] |
| 3, 6, 18, 20, 25, 26 | GND                 |

- The **Frame Address** is an 8-bit address input that allows the user to choose which frame is displayed in response to external triggering.
- **DMD Active** and **Ext Trigger** signals are copies of the signals mentioned above and perform the same functions.

### 3.1.6 COMMUNICATIONS LINK

This connects the Mosaic DMD Head to the PC using a USB 3.0 cable.

### 3.1.7 CONNECTOR SIGNAL ELECTRICAL SPECIFICATION

| Connector                 | Connector Type                    | Signal              | Signal Type    | Specification  |
|---------------------------|-----------------------------------|---------------------|----------------|--|
| <b>DMD Active</b>         | SMA                               | -                   | Digital Output | $V_{IH} > 2.0\text{ V}$ across a $50\ \Omega$ load<br>Can drive $> 50\ \Omega$ loads |
| <b>Ext Trigger</b>        | SMA                               | -                   | Digital Input  | $5\text{ V} > V_{IH} > 2.4\text{ V}$   |
| <b>External Interface</b> | 26-way High Density Female D-type | DMD Active          | Digital Output | See above  |
|                           |                                   | Ext Trigger         | Digital Input  | See above  |
|                           |                                   | Frame Address [7:0] | Digital Input  | As for Ext Trigger   |



## SECTION 4: INSTALLATION

**Important: Please move all equipment to the installation area at least 24 hours prior to the arrival of the Installation Technician.**

**This product must be installed by an Installation Technician or a trained Systems distributor authorised by Andor. The following is only provided to augment this.**

**There are no user serviceable parts within the Mosaic.**

### 4.1 LOCATION AND MOUNTING

- Temperature and humidity must meet the specifications in **Section 7.4 Operating Conditions**.
- 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.

### 4.2 VENTILATION

Do not cover equipment during operation.

### 4.3 ASSEMBLY

This product itself requires no assembly and will be installed by an Andor Technician. There are no user serviceable parts.

### 4.4 POWER CONNECTION AND PROTECTIVE EARTHING

- See **Section 5.1 Emergency Disconnection**.
- Before connection, check that the mains power socket used can provide the power as specified in **Section 7.1 Power Supply**.
- Always switch off power before connecting/disconnecting cables from the product.
- A mains power cable is provided with this product, but ensure that it satisfies local regulations for safety.
- Mains power is connected to the External Power Supply, 12V DC power is output to the connector on the rear panel of the product.
- An integral part of protection against electric shock in the case of a fault is the protective earth provided via the earth conductors in the mains cable. It is therefore vital that the earth system of the building, and in particular the socket, is constructed properly to provide suitable protection when needed.
- Do not pull cables by the sheath. Use the connector body.

## 4.5 MOSAIC CABLING

**All device interconnection cables will be installed by the Andor Installation Technician and should not be removed by the user.**

The External Trigger and DMD Active Input and Output use SMA connectors. If connecting a new cable carefully align the cable's central pin with the coupler on the Mosaic head then gently insert the cable into the coupler. While holding the cable in place turn the locking collar clockwise until its locked finger tight, do not use a tool to tighten further. Removal is the reverse of this process.

## 4.6 MOSAIC OPTICAL FIBRE

This is a non-user serviceable item and should not be disconnected from the Mosaic head or the Laser Source. If there is a problem, please contact Andor technical support (see **Section 1.1 Help & Technical Support**).

## 4.7 SOFTWARE INSTALLATION

If the device is supplied with Andor's iQ Software then the Installation Technician will ensure that the software is installed and operating correctly. For all other software programs please see the applicable User Guide for details. Future upgrades can be installed by the customer. The latest Andor software releases are available through MyAndor:

<http://my.andor.com/login.aspx>.

## 4.8 REMOTE INTERLOCK

All laser based Mosaic systems are supplied with a safety interlock kit which will be installed and tested by the Andor Installation Technician.

If further external interlocks, e.g. doors, need added, the modular nature of the interlock cable assembly allows for further interlocks to be added. Please contact Andor Customer Support to arrange this.

## 4.9 SYSTEM COMPONENTS AND ACCESSORIES

Only components and accessories specified and supplied by Andor are suitable for use with the Mosaic. Please contact your local Andor Representative for assistance with any accessory requirements.

## SECTION 5: OPERATION

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

### 5.1 EMERGENCY DISCONNECTION

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

**SWITCH OFF THE MAINS SOCKET AND REMOVE THE MAINS LEAD FROM THE EXTERNAL POWER SUPPLY.**

### 5.2 POWER-UP SEQUENCE

1. Ensure the microscope is configured with an objective at the nose piece, the correct filter cube in position and the transmitted light arm is in its fully upright position.
2. Power on the workstation.
3. Power on the Mosaic (the rocker switch shall illuminate green).
4. Start the control software program and ensure that it has connected to the device successfully.
5. Ensure that the USB laser controller is turned 'Off' if in Manual control mode or, if under Software Control, ensure that it is set to Zero power.
6. Power on the homogenizer.
7. Power on all light sources.
8. Allow at least 5 minutes for any laser source to warm up and stabilise its power output.

### 5.3 POWER-DOWN SEQUENCE

1. Use the control software to cease output from any connected light sources.
2. Close the control software e.g. iQ.
3. Turn the laser output off using the USB Laser Controller.
4. Power off all light sources.
5. Power off the homogenizer.
6. Power off the Mosaic.
7. Shutdown the workstation.

## 5.4 USING THE MOSAIC

### 5.4.1 CONTROL

The device is fully controlled by a software Graphical User Interface (GUI). The features available are unique to the control software used e.g. Andor iQ, MetaMorph or NIS-Elements. Please refer to the applicable User Manual for the software you are using.

The following describes the controllable features of the device to enable understanding of the device's use and the software GUI.

The following uses the term 'Mask' to refer to a binary image which defines the required illumination pattern. As the DMD is an array of mirrors the illumination pattern is constructed by the pattern of mirrors which are in the 'On' state. This is controlled by the software generating a binary (black and white) image file of the same dimensions as the DMD array where the white pixels represent an individual mirror in the 'On' state.

