QIOPTIQ
Photonics for Innovation
An Excelitas Technologies Company

iFLEX-iRIS™

OPERATING MANUAL

PREFACE

The Qioptiq iFLEX-iRIS™ delivers a single wavelength either via one single mode polarization maintaining fiber optic cable or via free space output directly from the laser. Your system has been configured as requested in your purchasing specification or purchase order and may not include all the features and options mentioned in this document.

This document contains information required in order to safely install and operate your iFLEX-iRIS™ laser system. There are no user serviceable components inside the Laser Head or Interlock Control Unit. Contact Qioptiq technical support if you believe that your system may have developed a fault.

TABLE OF CONTENTS

WARNING CONVENTIONS

The following symbols are used throughout this manual to draw your attention to items that require extra attention, particularly to situations that may result in damage to equipment or a hazard to health.

Danger! Action may present a hazard to personal safety.

Warning! Action may cause damage to equipment.

Danger! Laser radiation is present.

Danger! Action may present an electrical hazard to personal safety.

1 - PRECAUTIONS FOR SAFE OPERATION

This section describes the precautions for safe operation of the iFLEX-iRIS™ range of products.

Danger! Only suitably trained and qualified personnel should be allowed to operate this equipment. If your organization has a nominated Laser Safety Officer (LSO), this person should be consulted with regard to the appropriate precautions to be undertaken when using this product in you location.

1.1 Optical Safety

Warning! LASER RADIATION
AVOID EXPOSURE TO BEAM
CLASS 3B LASER PRODUCT

Due to the coherent properties and the low divergence angle of the laser radiation, even relatively small amounts of exposure can lead to permanent or serious injuries to eyes or skin. Therefore, it is important to follow the guidelines detailed in this manual, as well as laser safety regulations.

The iFLEX-iRIS™ range of lasers can emit in either the UV-A, visible or near IR wavelength bands with wavelengths ranging from 375nm to 852nm. The lasers have a range of different output power levels dependant on which variant has been selected (see section 2). The iFLEX-iRIS™ lasers are classified as Class 3B according to IEC 60825-1:2014. Ensure that you are familiar with the safety regulations for your particular model before operating the laser. Safety regulations vary in different countries; ensure that the iFLEX-iRIS™ is installed and operated with regard to local regulations.

General Precautions for the Safe Use of Lasers

- Only trained and qualified personnel should be allowed to operate the equipment.
- Avoid eye exposure to direct or scattered radiation.
- Protective eyewear must be suitable for the wavelength and intensity of the laser line.
- Use extreme caution if using protective eyewear since they prevent the operator from seeing the laser beam path.
- Ensure volatile substances (e.g. solvents, alcohol) are kept away from the laser source and beam path.
- Maintain a high ambient light level in the laser area. This ensures that the pupil remains constricted reducing the likelihood of eye damage.
- Never look directly into the laser light or to scattered radiation from reflective surfaces. Never look into the aperture of the laser or any fiber optic delivery cable.
- Experiments involving lasers should not be conducted at eye level. Ensure that setups are conducted at a suitably low height, especially if there is a possibility of seated operation.
- Post warning signs to inform personnel that a laser is in operation.
- Use only in accordance with IEC60825-14 or ANSI Z136.1.
- This product is not a toy.
- Do not aim laser at aircraft

1.2 Electrical Safety

There are no hazardous voltage levels accessible within the iFLEX-iRIS™ product range of lasers and accessories. There are no serviceable parts and the warranty will be void if the any enclosures are dismantled and/or the anti-tamper labels are broken.

Warning! Whilst there is good ESD protection in the laser it is advised to observe ESD precautions whilst handling the laser, especially when installing the equipment.

1.3 Compliance

The iFLEX-iRIS™ product range of lasers are CE & FCC compliant. Below is the EU Declaration of Conformity.

EU Declaration of Conformity

In accordance with EN ISO 17050-1:2010

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Object of the declaration:

Product	–	Single Wavelength Laser Module
Model/type		iFLEX-iRIS Product Range

Manufacturer	Qioptiq Photonics Limited
Address	Ensign Way, Hamble, Southampton, SO31 4RF, England, UK

This declaration is issued under the sole responsibility of the manufacturer

The object of the declaration described above is in conformity with the relevant Union harmonisation legislation:

2014/35/EU	The Low Voltage Directive
2014/30/EU	The Electromagnetic Compatibility Directive
2011/65/EU	The Restriction of Hazardous Substances Directive

Conformity is shown by compliance with the applicable requirements of the following documents:

Reference & Date	**Title**
EN61010-1:2010	Safety Requirements for electrical equipment
EN60825-1:2014	Safety of laser products
CICPR 11:2009 inc A1:2010, Class A	Radiated emission & conducted emissions AC port
ANSI C63.4:2014, Class A	Radiated emission & conducted emissions AC port
CISPR 22:2008, Class A	Radiated emission & conducted emissions AC port
EN61000-3-2:2014	Mains Harmonics
EN61000-3-3:2013	Mains voltage flicker (dmax = 4%)
EN61000-4-2:2009	Electrostatic discharge immunity test
EN61000-4-3:2006 inc A2:2010	Radiated electromagnetic field immunity test
EN61000-4-4:2012	Fast transient bursts immunity test
EN61000-4-5:2014	Surge Immunity test
EN61000-4-6:2014	Conducted immunity
EN61000-4-11:2004	Voltage dips and interruptions

Signed for and on behalf of:	Qioptiq Photonics Limited
Place of issue:	Southampton, England
Date of issue:	21 July 2017
Name:	Christopher Madin
Position:	Senior Director, Laser Technology
Signature:	

Qioptiq Photonics Ltd. Registered in England No. 2822648 VAT No. GB 568 3265 13
Registered Office: Glascoed Road, St Asaph, Denbighshire, LL17 0LL

1.4 Laser Labels

1.4.1 Location of the Laser Safety Labels

A table containing examples of the laser safety labels is shown below.

	Laser Safety Warning Label: Incorporates the elements required by IEC 60825-1:2014, specifically:- • Laser warning triangle • Laser product classification label • Maximum optical output parameters of the laser
	Laser Aperture

Table 1-1: Laser Safety Labels

The location of the labels can be seen in the following figure. Although the figure depicts an iFLEX-iRIS™ laser with the kineMATIX® manipulator, the Laser Safety Warning label is in the same location for all laser variants.

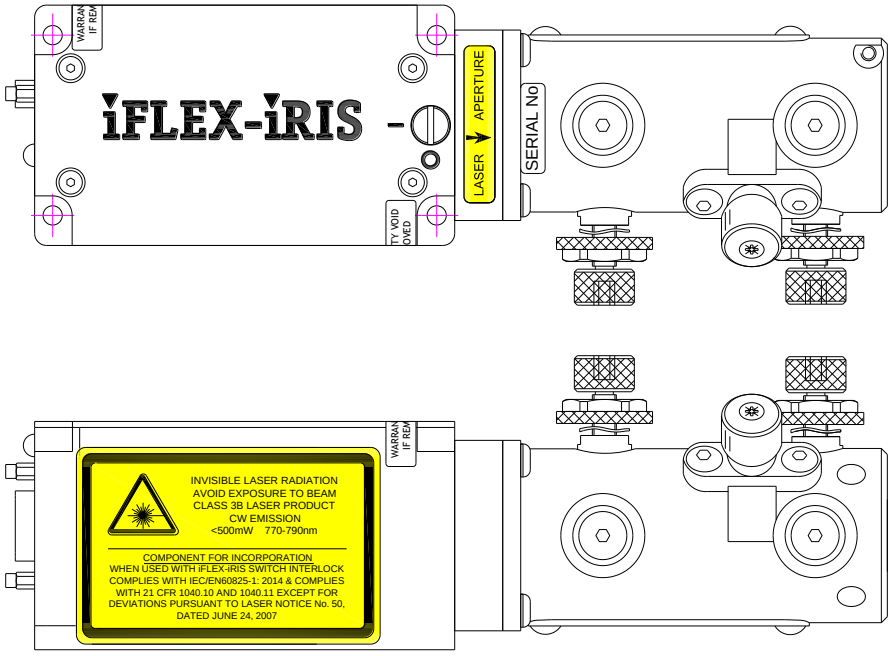

Figure 1-1: Laser Safety Warning label and aperture label position on the fiber coupled iFLEX-iRIS™ with kineMATIX® manipulator

For the free space iFLEX-iRIS™ lasers, the kineMATIX® manipulator is not fitted. As a result, the Laser Aperture label is fixed to the front of the laser next to the laser emission point; see Figure 1-2. The Laser Safety Warning label is fitted in the same place as the fiber coupled laser version.

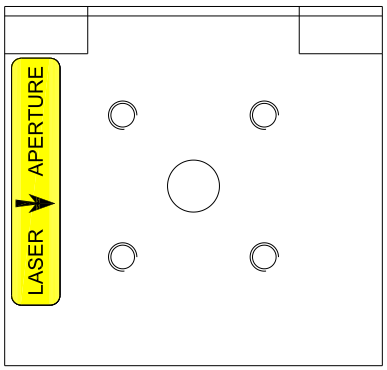

Figure 1-2: Laser Aperture label position on the free space iFLEX-iRIS™ laser without kineMATIX® manipulator

1.4.2 Location of the Laser Identification Label

An example and the location of the Laser Identification label can be seen in Figure 1-3. The label is in the same position regardless of laser variant.

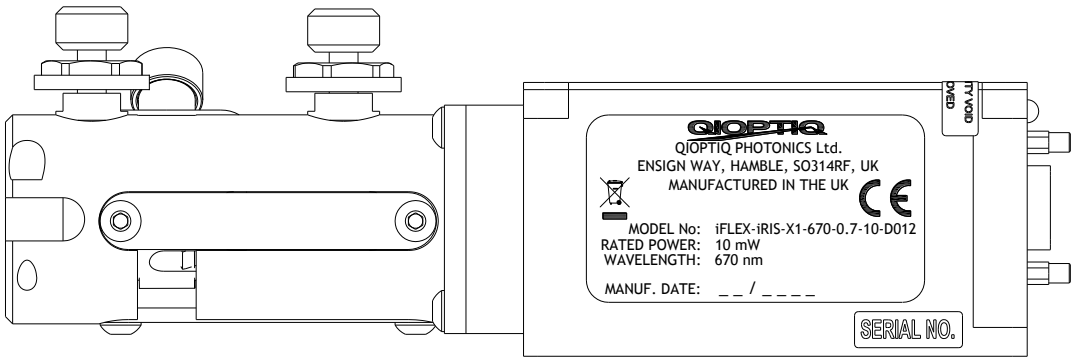

Figure 1-3: Example and location of the Laser Identification label on the fiber coupled iFLEX-iRIS™ laser with kineMATIX® manipulator

1.5 Safety Features

This section describes the safety features of the iFLEX-iRIS™.