### 5.4.2 OPERATIONAL MODE

There are two primary methods of displaying an illumination pattern using Mosaic:

- 1. Single Shot Mode** – A single mask is transferred from the PC directly to the DMD and exposed as specified:
  - This allows the dynamic selection or generation of masks by the control software.
  - The control software is responsible for the sequencing of masks and the exposure specification for each mask.
  - Masks can be displayed at over 700 fps (dependent on the workstation's capabilities).
- 2. Mask Memory Mode** – Up to 139 masks are uploaded to the device's on-board memory and then are referenced and exposed individually or in a defined sequence:
  - The masks, their exposure specification and any sequences need to be generated in advance and uploaded to the device.
  - This allows the fastest control of masks and sequences as it is under full Hardware Control (up to 2000 fps).
  - External triggering can allow full hardware synchronisation and control of exposures and sequences.

|                         |                    |  |
|-------------------------|--------------------|--|
| <b>Single Shot Mode</b> |                    | A single mask is transferred to the Mosaic Head from the control PC, along with a global exposure time and then exposed by an internal or external trigger.  |
| <b>Mask Memory Mode</b> | <b>Referencing</b> | Multiple masks are transferred to the Mosaic Head from the control PC and are stored into the on-board memory at defined addresses, optionally with exposure information for each mask.<br><br>An individual Mask is referenced and then exposed by a separate trigger. This allows dynamic Mask sequencing with no mask-data-transfer overhead.   |
|                         | <b>Sequencing</b>  | Multiple masks are transferred to the Mosaic Head from the control PC and are stored into the on-board memory at defined addresses.<br><br>A sequence of these masks is defined, optionally with Exposure and Gap information for each sequence event and a number of sequence repetitions to be performed. This is transferred to the Mosaic head and is actuated by a separate trigger. This can either increment through the masks or activate a fully automated sequence to begin. |

### 5.4.3 MASK REFERENCING MODES

If masks are loaded onto the Mosaic’s on-board memory then there are two ways of referencing which mask to select from memory to expose:

|                 |  |
|-----------------|--|
| <b>Software</b> | A software command from the control PC identifies the required mask for Exposure.                                |
| <b>Hardware</b> | The required mask is referenced by an 8 bit binary address input through the D-SUB External Interface Connector. |

### 5.4.4 TRIGGER MODES

There are multiple ways to trigger the exposure of an illumination pattern. The method available depends on the operational and referencing modes selected.

|                                |   |
|--------------------------------|---|
| <b>Mirror On</b>               | A software command Exposes the selected mask and leaves it exposed indefinitely.  |
| <b>Mirror Off</b>              | A software command turns all of the DMD Mirrors ‘Off’ and leaves them in this state indefinitely.   |
| <b>Expose</b>                  | A software command Exposes the currently selected mask for the defined exposure time.   |
| <b>Sequence Start</b>          | A software command triggers the Mosaic head to execute a predefined sequence of masks.  |
| <b>External Expose</b>         | A hardware signal is received via the External Trigger connector (SMA or D SUB) which exposes the currently selected mask for the defined Exposure time.<br>In Sequencing Mode the end of the exposure increments to the next mask, and awaits the next External Trigger to initiate its exposure.  |
| <b>External Bulb Mode</b>      | A hardware signal is received via the External Trigger connector (SMA or D SUB) which begins to expose the mask on the rising edge of the Trigger Signal and ends the exposure on the falling edge.<br>In Sequencing Mode the falling edge of the of the trigger signal increments to the next mask and awaits the next rising edge of the Trigger Signal to initiate its exposure. |
| <b>External Sequence Start</b> | A hardware signal is received via the External Trigger connector (SMA or D SUB) which triggers the Mosaic head to execute a predefined sequence of masks.   |

| Operational Modes |             | Mask Reference Mode | Compatible Trigger Modes |            |        |                |                 |               |                         |
|-------------------|-------------|---------------------|--------------------------|------------|--------|----------------|-----------------|---------------|-------------------------|
|                   |             |                     | Mirror On                | Mirror Off | Expose | Sequence Start | External Expose | External Bulb | External Sequence Start |
| Single Shot Mode  |             | N/A                 | ✓                        | ✓          | ✓      | -              | ✓               | ✓             | -                       |
| Mask Memory Mode  | Referencing | Software            | ✓                        | ✓          | ✓      | -              | ✓               | ✓             | -                       |
|                   |             | Hardware            | ✓                        | ✓          | ✓      | -              | ✓               | ✓             | -                       |
|                   | Sequencing  | Software            | -                        | ✓          | -      | ✓*             | ✓*              | ✓             | ✓*                      |

### 5.4.5 INVERT MODE

This modifier will invert the binary mask as it uploads it to the Mosaic head. This can be used with both Single Shot and Mask Memory modes.

### 5.4.6 SEQUENCING

Each software GUI will implement sequencing in its own manner, please refer to the applicable User Manual for guidance. The following shows how the sequences are implemented internally with the Mosaic:

- The Masks are loaded into the Mask Memory.
- The sequence Memory is populated as a series of entries (up to 1023 entries), each can specify one or more (consecutive) masks to display for a specified period and up to 65536 repetitions.
- A sequence command specifies one or more (consecutive) Sequence Memory entries to execute with up to 65536 repetitions.

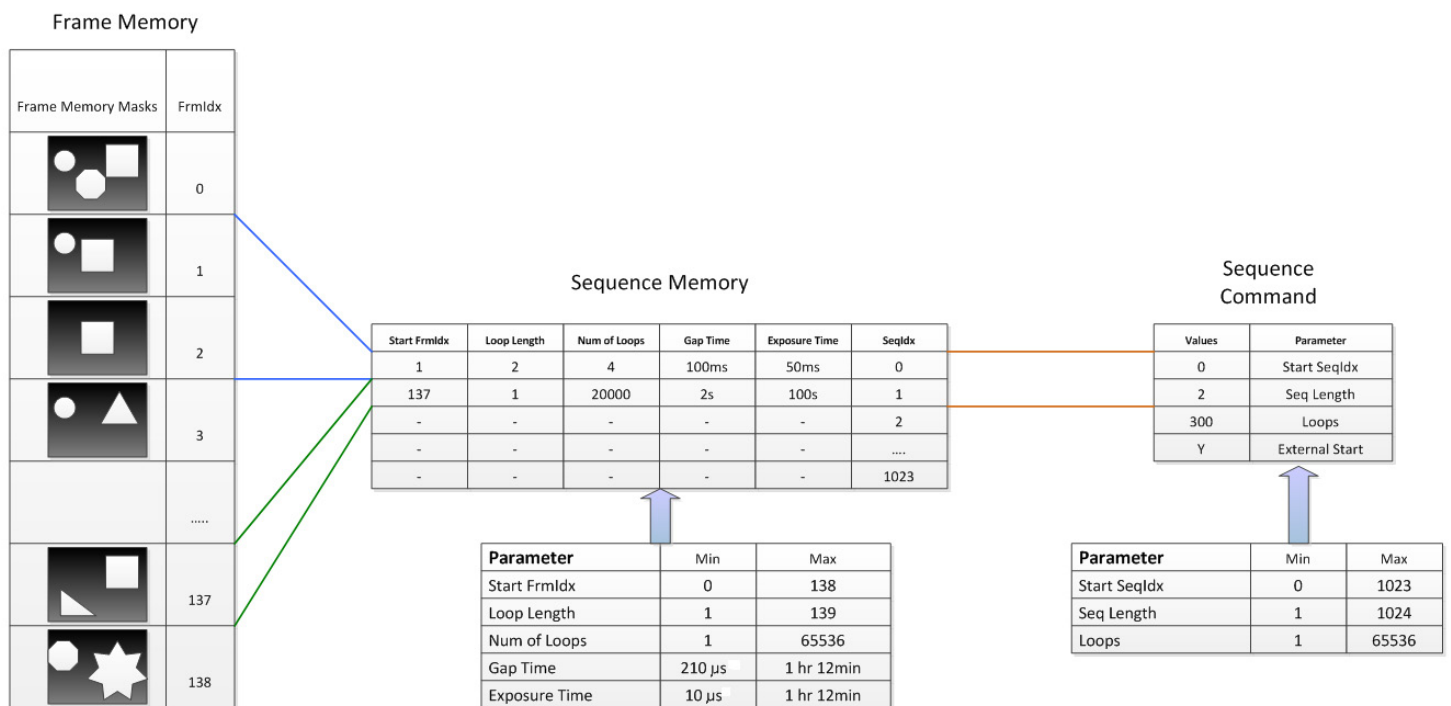


Figure 13: Mosaic3 Frame and Sequence memory

### 5.4.7 OVERLAP MODE

This applies to Sequencing operational mode and will remove any gaps between exposures so there will continually be a mask displayed and a minimum possible gap during mask transition. The DMD Active output signal will give a short (~5  $\mu$ s) dip to allow mask counting or the synchronisation of other hardware.

### 5.4.8 EXTERNAL TRIGGERING

An external digital trigger signal can be used to trigger an individual exposure in either Single Shot Mode or Referencing Mask Memory Mode. When used with Sequencing Mask Memory Mode the External Trigger signal will trigger the exposure of the currently loaded mask, and then increment and load the next mask in the sequence.

The signal can be interfaced via either the Ext. Trigger SMA connector or Pin 1 of the D-Type External Interface connector. In all Operational modes there is a 200  $\mu$ s delay between the rising edge of the trigger signal and the change in optical output.

### 5.4.9 EXTERNAL FRAME ADDRESSING

Pins 17-10 of the D-Type External Interface connector accept digital signals to specify a mask memory address from 0 -138 as a binary address [7:0].

### 5.4.10 DEVICE SYNCHRONIZATION (DMD ACTIVE OUTPUT)

The DMD Active Output produces an Active High digital signal when the DMD is exposing a mask. This can be used to hardware synchronise an additional piece of equipment (e.g. light source for DMD illumination). The signal goes high 4  $\mu$ s before the Optical Output changes and ends 3  $\mu$ s after the DMD finishes exposing.

### 5.4.11 BEAM SPLITTER PLUG OPERATION

The beam splitters are each contained in an interchangeable, kinematic type mount that we call a Beam Splitter Plug. A Beam Splitter Plug can contain optical elements to:

- Completely block transmission of light from the primary light source while allowing all the light from the secondary source to pass into the microscope.
- Provide both primary and secondary light to enter the microscope using a dichroic or other type of mirror.
- Allow only light from the primary source to pass through to the microscope, i.e. no optical element.

When installed, Beam Splitter Plugs are held in place in their respective beam splitter housings by magnets and kinematic mounts that assure repeatable alignment.

**Warning: Before changing a Beam Splitter Plug verify that the laser is turned off. Do not insert any object or body part into the Beam Splitter Plug aperture, even if the system is not engaged or powered on.**

Removal of a beam splitter plug is performed by grasping the large grey knob on the top of the plug, giving the knob a slight twist (this helps break the magnetic field) and lifting the assembly from the housing or block, as the case may be. Replacement of a beam splitter plug is performed by placing the selected plug into the block or housing desired and rotating the plug after it contacts the bottom until a strong (magnetic) detent is felt.

**Note: Removing the beam splitter plug will make the system inoperable. A safety interlock ceases all emission from the laser until the beam splitter is properly reinstalled.**

**Warning: Ensure that the Beam Splitter Plug is correctly orientated before the system is enabled.**

### 5.4.12 LAMP HOUSE FILTERS (NOT AVAILABLE ON MOSAIC INFINITY)

The Lamp House adapters of the Mosaic 3 model have a removable 38 mm filter holder which is usually fitted with a Heat Shield Filter.

To remove the lamp house filter, grip the holder and pull upwards as shown in figure 17 below.



Figure 14: Heat Shield Filter

#### Warnings:

- **The system should not be operated without a filter holder in position.**
- **The Lamp House Filter should not be removed while the Mosaic is in operation.**
- **Before changing the Lamp House Filter, ensure that the laser and lamp are turned off.**
- **Do not insert any objects into the Filter's Aperture even if the system is not engaged or powered on.**



## 5.5 CONDITIONS REQUIRED FOR LASER EMISSION

If supplied with a laser, laser radiation can only be emitted from the Mosaic when all the conditions below have been satisfied:

1. All cables are correctly connected to the control PC and between the Mosaic and its system components.
2. AC Power is applied to the Mosaic, its system components and the Power Switches (key switch) are 'ON'.
3. All interlock switches must be CLOSED.
4. The control software must successfully connect to the Mosaic.
5. The laser(s) must be successfully initiated by the control software or by the hardware interface.
6. An illumination pattern must be exposed by the Mosaic.