- CDRH/IEC 60825-1 Compliance

The iFLEX-iRIS™ product range is complaint with CDRH regulations defined in Title 21 of the Code of Federal Regulations (CFR) and with IEC 60825-1, provided the laser is used with Qioptiq's iFLEX-iRIS™ Interlock Control Unit (015227). If the product is not used with Qioptiq's iFLEX-iRIS™ Interlock Control Unit, it is the user's/integrator's responsibility to ensure that these regulations are met in their system.

- Protective Housing

The laser radiation from the iFLEX-iRIS™ is completely contained within the aluminum alloy laser chassis and lid, except where it exits the laser at the laser aperture (Ø5.5mm hole) located at the front of the laser or at the output end of the fiber. The lasers are designed to be operated as assembled. The warranty is void and product safety compromised if the protective housing is disassembled.

- STATUS Indicator

The iFLEX-iRIS™ has a status LED on the end panel of the laser, next to the Laser Control I/O connector, which indicates power to the laser as well as laser emission.

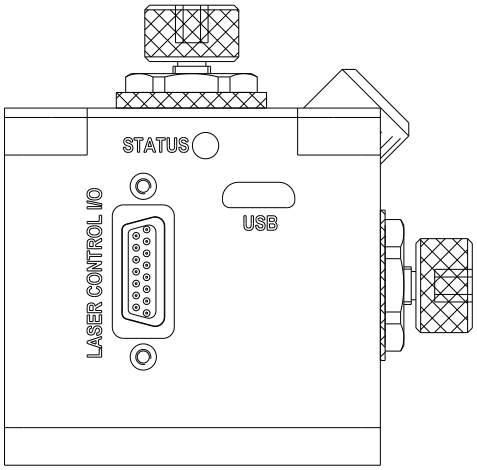

Figure 1-4: Position of the Status LED on the rear panel of the iFLEX-iRIS™.

A table detailing the status LED emission states for different laser operating conditions is shown in Table 1-2.

LED Emission	Operating Condition		
	Electrical Power	Internal Temperature	Laser Enable
OFF	OFF	OFF	OFF
Red+Blue (ON for 4sec during bootloader scan)	Switch ON	NA	OFF
Blue Flashing	ON	STABILIZING	OFF
Blue	ON	LOCKED	OFF
Blue Flashing	ON	STABILIZING	ON
Red+Blue (Purple)	ON	LOCKED	ON

Table 1-2: LED Emission Sates

Danger! When the status LED is indicating PURPLE, laser emission from the laser is possible. HOWEVER, laser safety precautions should be taken before the power is connected to the laser.

Note:

- If wearing laser safety eyewear for UV-blue wavelengths, then only the red Laser Enabled illumination LED will be seen (not purple).
- If wearing laser safety eyewear for red wavelengths, then only the blue Laser Ready illumination LED will be seen (not purple).
- The white LED Laser Emission indicator on the iFLEX-iRIS™ Interlock Control Unit is seen through all laser safety eyewear.

Mechanical SHUTTER

The iFLEX-iRIS™ laser has an integrated shutter. When the screw slot on the shutter is positioned so that it points at the laser aperture ‘1’, the shutter is open. With the shutter closed (screw slot point at ‘0’), no emission from the laser is possible; Figure 1-5 depicts the shutter in the closed position.

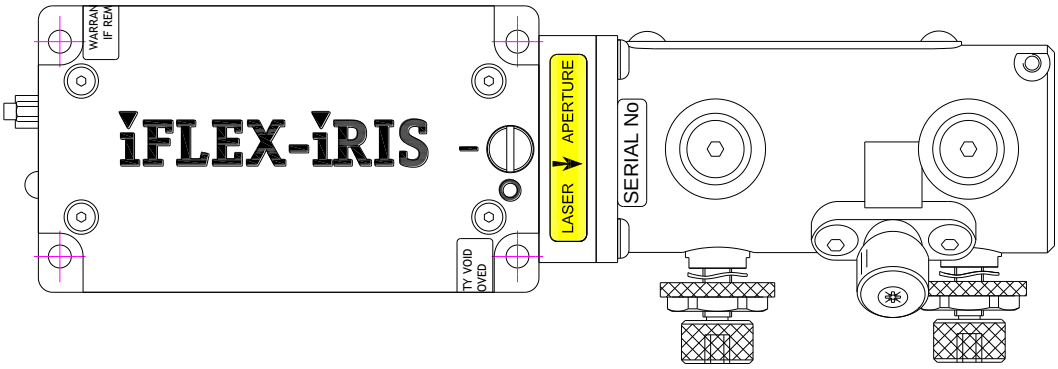

Figure 1-5: Fiber coupled laser with the shutter in the closed position

- Interlock Control Unit

The iFLEX-iRIS™ Interlock Control Unit contains: a key switch which cannot be withdrawn once turned to the ‘ON’ position; a power indicator LED to indicate when power is applied to the Laser Head; and an Interlock Socket which must be connected to the user’s interlock circuitry or used with the shorting plug provided.

2 - DESCRIPTION AND SPECIFICATIONS

2.1 Product Description

The iFLEX-iRIS™ is a miniaturized laser source with an optional modular fiber delivery system. It can be configured to have a free space output or to be fiber coupled into a single mode polarization maintaining fiber. The free space option comes in two formats, a center beam or offset beam variant. The system is mode-hop free and wavelength stabilized as a direct result of active temperature control.

Novel design and proprietary manufacturing processes eliminate the need for user alignment of the internal laser source and the kinematic design of the laser-to-fiber coupling enables true turn-key installation and operation. Its flexible design ensures that in most cases the iFLEX-iRIS™ can be retrofitted in the field, minimizing system downtime and allowing the user to reconfigure the system as their requirements change.

Specifications are subject to change. Download our latest iFLEX-iRIS™ datasheet from www.qioptiq.com for up-to-date specifications.

2.2 Features

Some of the product features include:

- High stability, high beam quality
- Low noise
- Stable power control over full control range
- Miniaturized size for low impact on instrument design
- Integrated electronics and TEC temperature stabilized control
- USB & RS232 control and monitoring
- Conductively cooled through baseplate
- Plug and Play modular fiber optic coupling with the kineFLEX®
- Analogue/Digital Modulation up to 5MHz bandwidth

The main feature of the laser is that it is always operating in a closed-loop power control mode, even during modulation, resulting in excellent optical output power stability across all modes of operation.

2.3 System Overview

The iFLEX-iRIS™ laser is a temperature stabilized collimated semiconductor laser diode. The beam is circularized by an anamorphic prism pair. Excellent power stability is achieved by monitoring the laser power which is fed back into a closed loop system in the control electronics. This power control is active in all modes. For fiber coupled lasers, a kineMATIX® manipulator is attached to the front of the laser. This enables alignment of the fiber to the laser beam resulting in very stable, high coupling efficiencies. Power and control of the laser is achieved through the I/O connector on the back of the laser which is a micro sub D15 way connector; the pin designations are described in Section 4. The USB connector can be used for software control of the laser including enabling/disabling the laser, setting the output power and general system parameter monitoring.

The free space laser has the option to choose between two different locations of the laser aperture. One option is to have the laser aperture located centrally in the laser housing and will allow the fitting of a kineMATIX® manipulator and fiber at a later date; see section 2.5 for mechanical details of both options. The second option is to have the laser aperture offset 4.5mm from center and does not support the fitting of a kineMATIX® manipulator. In both options, the beam height is 19mm.

A schematic representation of the laser can be seen below in Figure 2-1 (thick red Arrows depict the laser beam propagation whilst the blue thin arrows indicate electrical interconnections). For free space lasers, the kineMATIX® manipulator is not fitted to the laser.

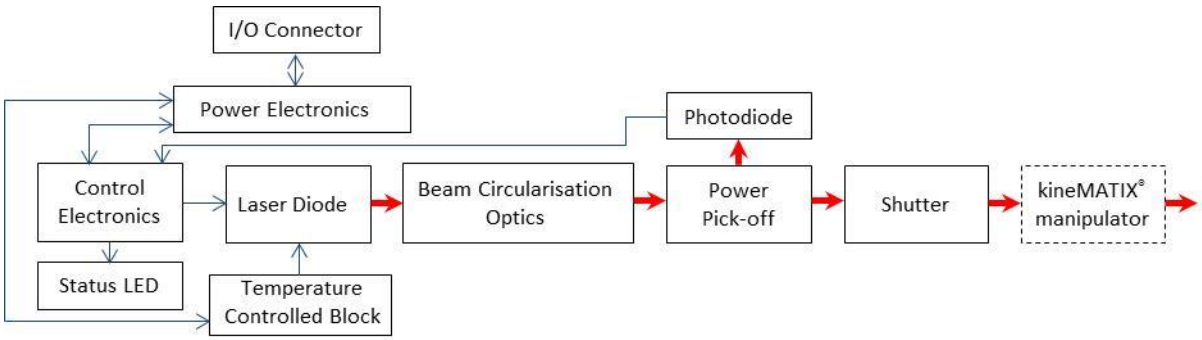

Figure 2-1: iFLEX-iRIS™ schematic

2.4 Specifications

Wavelengths (nm) and Power (mW)																				
375	405	413	445	458	473	488	505	515	520	532	561	594	633	637	642	647	660	670	730	780	852
20 40 50	50 100 200 220	100	20 50 75	20 70	75	20 40 100 140	50	20 50 60	30	20 40	20 50	20	30 70	20 100	20 40 100	50	80	10	20	70	35

Table 2-1: Free Space Laser Specifications (See latest datasheet for up to date information)

Wavelengths (nm) and Power (mW)																				
375	405	413	445	458	473	488	505	515	520	532	561	594	633	637	642	647	660	670	730	780	852
25 30	30 50 130 150	65	20 50	45	50	20 50 90	30	40	20	25	30	12	20 45	65	20 65	30	50	6	10	45	20

Table 2-2: Fiber Coupled Laser Specifications (See latest datasheet for up to date information)

Warning! Output power of laser might exceed rated power by up to 15%.

Specification	Value			
	iFLEX-iRIS, 375-520nm & 633-852nm	**532**	**561**	**594**
Spatial mode, TEM_{00}	M^2 < 1.2 typ			
Beam Ø at $1/e^2$	0.7 ± 0.2 mm			
Beam circularity	≤ 1:1.2			
Pointing stability	< 5 µrad/°C			
Static beam alignment	Beam centration < 0.3 mm Beam alignment < 5 mrad			
Polarization ratio	≥ 200:1, Vertical ± 2°			
Power supply	12V DC, 1A			
Base plate temp.	40 °C maximum			
Heat dissipation	12 W maximum, < 5W typical			
Operation modes	CW, Digital Modulation, Analogue Modulation, Mixed Mode Modulation, Computer Control	CW		
Power stability, 8 hrs	< 0.5 %	< 2 %		
RMS noise (20Hz - 20MHz)	< 0.05* %	< 0.3* %, <0.1% 561nm		
Peak-Peak noise (20Hz to 1MHz)	< 0.5* %	< 3* %		
Max Periodic noise spike (1KHz - 1MHz @ 10-100% power)	< 0.05* %	<0.3*%		
CW, power adjust	0%, 0.1 - 100%	Off, 50-100% and at 561nm Off, 15-100%		
Digital Modulation Bandwidth Extinction ratio Rise / fall time	Digital signal DC to 5 MHz 1,000,000:1 < 100 nsec	OEM options		
Analogue Modulation Bandwidth Extinction ratio Rise / fall time Power adjustment	0 - 5V signal DC to 5 MHz 1,000,000:1 < 100 nsec Off and 0.1-100%	OEM options		
Mixed Modulation	Two input ports for modulation Same specifications as above Digital and Analogue. Simultaneous input signals for a) fast digital On/Off, and b) analogue power adjustment via external 0-5V input or internal software setting	OEM options		
Communication	micro-USB, RS232	OEM options		
Environment	Operating temp. 10-40 °C, Storage temp. 10-50°C, Humidity is non-condensing			

Table 2-3: Free Space Laser Specifications Continued

*wavelength specific

To avoid condensation occurring on the internals of the laser, the ambient temperature and humidity need to be considered and if necessary controlled. The laser diode is thermally stabilized to be at 25°C and so dew points above 23°C could cause condensation to occur. Ambient temperatures and relative humidity conditions which occur on or above the blue line in the figure below, are conditions where condensation could occur and should be avoided.

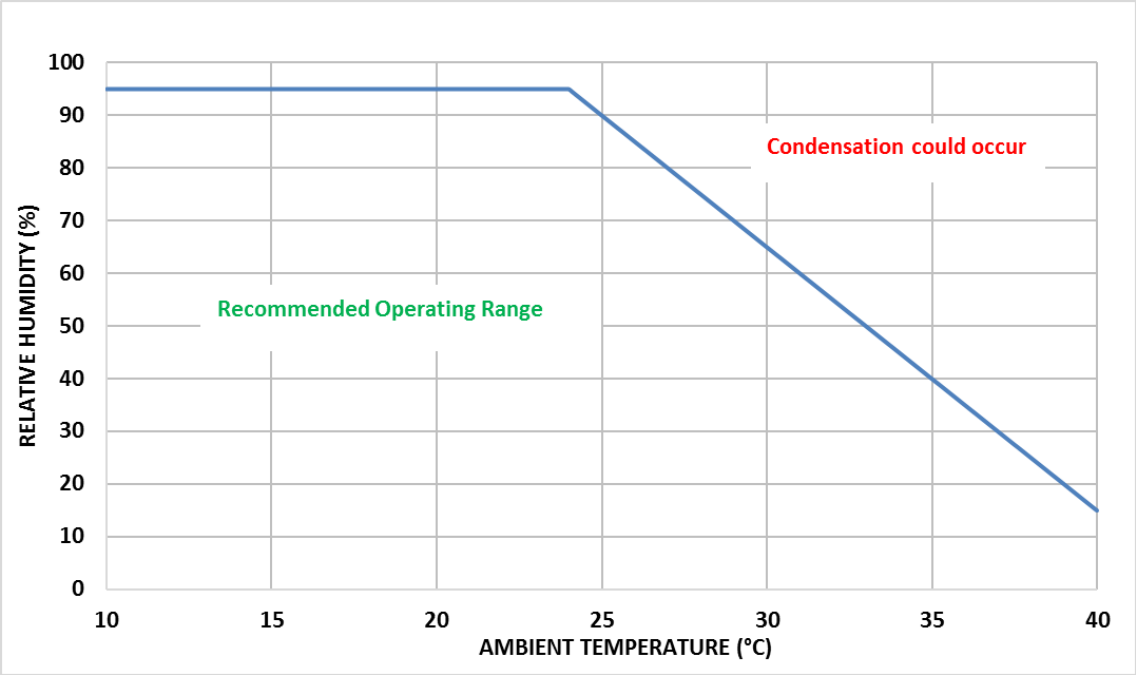

Figure 2-2: Potential condensation points for the iFLEX-iRIS™

2.5 Laser Dimensions

The dimensions of the iFLEX-iRIS™ with and without the fiber manipulator are shown in the following figures.

Laser Dimensions		
Without kineMATIX®	70 (L) x 40 (W) x 38 (H)	mm
With kineMATIX®	142 (L) x 51[1] (W) x 51[1] (H)	mm
Mass	<1	kg

Table 2-4: Laser Dimensions

[1] Dimension for width and height max values defined by the maximum extension of the kineMATIX® manipulator screws

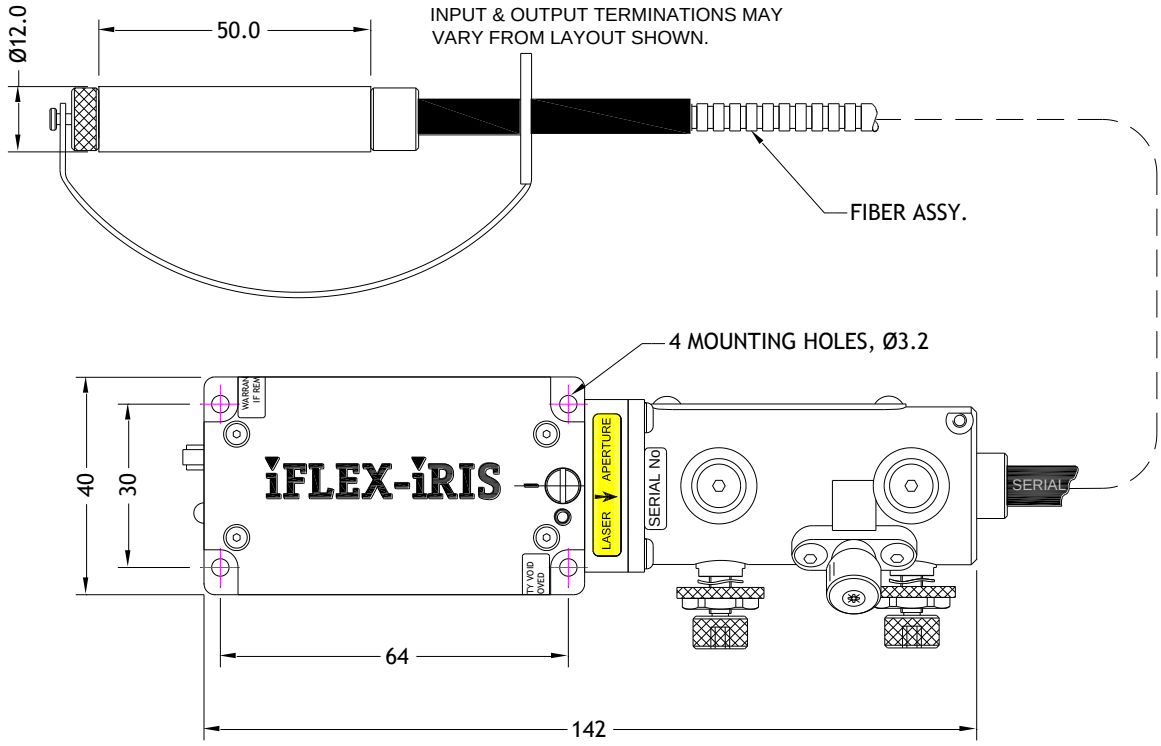

Figure 2-3: Top view of the laser with kineMATIX® manipulator and fiber assembly (other output terminations available – see section 2.6)

The iFLEX-iRIS™ is available in three different formats; the designation in brackets corresponds to the order code format detailed in section 9.

- Free space output with centralized output beam (X0)
- Fiber coupled laser using the kineMATIX® manipulator (X1)
- Free space output with offset output beam (X2)

The dimensions of the three different options are shown in the following figures.

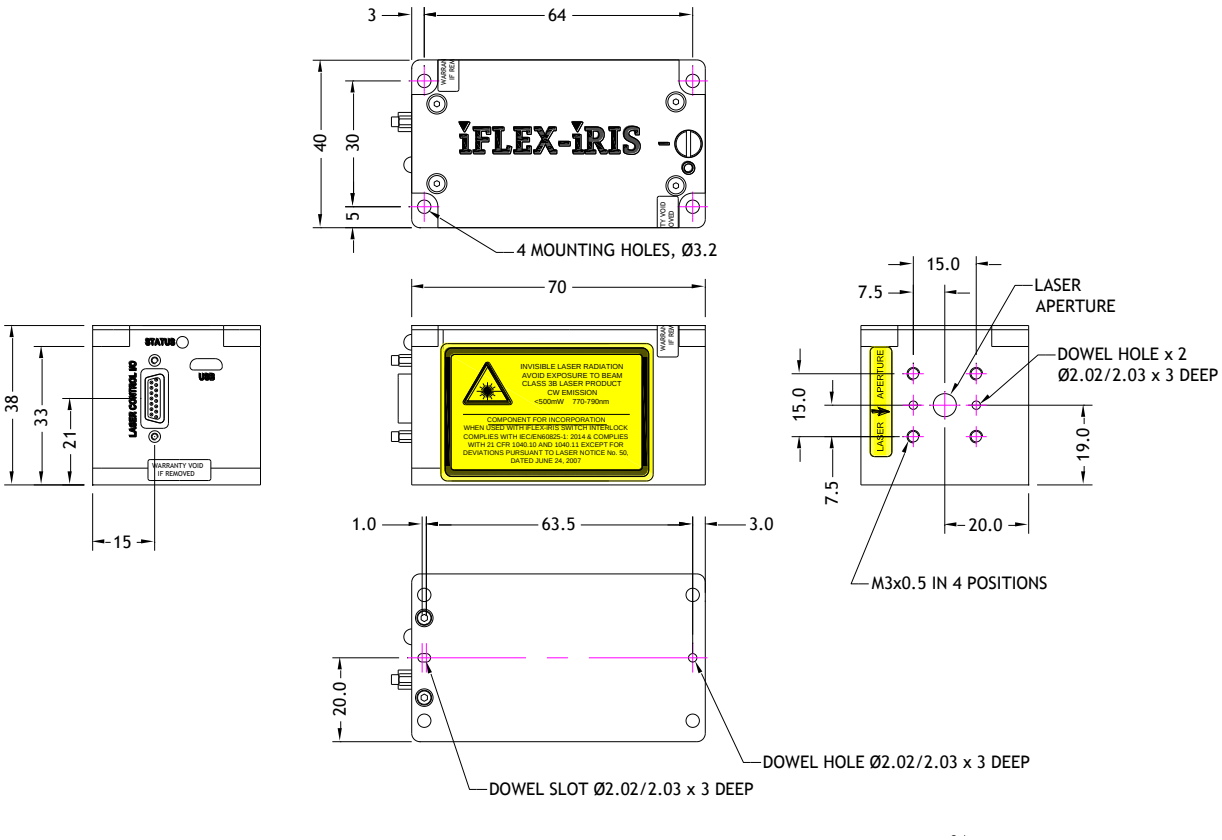

Figure 2-4: Free space laser with centralized output beam (X0)

The centralized free space iFLEX-iRIS™ laser, has a beam height of 19.0mm. Whilst not included in the laser, a kineMATIX® manipulator can be retrofitted to the laser if required.