## 5.6 OPTICAL ALIGNMENT

The system shall be installed and aligned by the Installation Technician and will be optimized for an objective selected by the user. The system's alignment should not drift or change.

The user may however wish to alter the size of the illumination spot (and therefore power density) of the laser onto the DMD.

### 5.6.1 ILLUMINATION MAGNIFICATION/POWER DENSITY CONTROL

The laser illuminator subsystem (fibre collimator) is configured to illuminate a nearly circular spot on the DMD that corresponds to the user's desired work area. For users that wish to use the highest power densities, the area should be as small as is practical.

Determine the desired area for laser illumination on the imaging monitor. The diameter of the spot may be adjusted to achieve higher power densities (a smaller spot) or lower power densities (a larger spot).

Adjustment is made by loosening the 2 button head screws indicated on the zoom section of the fibre collimator and sliding the screw heads (and thereby sliding the lens elements underneath) in opposite directions to obtain the desired spot size while maintaining a sharp focus at the edge of the spot.

**Note: Coloured dots are applied to the fibre collimator housing during installation and training to guide the user to several pre-determined positions with sharp focus.**



Figure 15: Fibre Collimator

While the focus and size are not critical, they deserve some attention. The first image (left) shows a picture of a poorly focused spot and the second (right) shows a sharply focused large spot.

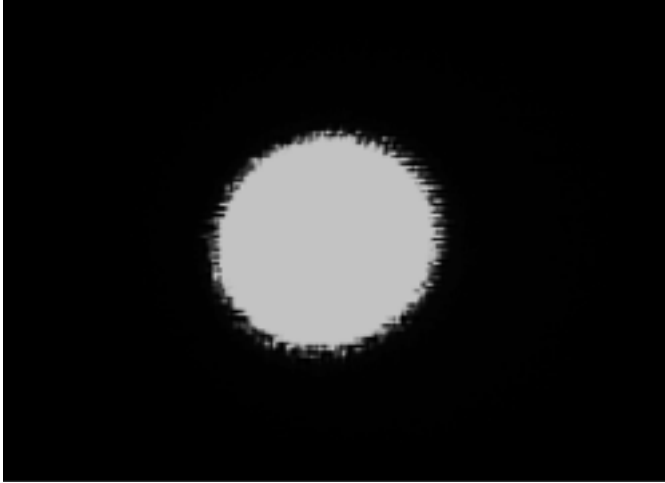


Figure 16: (left) Small but poorly focused spot, (right) Larger but sharply focused spot

## 5.6.2 CENTRATION OF THE LASER ILLUMINATION ON THE DMD

In this discussion, we assume that the eyepieces and the imaging camera are “parcentric” and “parfocal” i.e. maintain the subject in centre of field of view and in focus respectively, on changing magnification.

To view the laser spot for size and centration, select the objective to be used with the Mosaic and focus on the fluorescence sample (provided).

Select the provided Mosaic fluorescence filter cube and imaging camera port for viewing. This will engage the eyepiece laser interlock and allow the laser to turn on when requested. Configure the Mosaic software or software toolbar installed in the imaging system (refer to supplied software guide) to illuminate the entire Mosaic field of view and set the laser to a low power setting. Activate the laser illuminator source and view the spot within the imaging system field of view.



Figure 17: Laser Spot

Determine the centre of the imaging system field of view using your imaging system drawing tools. Use the joystick “tee” handle (provided) in the Position Socket of the fibre collimator shown in Figure 21 and adjust with pitch and yaw movements to bring the laser spot to the camera centre.

### 5.6.3 CENTRATION OF THE ILLUMINATION TO THE MICROSCOPE

When a laser illumination source is installed, the microscope will have a Fluorescent Target installed in the nosepiece turret. Rotate the turret to the fluorescent target's position. In the case of an inverted microscope, remove any slide carrier or shield such that the entire window of the fluorescent target may be viewed.

If an upright microscope is employed, place a mirror (provided) down on the stage, such that the fluorescent target window can be viewed. The fluorescent target safely shows the location of the laser illumination beam as it reaches the nosepiece plane, by converting the laser radiation entirely to non-coherent fluorescence emission.

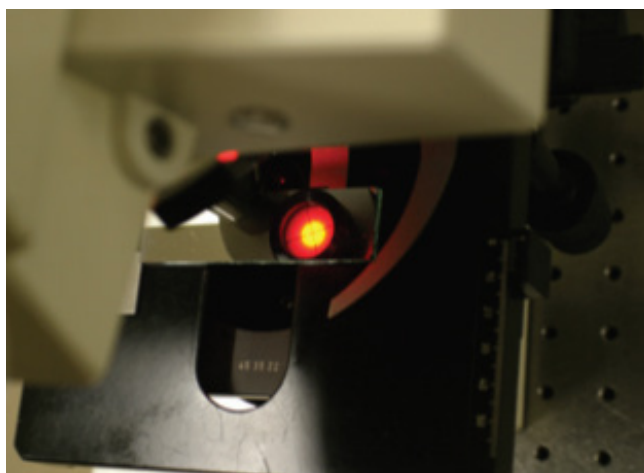


Figure 18: Laser Spot on Fluorescent Target

Select the appropriate dual illuminator beam splitter plug and wide field illuminator beam splitter plug for your intended application and install these assemblies in to the Mosaic optical head. Place the provided Mosaic fluorescence filter cube into the active position.

Configure the Mosaic software to illuminate the entire Mosaic field of view. Set the laser to a low power setting and view the spot pattern on the target with the laser illuminator source active. An orthogonal grid of 2 to 3 spots across and down will be visible on the target and one spot will be brighter than the rest. Employ the joystick in the Angle Socket (Figure 21) in pitch and yaw axes to bring the bright spot to the cross line on the target. This alignment assures that the laser illumination propagates down the optical axis of the objectives. Turn off the laser.

Because the two adjustments, position (5.6.2) and angle (5.6.3), are not quite independent, it may be necessary to do a second iteration of these two adjustments for ideal alignment.

### 5.6.4 SOFTWARE REGISTRATION/CALIBRATION

The imaging system may need Mosaic registration calibration with the objectives and fluorescence filter cubes desired for the work planned. This maps the requested Region of Interest drawn for illumination onto the DMD's pixels to accurately target the sample.

This will be a function specific to the selected control software, please consult the appropriate User Manual for guidance.