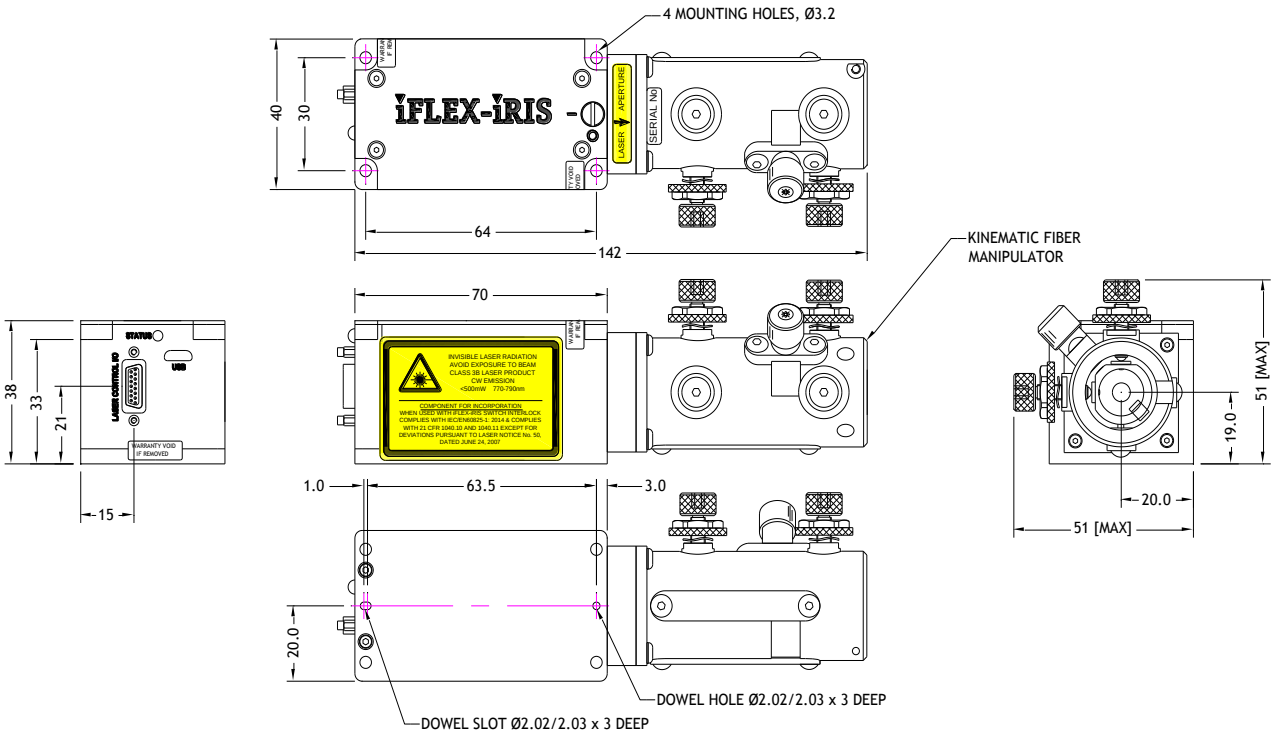

Figure 2-5: Fiber coupled laser using the kineMATIX® manipulator (X1)

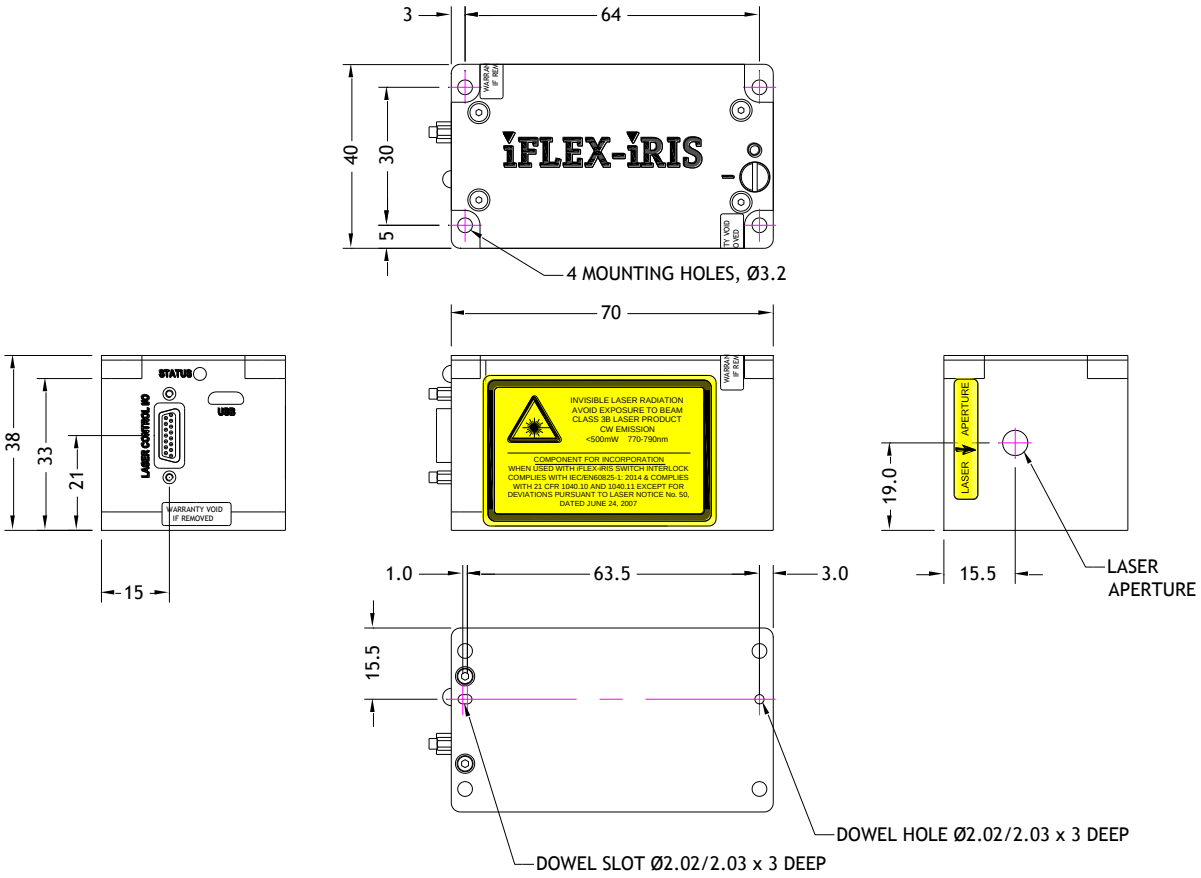

Figure 2-6: Free space laser space output with offset output beam (X2)

The offset beam free space iFLEX-iRIS™ laser, has a beam height of 19.0mm but is offset from the central location by 4.5mm. A kineMATIX® manipulator cannot be fitted to this laser.

2.6 Fiber Output Termination Options

Qioptiq's kineFLEX® fiber delivery cables can be configured to have a collimated output beam or to be connectorized. Both options are described in the following sections.

2.6.1 Collimated Output Beam

The standard collimated output delivery tube has an outline of Ø12 x 50mm and undergoes precision alignment to minimize the beam position and beam angle errors. The specifications are shown in the table below.

Parameter	Value	Units
Beam Diameter	0.7	mm
M Squared	Typically 1.1	-
Pointing Stability	≤ 1	µrad/°C
Beam Divergence	Diffraction Limited	-
Beam Position	≤ ± 0.15	mm
Beam Angle	≤ ± 0.5	mrad
Mechanical Dimensions	Ø12 x 50	mm

Table 2-5: Fiber output details

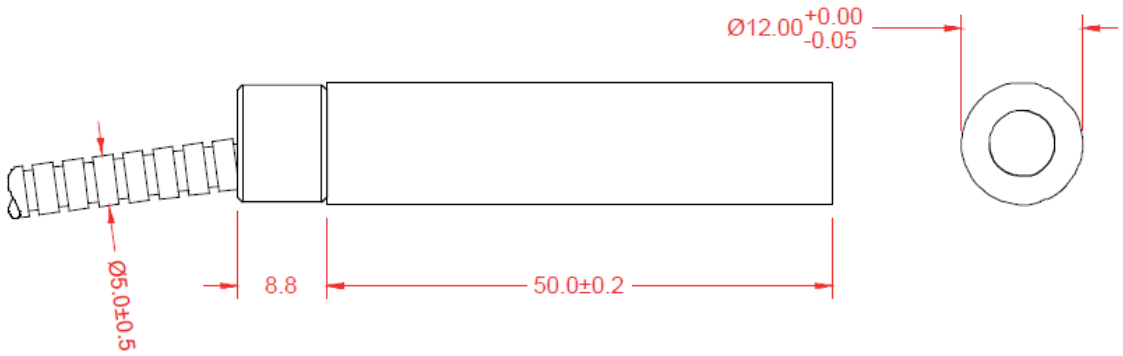

Figure 2-7: Standard output collimator Ø12 x 50mm

2.6.2 Connectorized Output Beam

Qioptiq's connectorized fiber terminations employ a high-precision FC/PC connector designed for polarization maintaining (PM) fiber applications. The connector minimizes rotational errors in the PM fiber axis by using specially designed ferrules and connector housings; however all other aspects of the connector are compatible with the industry narrow key standard.

For all PM fiber connectors the connector key is actively aligned with the slow axis of the fiber. Non-PM versions use the same connector but without the polarization alignment. The various options are shown below:-

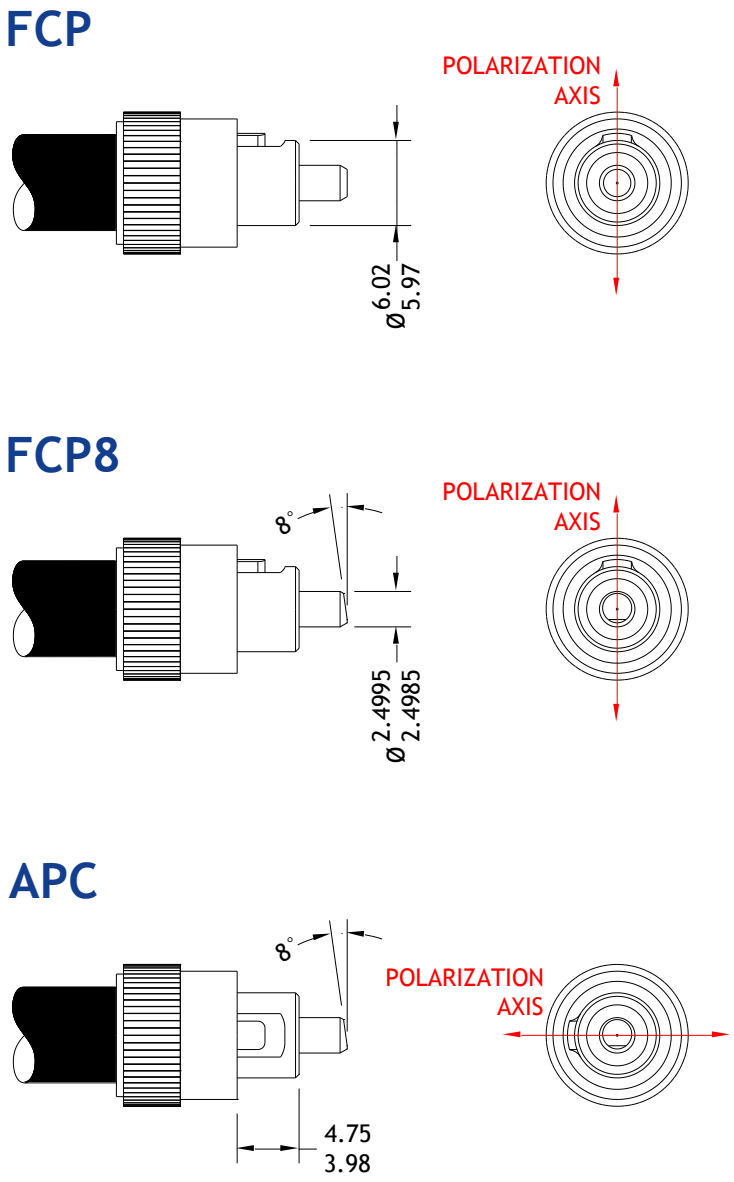

Figure 2-8: Connectorized fiber output options

2.7 Interlock Control Unit (015227)

All end user customers and any OEM customers requesting it, are supplied with an Interlock Control Unit. A diagram of the iFLEX-iRIS™ Interlock Control Unit is shown in Figure 2-11. It provides a user with the following features:

- A key-actuated power switch
- An interlock connector (see section 3.5 for details)
- An emission indicator
- Modulation input connections
- Separate laser enable switch
- A 9-way sub D-type connector for RS232 control of the laser
- General IO connection for monitoring laser analogue lines

The key-actuated power switch must be turned to ON for the Interlock Control Unit to operate. Once in the ON position, the key cannot be withdrawn.

Danger! Personnel with access to the key for the Interlock Control Unit should be fully trained in laser safety procedures and familiar with the iFLEX-iRIS™ product.

Further details of the Interlock Control Unit are covered in sections 3.6, 4.1.4 and section 5.5.

The features on the front and back panels of the Interlock Control Unit are shown in Figure 2-9 and Figure 2-10, respectively.

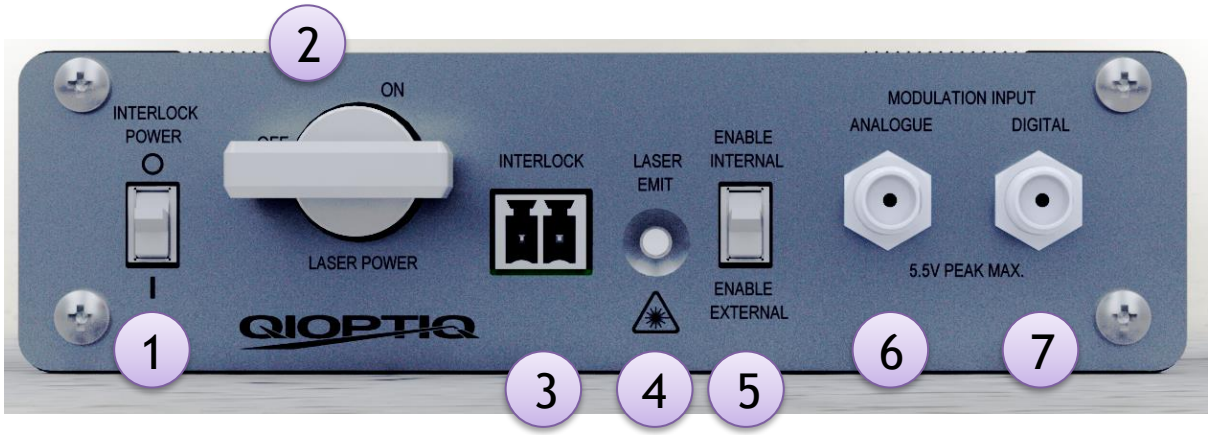

Figure 2-9: Front panel view of the iFLEX-iRIS™ Interlock Control Unit detailing the location of the different connectors and indicators

Figure 2-10: Rear panel view of the iFLEX-iRIS™ Interlock Control Unit detailing the location of the different connectors

Table 2-6 provides details of the Interlock Control Unit features.

Item	Description	Function
1	Interlock Power Switch	Switches the 12V power to the Interlock Control Unit. Illuminates green when powered.
2	Laser Power Key Switch	When turned to the 'ON' position supplies power to the laser, if the interlock circuit is closed. When ON, the key cannot be removed.
3	Interlock Connector	Input connector for the user's own interlock safety systems. A connector with jumper link is provided.
4	Laser Emit LED	White LED that indicates power is applied to the laser and that emission could occur.
5	Enable Switch	Allows the user to define how the laser enable line is supplied to the laser. In the 'Enable Internal' position, the enable line is supplied from the Interlock Control Unit removing the need for the user to provide an enable signal. In the 'Enable External' position, the enable line has to be supplied by the user via pin 6 (0V return pin 5) on the iRIS Laser IO connector (see section 4.1.4 for pin arrangement).
6	Analogue Modulation Connector	SMA connector for Analogue Modulation.
7	Digital Modulation Connector	SMA connector for Digital Modulation.
8	iRIS Laser Control (Laser Connection)	Connects the Interlock Control Unit signals to the laser. Fit the supplied 15way interconnect cable from this connector to the iFLEX iRIS™.
9	iRIS Laser IO	A mini DIN connector that allows the user to access the following signals from the laser: - Laser Current Monitor – Laser Power Monitor – Laser OK line – Laser Enable Line. These are direct connections with the laser.

10	RS232 Interface	The DB9 connector allows the user to interface with the RS232 IO lines from the laser.
11	Power Connector	Connect the iFLEX iRIS™ 12V PSU here.

Table 2-6: Description of the Interlock Control Unit features

The dimensions, shown in millimeters) of the Interlock Control Unit are shown in Figure 2-11.

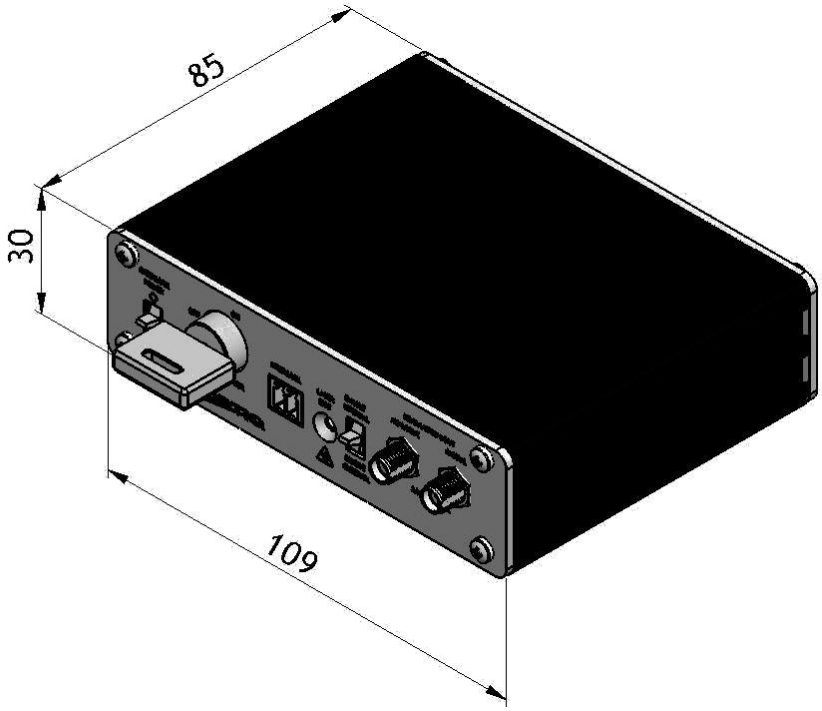

Figure 2-11: Dimensions of the iFLEX-iRIS™ Interlock Control Unit (in mm)

3 - INSTALLATION

3.1 Unpacking and Inspection

The iFLEX-iRIS™ will be shipped in specially designed packaging. Upon receiving the package, check the condition of the outer layer for damage. The package will have left Qioptiq in good condition; if any damage is seen, (with the exception of cosmetic damage that is consistent with normal transportation) please contact your Qioptiq representative before unpacking the contents.

Please save the packaging, as the specially designed carton will ensure adequate protection should you need to return your system at a later date for service or upgrading.

Warning! The fiber optic manipulator must not be used as a handle. This is a precision component and could be damaged if used as a lifting aid.

Warning! Ensure that appropriate ESD precautions are taken when handling the laser.

Each order is specific to individual customer requirements and as a result the shipping contents will vary. A table detailing the available accessories is shown below.

Item	QPL Part Number	End Users	OEM Users
Laser (iFLEX-iRIS™)	01XXXX*	✓	✓
Fiber (kineFLEX®)	01XXXX*	○	○
Fiber Alignment Tool	012364	○	○
Torque Wrench	012130	○	○
iFLEX-iRIS™ Interlock Control Unit and PSU	015227	●	○
iFLEX-iRIS™ OEM PSU	014986	-	○
iFLEX-iRIS™ OEM PSU with breakout cable	015208	-	○
Interlock Control Unit Only	015218	-	○
Interlock Plug (spare)	015273	○	○
Keys for Interlock Unit (spare)	015272	○	○
Power Supply for Interlock Unit (spare)	015216	○	○
Interconnect cable to iFLEX-iRIS™ (spare)	015217	○	○
Four M3x40 Mounting Screws	014688	✓	✓
Manual & Software on USB Stick	015230	✓	○
Packaging	-	✓	✓

Table 3-1: Laser and accessories

- ✓ Included with the laser
- ● Included in End User CDRH compliant pack
- ○ Available on request
- * Part number model specific

3.2 Heat Sink Requirement

The iFLEX-iRIS™ lasers have an operational baseplate temperature range of 10-40°C. Temperatures above, or below this could result in the temperature stabilization circuitry no longer being able to maintain temperature lock. This results in the laser being put into an error state and turning off (status LED = blue; see section 4). It is recommended that a heatsink is used with the iFLEX-iRIS™ and that it must be adequate for the conditions that the laser is operated in; typical thermal resistance is 5°C/W.