## 5.7 CHANGING THE DICHOIC POSITION (MOSAIC INFINITY)

The Mosaic Infinity Dichroic slider enables the selection between three positions. Move the Slider between the positions as required- . These are defined in the adjacent label (Figure 22) to indicate which dichroic option is available at each position. An example of the label is shown in Figure 23.

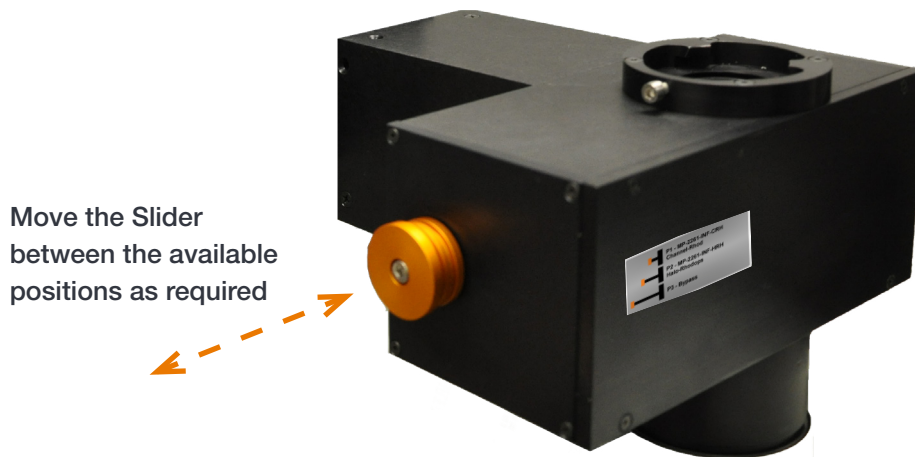


Figure 19: Dichroic Slider on Mosaic Infinity

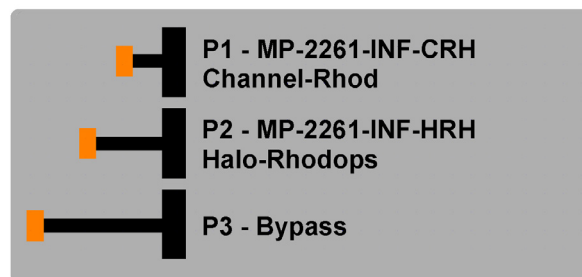


Figure 20: Dichroic Slider Label

## 5.8 RISK MITIGATION

### 5.8.1 INTERLOCK SAFETY SYSTEM TESTING

If a laser system is present then the operation of the Interlock safety system should be tested prior to use of the system.

When the system is operational, partially remove a Beam Splitter plug and ensure that the Emission LED on the front of the diode lasers controller extinguishes.

If a fault is ever observed please report it immediately to your local Andor Support representative and stop all use of the product.

### 5.8.2 MECHANICAL HOUSING

Once installed, the Mosaic device and the microscope form the Protective Housing of the product. No components, panels, connections or linkages should be loosened or removed to avoid exposure to hazardous radiation.

## SECTION 6: MAINTENANCE

### WARNINGS:

#### Important:

**The system should be powered-down prior to performing the maintenance checks, except for the interlock checks.**

**Contact your Andor Support Representative with any queries or issues.**

**Do not use equipment that is damaged.**

### 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 exterior of the product, only use a damp, lint-free cloth. Do not wet the connectors.
- Use water only- do not use solvents, cleaning agents, or aerosols.

### 6.1 OPTICAL ELEMENTS

**Only** the Beam Splitter Plugs should be attempted to be cleaned by the user. Training in the correct technique will be given by the Andor Installation Technician. No other optical elements are user serviceable:

- Only attempt to clean if particulates are causing visible non-uniformities in the illumination field.
- Visually inspect the optic and do not attempt cleaning if particulates are not visible to the naked eye.
- Use disposable optical grade swabs or lint free tissue and an optical solvent.
- Work with single passes in one direction and then dispose of the swab.

### 6.2 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:

- Perform the interlock checks as listed in the 'Guidelines for the Safe Operation of Laser Products' at the start of this document.
- 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.

## 6.3 ANNUAL ELECTRICAL SAFETY CHECKS

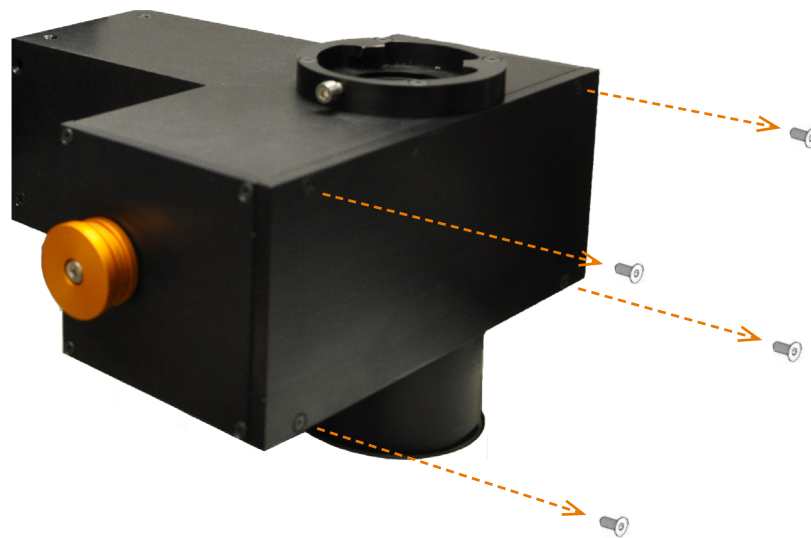
It is advisable to check the integrity of the insulation and protective earth of the product on an annual basis, e.g. U.K. PAT testing.

## 6.4 CHANGING THE DICHOIC (MOSAIC INFINITY)

The Mosaic Infinity features a manual dichroic slider (see also section 5.7) enabling the user to switch between the installed dichroic filters. If a new dichroic is to be exchanged or added please follow the instructions outlined below:

### WARNINGS:

- Turn off lasers before beginning this procedure
  - Take care handling optical components, following standard practices for good optical handling techniques
1. Ensure that lasers are powered off.
  2. Remove the 4 M3x8mm screws on the access panel on the dichroic module (shown below).