A graph of the heat dissipated by the iFLEX-iRIS™ for different ambient temperatures is shown below in Figure 3-1.

Warning! The mounting surface of any utilized heat sink must be flat, to within < 0.05mm, to avoid damage to the laser and ensure good thermal contact.

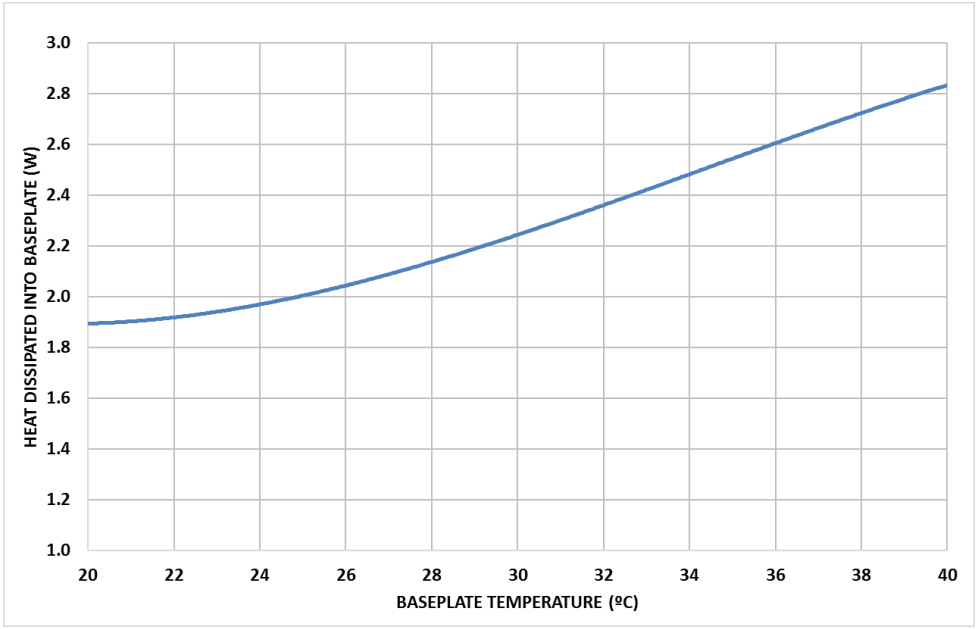

Figure 3-1: Estimated heat dissipation of the iFLEX-iRIS™ lasers. Note: the dissipation values of individual lasers will vary depending on the particular drive current of the laser diode

Warning! Do not use thermal interface compounds between the laser and the heat sink since this could cause contamination in the laser reducing its lifetime and performance.

3.3 Mounting the Laser

The iFLEX-iRIS™ has four mounting holes of diameter Ø3.2. Qioptiq recommend using M3 x 40 socket cap head screws (Qioptiq p/n: 014688) which are supplied with the laser. Do not mount laser or any power supply units onto flammable surfaces. When tightening the screws, ensure that a diagonal pattern is used to provide an even distribution of the load and prevent any warping of the base which could lead to beam pointing instability. Screws should be torqued in a diagonal pattern to 100 Ncm.

3.4 Handling the Fiber

Danger!

Class 3B Laser: Do not handle the output of the fiber when the laser is on. Serious damage and permanent blindness could occur as a result of direct exposure to the laser beam.

For safety, it is essential that the output of the fiber is not handled when the laser is on. Before switching on the power to the laser:-

- Ensure that the output of the fiber is held securely in position, preventing it from rolling or moving.
- Ensure that the output of the fiber is pointing in an appropriate direction to ensure a safe beam path once the laser is emitting.

It is essential that suitable fiber handling is maintained to protect the fiber delivery cable from damage.

Warning!

Ensure that the following fiber handling procedures are adhered to otherwise damage could occur to the fiber.

General Precautions for handling the fiber optic cable

- Ensure that the minimum bend diameter of the fiber (Ø50mm diameter) is not exceeded.
- Ensure that no objects are placed or enter the fiber lens tubes since this could damage the lenses used to collimate the input/output beam of the fiber.
- Always remove the protective metallic dust caps from the output of the fiber delivery cable before applying power to the laser.
- Do not trap the fiber delivery cable since this could break the fiber.
- Do not drop or knock the fiber delivery tubes on hard surface since this could damage the alignment of the lenses used to collimate the input/output of the fiber delivery cable.
- Always replace the protective metallic dust caps when the fibers is not in use.

3.5 Remote Interlock

For iFLEX-iRIS™ lasers supplied with the Interlock Control Unit, the interlock connector should be used to interface to a remote switch to stop laser emission in the event that a restricted access door or panel is opened or an emergency shutdown switch is pressed.

The remote interlock connector is located on the front of the Interlock Control Unit and is a CamdenBoss 2-way Terminal Socket (Part CTB932HD/2). An interlock shorting plug is provided with every iFLEX-iRIS™ Interlock Control Unit to directly short the remote interlock connection, provided that it is safe to do so in the user's application or installation. This is a CamdenBoss 2-way Terminal Plug (Part CTB92HD/2).

The remote interlock connection provides the final stage in the 12VDC circuit to the safety interlock. Once the interlock circuit goes open circuit the laser supply turns off.

Interlock details:-

- The open-circuit voltage between the interlock terminals is 12Vdc.
- The short-circuit current between the terminals is 100mA
- Never connect the output or the return terminal to ground/0V/chassis.
- Never connect any other voltage source to the output and return lines on the interlock.
- The interlock line is protected from shorting to ground with a self-resetting fuse.

- Trip current 300mA.
- Trip time max is 0.2 seconds at 1A.
- In the event of a trip (either line shorting to ground) the interlock unit will disconnect/trip and the power to the laser will be removed (Status LED on laser = off, Emission Indicator on Interlock Control Unit = OFF). Disconnect the interlock plug and fault find the EXTERNAL wiring ensuring no shorts to ground. Reconnect interlock connection and initiate the normal power up.

- UNDER NO CIRCUMSTANCES WILL THE CUSTOMER NEED TO OPEN THE ENCLOSURE OF THE INTERLOCK CONTROL UNIT. Doing so will invalidate the warranty.

3.6 iFLEX-iRIS™ CDRH Compliant System Connection

Diagrams of the front and rear panels of the iFLEX-iRIS™ Interlock Control Unit can be seen in Figure 3-2 and Figure 3-3, for reference.

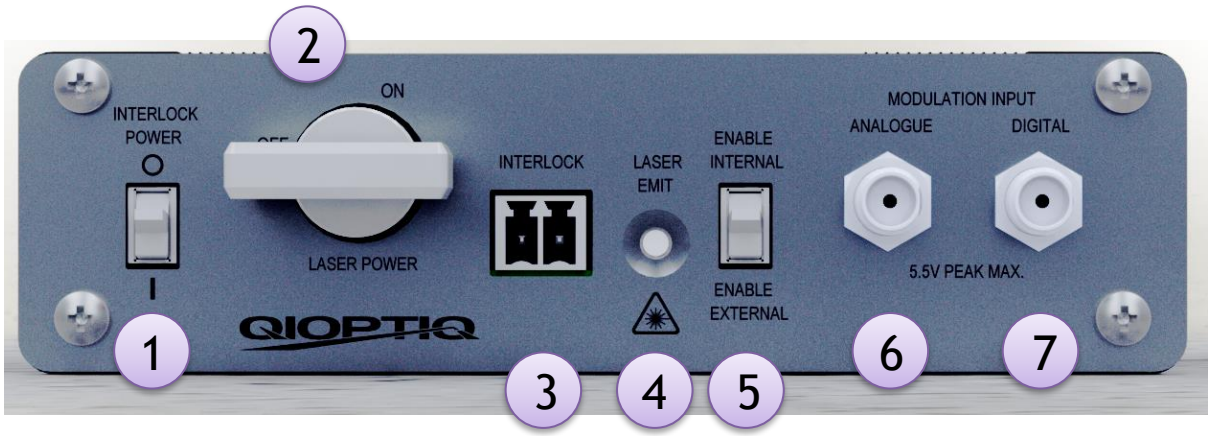

Figure 3-2: Front panel view of the iFLEX-iRIS™ Interlock Control Unit

Figure 3-3: Back panel view of the iFLEX-iRIS™ Interlock Control Unit

Before applying any electrical power to the iFLEX-iRIS™ Interlock Control Unit, ensure that all cables are connected securely according to the following instructions.

1. **Connect the Laser Interconnect Cable.**

This cable connects the Interlock Control Unit (015227) to the iFLEX-iRIS™. Connect one end of the cable into the iRIS LASER CONTROL❸ connector on the Interlock Control Unit and the other end to the LASER CONTROL I/O connector on the iFLEX-iRIS™.

2. **Connect the Interlock Plug**

Fit the shorting Interlock Plug or remote circuitry into the iFLEX-iRIS™ Interlock Control Unit connector marked INTERLOCK❸. If using the shorting Interlock Plug instead of the remote circuitry, the user does so at their own risk.

3. **Set the Laser Enable Line switch**

Set the Laser Enable switch❺ to the external position. This switch can be used to set the Laser Enable line between internal and external control. When switched to the internal position, the Interlock Control Unit supplies a 5V signal to the Laser Enable line removing the need for the user to input the signal. When switched to the external position, the Laser Enable line is connected to PIN 6 of the Laser IO connector❾ on the back panel of the Interlock Control Unit. The user will then need to apply a laser enable signal to PIN 6 to turn the laser ON.

4. **Connect the iRIS Laser IO connector (if required)**

If required, connect signals into the Laser IO connector❾. This is a Mini DIN connector and allows the user access to the following laser signals (these are as outlined in section 4.1.1)

a) Laser Current Output
b) Laser Power Output
c) Laser OK
d) Laser Enable

There is also a 5V 100mA output for the user to use as required. Details of this connector can be found in section 4.1.4.

5. **Connect Digital Modulation Input (if required)**

If digital modulation is required, use a standard SMA cable to connect the digital modulation connector❼ on the Interlock Control Unit to a relevant signal generator. The default iFLEX-iRIS™ laser for operating with the Interlock Control Unit has an operating mode defined by the configuration code –D012; see section 9 for details of the different configuration codes of the iFLEX-iRIS™. This laser configuration has the digital modulation operation set to be Inverted (0V=100% output). Therefore, no signal needs to be applied to the digital modulation line to switch the laser on.

Consequently, if digital modulation is not required for operation, no connection needs to be made to this connector.