3. Remove the 4 M3x12mm screws which secure the required dichroic mount to the dichroic slider. Take care so that the screws do not fall down into the microscope as they may damage the microscope's objective lens
4. Fasten the new dichroic into the required position.
5. Fasten the access panel to the dichroic module by fastening the 4 screws previously removed.

## SECTION 7: TROUBLESHOOTING

### 7.1 TROUBLESHOOTING EXAMPLES

Refer also to the operation and troubleshooting information provided with your other system components. Contact your Andor customer support representative if you require further assistance.

## 7.2 PROBLEM REPORTING FORM

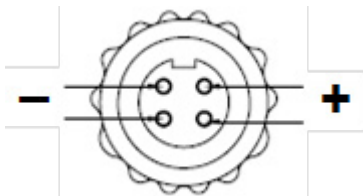
Please have the following information when connecting customer support:

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



## SECTION 8: TECHNICAL SPECIFICATIONS

### 8.1 AC/DC POWER SUPPLY REQUIREMENTS

| Parameter                                      | Specification  |
|--|--|
| <b>Mains Input Voltage Range</b>               | 100 – 240 V a.c. (typical)   |
| <b>Mains Input Frequency Range</b>             | 43 – 67 Hz (typical)   |
| <b>Mains Input Steady State Current</b>        | 0.1 A max. based on typical voltage range above  |
| <b>Low Voltage Output</b>                      | 12 V d.c. $\pm$ 5%   |
| <b>Low Voltage Output Ripple</b>               | 200 mV max.  |
| <b>Low Voltage Steady State Current Output</b> | 1 A max.   |
| <b>Low Voltage In-rush Current Capability</b>  | Shall start up a load whose in-rush current from a 0.1 $\Omega$ source resistance is 21A min. peak and a pulse width of 80 $\mu$ s min. measured at half the peak  |
| <b>Low Voltage Output Connector</b>            | <p>Tyco 3-1437719-3 4-pin Triad Female Cable Plug, which uses UL 94 V-0 insulators</p> <p>Pins are shown looking into the connector from the insertion side:</p>  |
| <b>General Safety Requirements</b>             | The power supply must be certified to an appropriate IEC standard, e.g. IEC 60950-1, and meet the reinforced insulation from mains requirement of IEC 61010-1  |
| <b>Power Supply Overvoltage Category</b>       | CAT II. An overvoltage category of CAT II means that the power supply 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.                         |

### 8.2 POWER CONSUMPTION

| Parameter  | Specification      |
|--|--------------------|
| <b>Mosaic USB DMD Head + External Power Supply</b> | 6W (typ. & max.)   |
| <b>Mosaic USB DMD Head Only</b>                    | 4.8W (typ. & max.) |

### 8.3 ELECTRICAL SPECIFICATIONS (I/O)

See **Section 3.1.7 Connector Signal Electrical Specification.**

## 8.4 OPERATING CONDITIONS

The product has been designed for the following operating conditions:

| Parameter             | Specification   |
|-----------------------|---|
| Location              | Indoor use  |
| Operating Temperature | +10 to +30 °C   |
| Relative Humidity     | 80 % non-condensing   |
| Altitude              | Up to 2000 m  |
| Rated Pollution       | Pollution Degree 2. Normally only non-conductive pollution occurs. Occasionally, however, a temporary conductivity caused by condensation must be expected. |

- This product has not been designed to operate correctly in direct sunlight.
- The term “indoor use” also implies that it is not designed to expect water spills.
- Whilst running an experiment try to keep the room temperature as stable as possible.

## 8.5 STORAGE AND TRANSPORTATION

- The packaging used for the original delivery should be retained for further use.
- The packaging unit must be protected from excesses of weather.

| Parameter           | Specification         |
|---------------------|-----------------------|
| Storage Temperature | -20 to +70 °C         |
| Relative Humidity   | ≤ 90 % non-condensing |

## 8.6 PERFORMANCE SPECIFICATIONS

| Parameter                                      | Specification   |
|--|---|
| Potential Wavelength Range                     | 360 nm to 800 nm (minimum 5 % at all wavelengths)   |
| Laser Wavelengths                              | See laser source(s) labels and/or explanatory label on microscope   |
| Maximum Power at Microscope Stage              | See explanatory label on microscope   |
| Intensity Stability                            | Absolute dependent on illumination source   |
| Extinction Ratio                               | > 800:1   |
| Minimum Resolvable Spot                        | Diffraction limited with 100x objective   |
| Minimum Exposure Time                          | 50 µs – Software or External Expose, Sequence (All Operational modes)<br>200 µs – Overlap mode (Software or External Expose)<br>200 µs – External Bulb Mode |
| Maximum Exposure Time                          | 200 seconds – Software Exposure<br>Infinity – Software Mirrors On<br>200 seconds – External Exposure Trigger<br>Infinity – External Bulb Mode Trigger       |
| Minimum Sequence Mode Gap Time                 | 200 µs  |
| External Trigger Rising Edge to Exposure Delay | < 200 µs  |
| Minimum Exposure Time Accuracy                 | +/- 1 µs for all defined exposure times<br>+/- 10 µs External Bulb Mode   |
| Minimum Exposure Time Precision                | +/- 0.2 µs  |

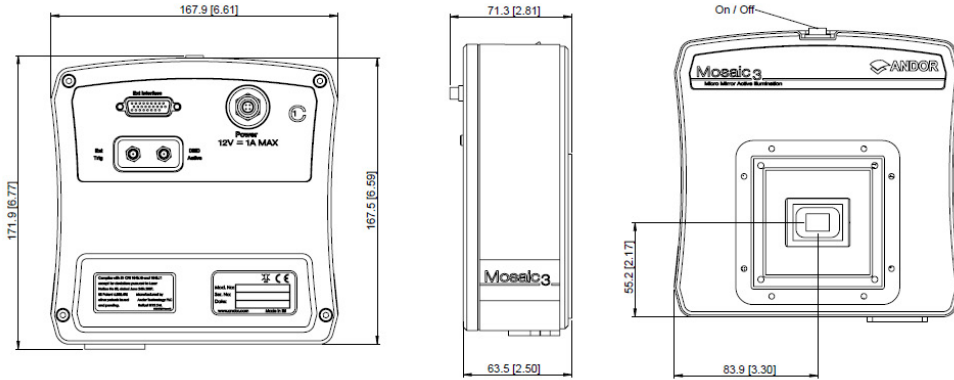
## 8.7 LASER SOURCES

See the relevant manual on the “Instructions Manuals” CD-ROM supplied with the Mosaic.

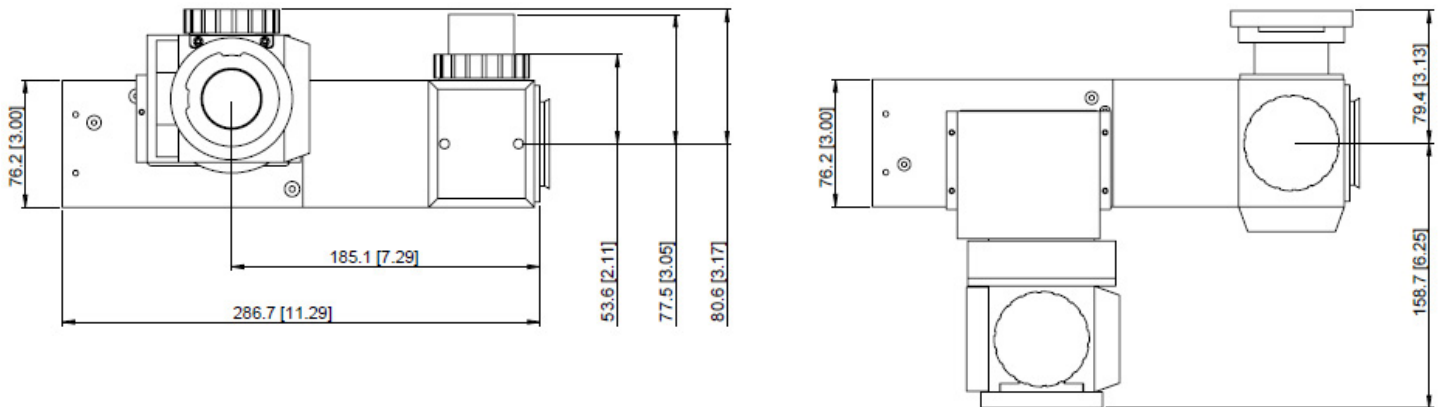
### APPENDIX A: MECHANICAL DRAWINGS

All Dimensions: mm [inches]

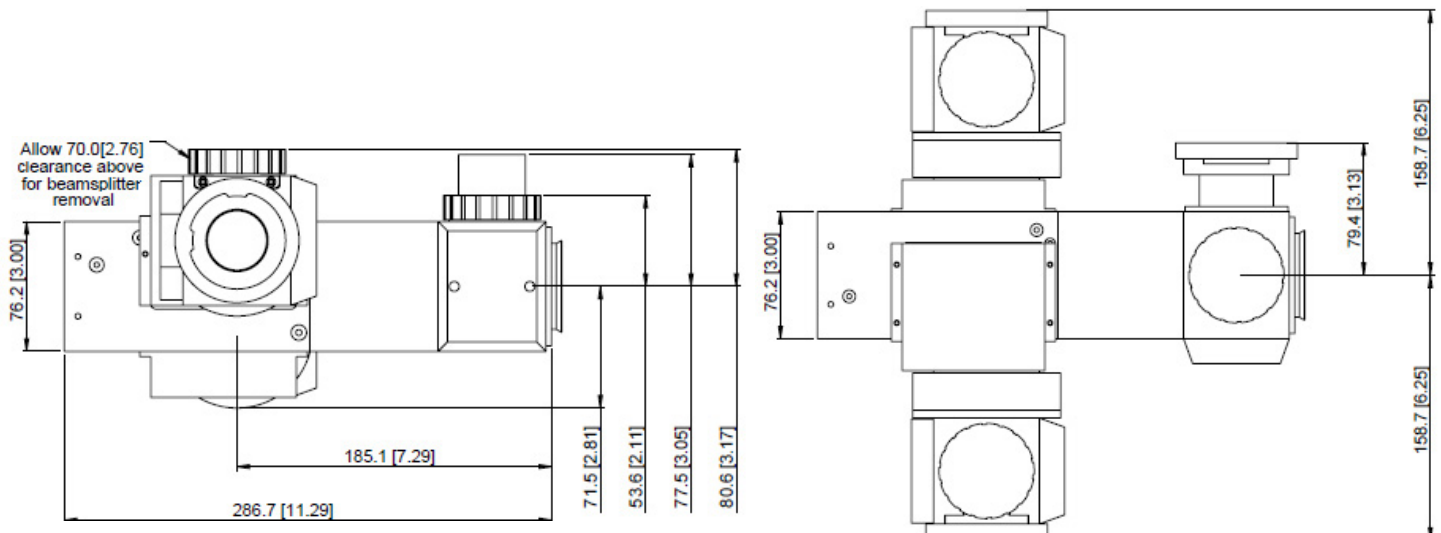
#### Mosaic 3 Head (all models)