6. Connect Analogue Modulation Input (if required)

The default iFLEX-iRIS™ laser for operating with the Interlock Control Unit has an operating mode defined by the configuration code –D012; see section 9 for details of the different configuration codes of the iFLEX-iRIS™. This laser configuration has the Power Control Source set to Internal mode. In this mode, the output power of the laser can only be controlled through software commands; see section 6 for details. Consequently, the Analogue modulation line is effectively disabled.

If analogue modulation is required, use a standard SMA cable to connect the analogue modulation connector❻ on the Interlock Control Unit to a relevant signal generator; the limits of this control line are detailed in section 5.2. In order to use the analogue modulation connector, the Power Control Source must be changed to External mode. This can be done by using the software commands; see section 6 for details. Ensure that the following steps (7-10) in this section have been completed before applying power to the iFLEX-iRIS™. If using the Qioptiq supplied Graphical User Interface (see section 6.3 for details), ensure that the 'Analogue Modulation Input' radio button is selected. If using software commands through RS232 or USB interface, use command 28 to change the source of power control to external; see section 6.4.1 for details.

7. Connect a RS232 cable (if required)

If RS232 control is required, connect a standard RS232 DB9 to DB9 cable to the RS232 port to be able to make use of the iFLEX-iRIS™ PC software; see section 6 for details.

8. Installing the Fiber Optic Cable

If the purchased iFLEX-iRIS™ system has a kineFLEX optical fiber delivery, the Laser Head will be supplied with a kineMATIX® fiber manipulator which has been factory aligned to the specific kineFLEX® fiber shipped with the system. The kineFLEX® fiber is linearly polarized and is fitted with a polarization ring (P-Ring) to align the kineFLEX® polarization axis to that of the iFLEX-iRIS™ Laser Head; see Figure 3-5.

To install the fiber optic cable:-

a) First, remove the retaining screw **H** on the kineMATIX® manipulator; see Figure 3-4.
b) Next, press down the locking mechanism, **E**, on the manipulator (the locking mechanism is stiff by design to prevent accidental release of the fiber. Constant pressure needs to be applied to keep it pressed down)

c) Align the P-Ring bar, **J**, with the slot on the side of the kineMATIX® manipulator and then insert the kineFLEX® input coupler assembly into the manipulator whilst continuously pressing the locking mechanism, **E**, down.

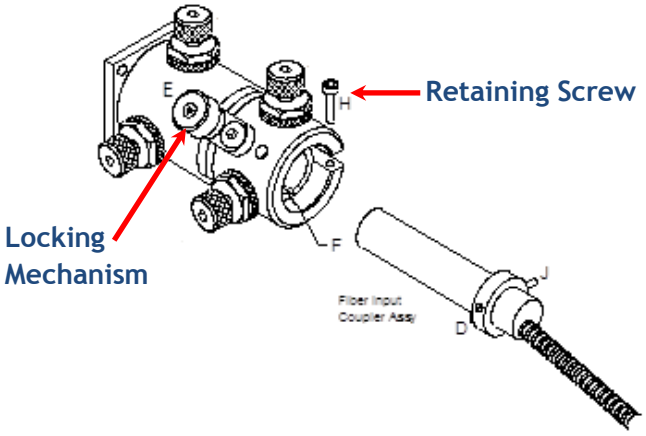

Figure 3-4: kineMATIX® manipulator with fiber input coupler

d) Apply a small rotation to the kineFLEX® fiber input coupler until the P-Ring notch fits into the kineMATIX® groove
e) Release the locking mechanism, **E**
f) Replace the retaining screw, **H**

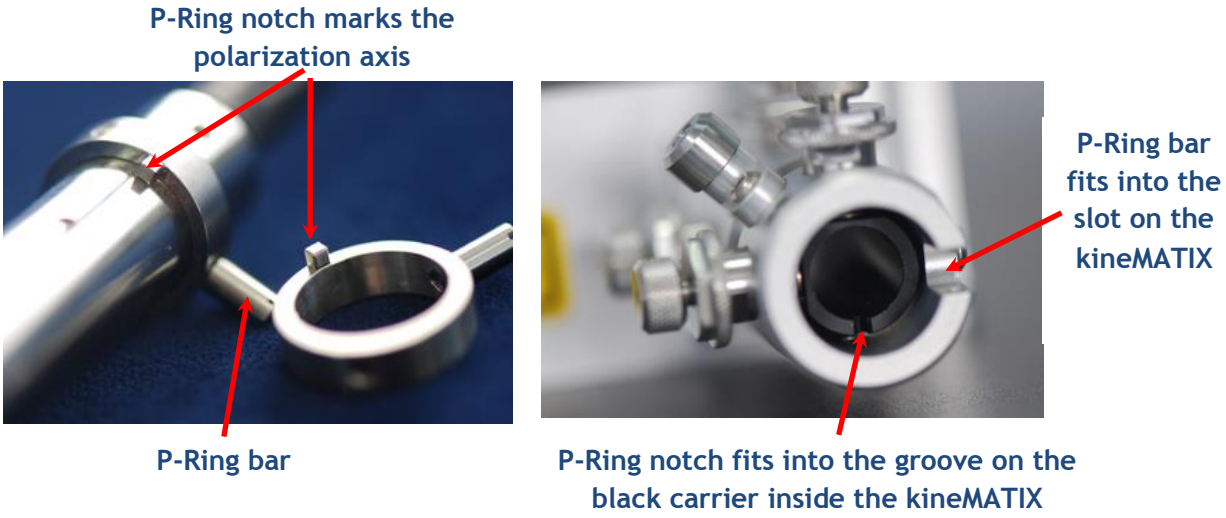

Figure 3-5: Identification of the optical fiber polarization alignment features

Warning!  If the kineMATIX® groove and P-Ring notch do not align, then the fiber will not fit properly into the kineMATIX® and the output power might be lower than expected.

Warning!  **Do not use excessive force whilst inserting the fiber input coupler tube into kineMATIX®.** Excessive force may cause damage to the carrier inside the kineMATIX®.

During the lifetime of the product it may be necessary to realign the optical fiber to the laser output. In this case, the full re-alignment procedure can be found in section 11.

9. Ensure Laser Output Routed Safely

If a free space (X0 or X2) iFLEX-iRIS™ is in use, ensure that the aperture of the laser housing is pointing in an appropriate direction to ensure a safe beam path once the laser is emitting.

If a fiber coupled iFLEX-iRIS™ laser is in use, ensure that the fiber is routed to maintain the minimum bend diameter (Ø50mm diameter) or greater and that the output delivery end of the fiber is held securely and pointing in a safe direction.

10. Connecting the Power Supply

Once all the electrical connections are secure and the output beam from either the Laser Head or kineFLEX® is routed safely, the power supply can be connected into the Interlock Control Unit via the Qioptiq PSU connector port. Only once all the previous steps have been completed can an IEC cable (C13) be plugged into the socket on the rear of the power supply and then connected to an AC mains outlet.

4 - ELECTRICAL CONNECTION

This section details the electrical connection and operation of the iFLEX-iRIS™.

4.1 Connectors and Indicators

4.1.1 Laser Control I/O Connector

The Laser Control I/O connector is a Micro sub D 15 way connector. The position of the connector and pin arrangement is shown below in Figure 4-1 .

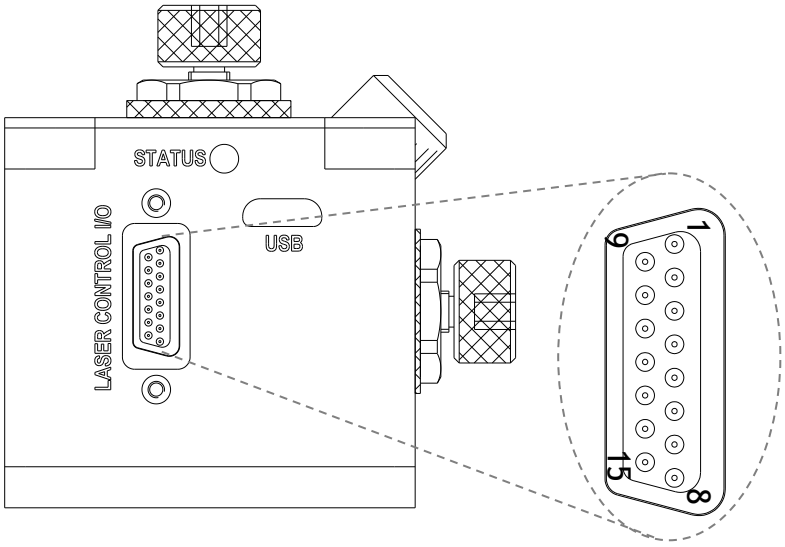

Figure 4-1: Location and pin out of the Laser Control I/O connector

A table detailing the pin assignments of the I/O connector is shown in Figure 4-1 below.

PIN	Function	Min (V)	Max (V)	Signal	Type	Operation	Description
1	Monitor Photodiode Output	0	5.0	Output	Analogue	Scale: 4V output = 100% power (Min. load impedance = 10k)	A voltage signal proportional to the output power of the laser
2	Operating Current Output	0	2.5	Output	Analogue	Scale: 5mV/mA (Min. load impedance = 10k)	A voltage proportional to the current being drawn by the laser diode
3	Analogue Modulation Control	0	5	Input	Analogue	5V = 100% output power[2]. 600Ω input impedance	Controls the output power level of the laser
4	Laser Enable[3]	0	5	Input	Digital	ON > 2V, OFF <0.8V. 100k input impedance	Enables the laser
5	Laser OK Signal	0	3.3	Output	Digital	3.3V = Laser OK. Source impedance 1k	Signal indicates the software has initialized & TEC block has stabilized.
6	RS232 TX	RS232 Levels		Output		RS232 Communications Transmit Line	This is connected to the receive line of the PC
7	Laser Supply Voltage	11	16	Input	Power	Up to 1A	Voltage supply for the laser
8	RS232 RX	RS232 Levels		Input		RS232 Communications Receive Line	This is connected to the transmit line of the PC
9	Reserved						
10	0V Return	0V			Power		Signal and power return path
11	0V Return	0V			Power		Signal and power return path
12	Digital Modulation Input[4]	0	5	Input	Digital	OFF > 2V ON < 0.8V 600Ω input impedance	Digital Modulation signal for the laser
13	0V Return	0V			Power		Signal and power return path
14	0V Return	0V			Power		Signal and power return path
15	0V Return	0V			Power		Signal and power return path

Table 4-1: Interface connector details with the default activation levels.

[2] On request by OEM users only, the laser can be configured to have 0V=100% output power, 5V = 0% output power (600Ω input impedance).
[3] On request by OEM users, the Pin operation can be reversed so that: OFF > 2V and ON < 0.8V.
[4] Pin operation can be reversed so that: ON > 2V and OFF < 0.8V. See section 6 Software Interface for details.