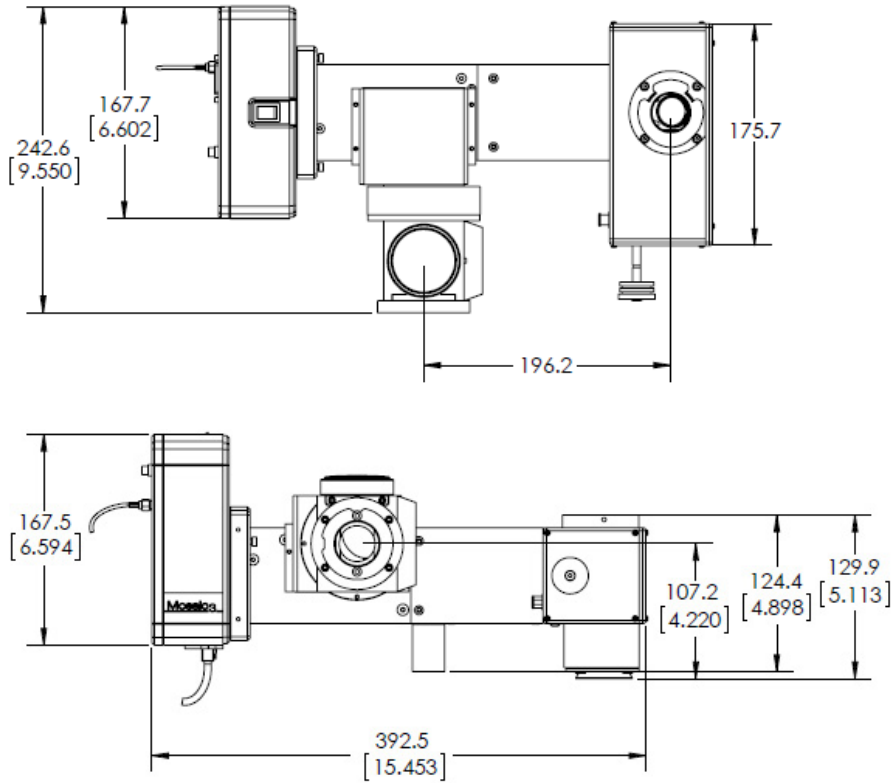
#### Mosaic 3



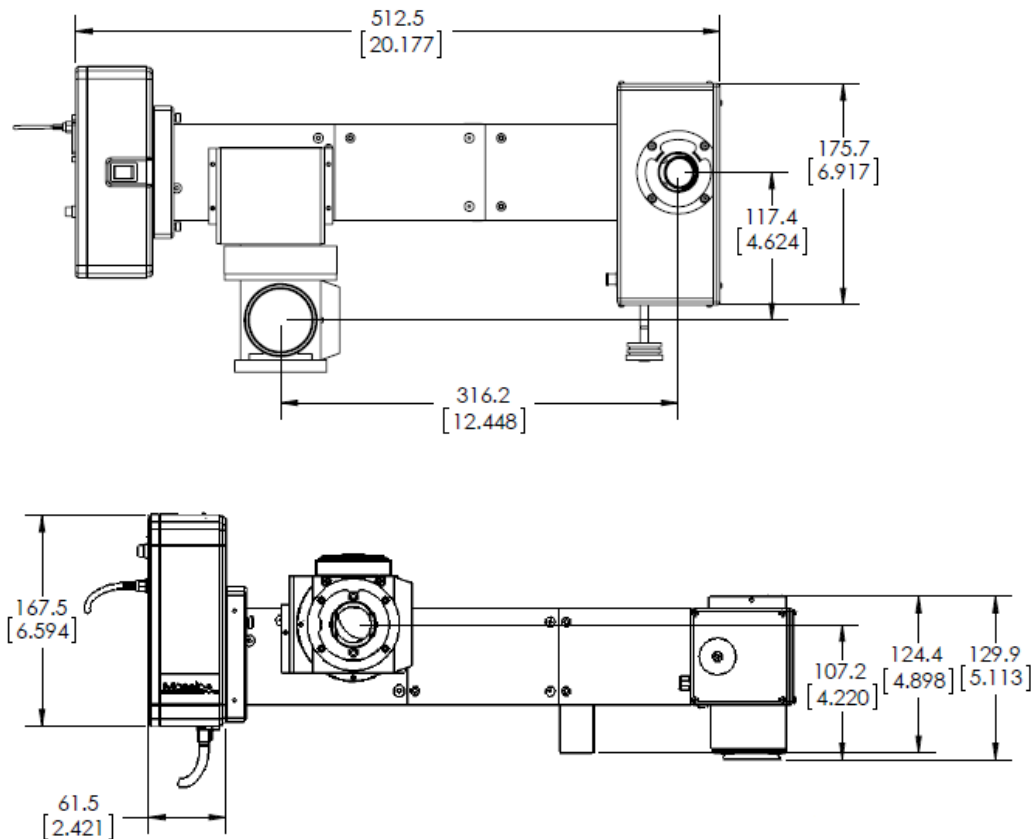
#### Mosaic 3 Duet



### Mosaic Infinity (1.0X)



### Mosaic Infinity (0.5X)



## APPENDIX B: GLOSSARY

|                          |  |
|--------------------------|--|
| <b>AC</b>                | Alternating Current (Mains)  |
| <b>AC/DC</b>             | An electronic device that converts AC electricity (usually mains) into a DC voltage (usually a safe low voltage)   |
| <b>ADC</b>               | Analogue-to-Digital Converter: Converts an analogue voltage to a digital signal.   |
| <b>CLSM</b>              | Confocal Laser Scanning Microscopy   |
| <b>DC</b>                | Direct Current   |
| <b>DMD</b>               | Digital Micro-mirror Device  |
| <b>Electrophysiology</b> | The study of the electrical properties of biological cells and tissues   |
| <b>EMC</b>               | Electromagnetic Compatibility  |
| <b>ESD</b>               | Electrostatic Discharge  |
| <b>EU</b>                | European Union   |
| <b>Fluorophore</b>       | A fluorescent chemical compound that can re-emit light upon light excitation. Light energy of a specific (excitation) wavelength is absorbed and re-emitted at a longer and lower energy (emission) wavelength.                                |
| <b>fps</b>               | frames per second  |
| <b>IO</b>                | Input/Output: Generic input and output electrical signal connections   |
| <b>iQ</b>                | Andor software used to control microscopy systems  |
| <b>LED</b>               | Light Emitting Diode   |
| <b>MEMS</b>              | Micro-Electro-Mechanical Systems: Devices made up of components between 1 to 100 micrometres/microns in size   |
| <b>Optogenetics</b>      | A neuromodulation technique employed in neuroscience that uses a combination of techniques from optics and genetics to control the activity of individual neurons in living tissue   |
| <b>Optophysiology</b>    | The study of the response of biological cells and tissues to light   |
| <b>PCI</b>               | Peripheral Component Interconnect: A computer local bus standard for attaching hardware devices in a computer that can take either the form of integrated circuits fitted onto the motherboard itself, or expansion cards that fits into slots |
| <b>PCIe</b>              | PCI Express: A high-speed replacement for PCI that has different motherboard add-in slots and uses different signalling  |
| <b>Photobleaching</b>    | The photochemical destruction of a dye or a fluorophore  |
| <b>SMA</b>               | Sub-Miniature version A: Coaxial RF connectors with a screw type coupling mechanism, and available in 50 $\Omega$ impedance only.  |
| <b>USB</b>               | Universal Serial Bus: A common PC wire-based communications interface with electronic devices  |

## 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: [www.andor.com/pdfs/literature/Andor\\_Standard\\_Warranty.pdf](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