4.1.2 Status LED

The iFLEX-iRIS™ has a status LED on the end panel of the laser, next to the Laser Control I/O connector, which indicates power to the laser as well as laser emission.

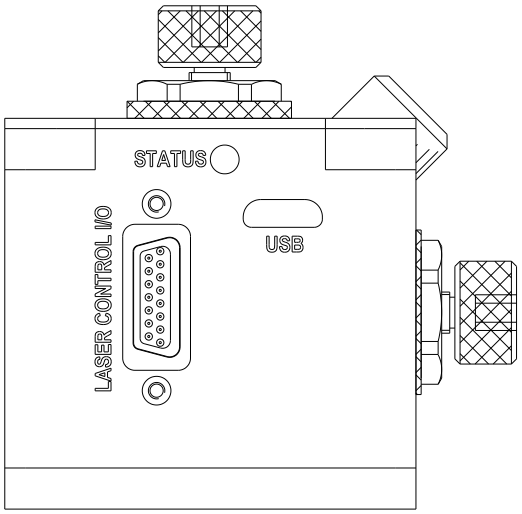

Figure 4-2: Position of the Status LED on the rear panel of the iFLEX-iRIS™.

A table detailing the status LED emission states for different laser operating conditions is listed in Table 4-2.

LED Emission	Operating Condition		
	Electrical Power	Internal Temperature	Laser Enable
OFF	OFF	OFF	OFF
Red+Blue (Purple) (ON for 4sec during bootloader scan)	Switch ON	NA	OFF
Blue Flashing	ON	STABILIZING	OFF
Blue	ON	LOCKED	OFF
Blue Flashing	ON	STABILIZING	ON
Red+Blue (Purple)	ON	LOCKED	ON

Table 4-2: LED Operating Modes

Danger! When the status LED is indicating PURPLE, laser emission from the laser is possible. HOWEVER, laser safety precautions should be taken before the power is connected to the laser.

4.1.3 USB Connector

The USB connector is located on the back of the iFLEX-iRIS™ and is a micro USB type B socket. The voltage levels are compatible with USB 2.0 specification and the pin connections are shown in the table below.

PIN	Connection
1	V_{BUS}
2	D-
3	D+
4	ID
5	GND
Connector case	Floating/Case

Table 4-3: USB pin and voltage assignments

4.1.4 Interlock Control Unit User Connections

The iFLEX iRIS™ Interlock Control Unit has a number of user interface connections. Refer to Figure 4-4 which outlines all the user connections available.

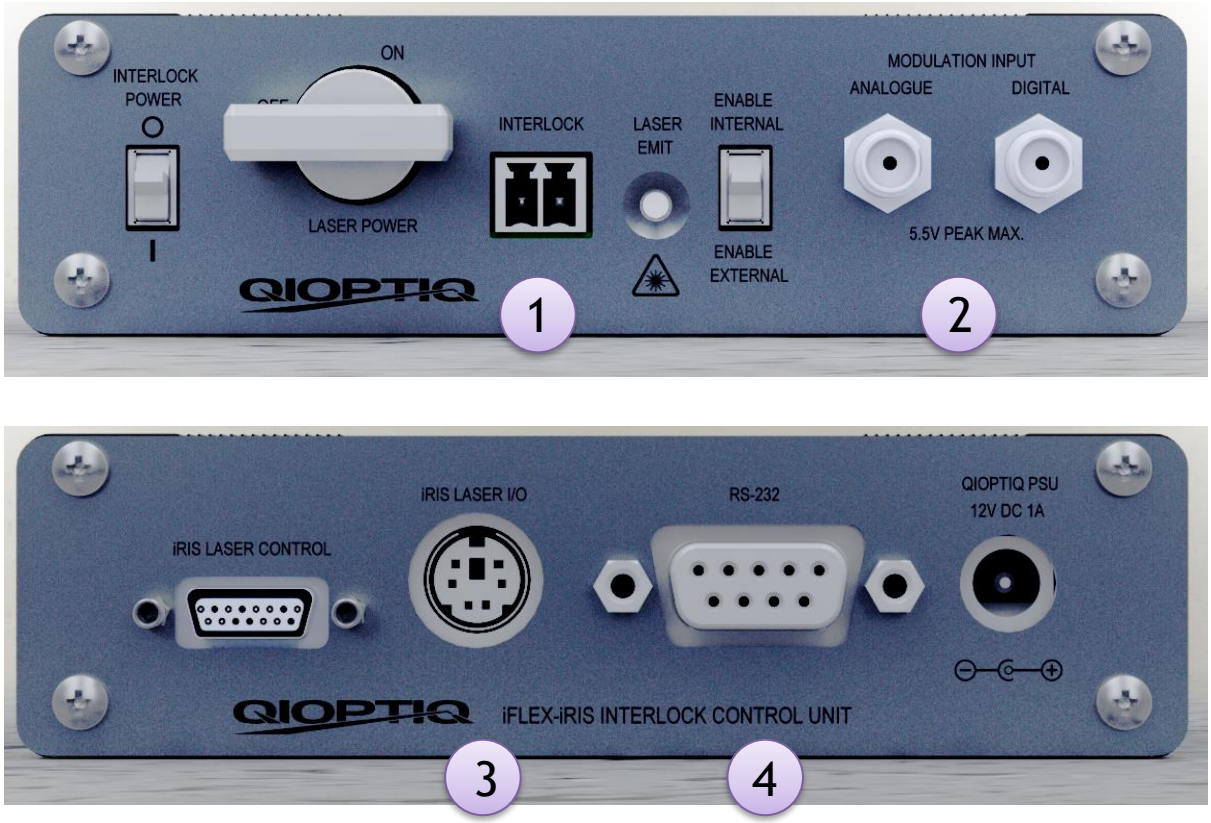

Figure 4-4: Interlock Control Unit User connections

1: INTERLOCK

- The open-circuit voltage between the interlock terminals is 12Vdc.
- The short-circuit current between the terminals is 100mA
- Never connect the output or the return terminal to ground/0V/chassis.
- Never connect any other voltage source to the output and return lines on the interlock.
- The interlock line is protected from shorting to ground with a self-resetting fuse.
    - Trip current 300mA.
    - Trip time max is 0.2 seconds at 1A.
    - In the event of a trip (either line shorting to ground) the interlock unit will disconnect/trip and the power to the laser will be removed (Status LED on laser = off, Emission Indicator on Interlock Control Unit = OFF). Disconnect the interlock plug and fault find the EXTERNAL wiring ensuring no shorts to ground. Reconnect interlock connection and initiate the normal power up.

2: MODULATION INPUTS

Both the Analogue and Digital Modulation inputs have SMA input connectors. SMA to BNC cables are readily available for users to ensure quality control signals. The SMA inputs are directly connected to the laser and the maximum input voltage on either input is 5.5V.

See Table 4-1: Interface connector details for further information on input impedance and signal level details.

3: iRIS Laser I/O

Details of the Mini DIN connector or outlined in Table 4-3 below. Mating part for the Mini DIN connector: MD-60 from CUI Inc.

Pin	Function	Min (V)	Max (V)	Signal	Type	Operation	Description
1	5V Output	5.0	5.0	Output	Analogue	Limited to 100mA loading	For use by user
2	Operating Current Output	0	2.5	Output	Analogue	Scale: 5mV/mA (Min. load impedance = 10k)	A voltage proportional to the current being drawn by the laser diode
3	Monitor Photodiode Output	0	5.0	Output	Analogue	Scale: 4V output = 100% power (Min. load impedance = 10k)	A voltage signal proportional to the output power of the laser
4	Laser OK Signal	0	3.3	Output	Digital	3.3V = Laser OK. Source impedance 1k	This signal indicates the software has initialized & TEC block has stabilized.
5	0V Return	0V		Power		Signal return path	
6	Laser Enable[5]	0	5	Input	Digital	ON > 2V, OFF < 0.8V. 100k input impedance	Enables the laser

Table 4-3: USER IO connector pinout details.

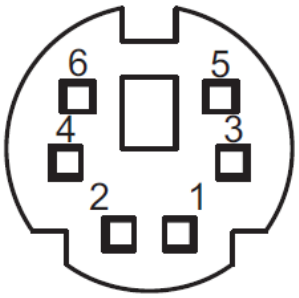

Figure 4-5: Pin assignment of USER IO connector (View from rear panel)

[5] On request by OEM users, the Pin operation can be reversed so that: >2V =OFF and < 0.8V = ON.

4: RS232

The RS232 interface makes use of only three connections.

Rx Data - Pin 3
TX Data - Pin 2
0V - Pin 5

Refer to Figure 4-6 below which outlines the internal loop connection as well as the external connections details.

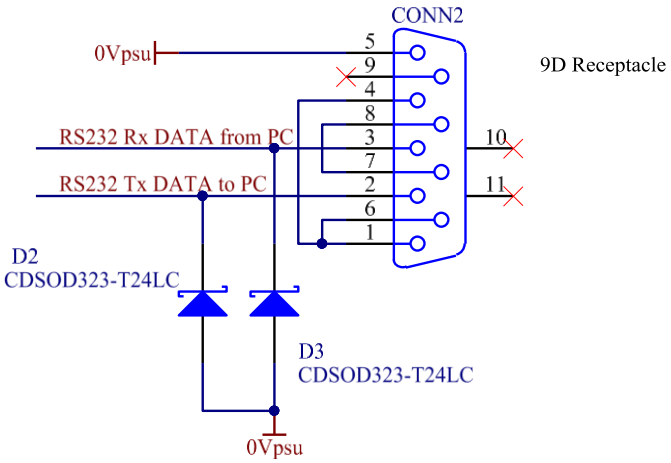

Figure 4-6: RS232 Connection

4.2 Power Supply Options

Qioptiq understands that each customer has different requirements for controlling their laser system and so has provided several different options to power and control the lasers. The main options for end users and OEM customers are detailed in the following sections.

Danger! Connecting any of these power supplies to the laser and applying AC power to the power supply could result in laser emission. Ensure that the output beam of the laser is routed safety before applying AC power to the power supply.

Danger! Ensure that a fused local mains plug to IEC connector (C13) is used to connect the power supply to the mains power.

USER:	CONTROL/PSU OPTION	NOTE
End User	015227	Interlock Control Unit with PSU.
OEM option 1	015208	12V Supply with breakout cable
OEM option 2	014986	12V only to the lasere

Table 4-4: Table detailing the power supply options (PSU). The system is ONLY CDRH compliant when using the Interlock Control Unit.

Alternatively, the laser can be purchased by OEM customers without a power supply. On request, Qioptiq can supply an adapter cable which converts the micro sub 15 way I/O connector to a 9-way sub D pin out arrangement; see adapter cable descriptions in section 4.2.5.

4.2.1 End User Power Supply (015216)

Power Supply 015216 has a standard 2/5mm DC jack output. Centre pin is +12V. This PSU is supplied with the Interlock Control Unit but can be purchased as a spare.

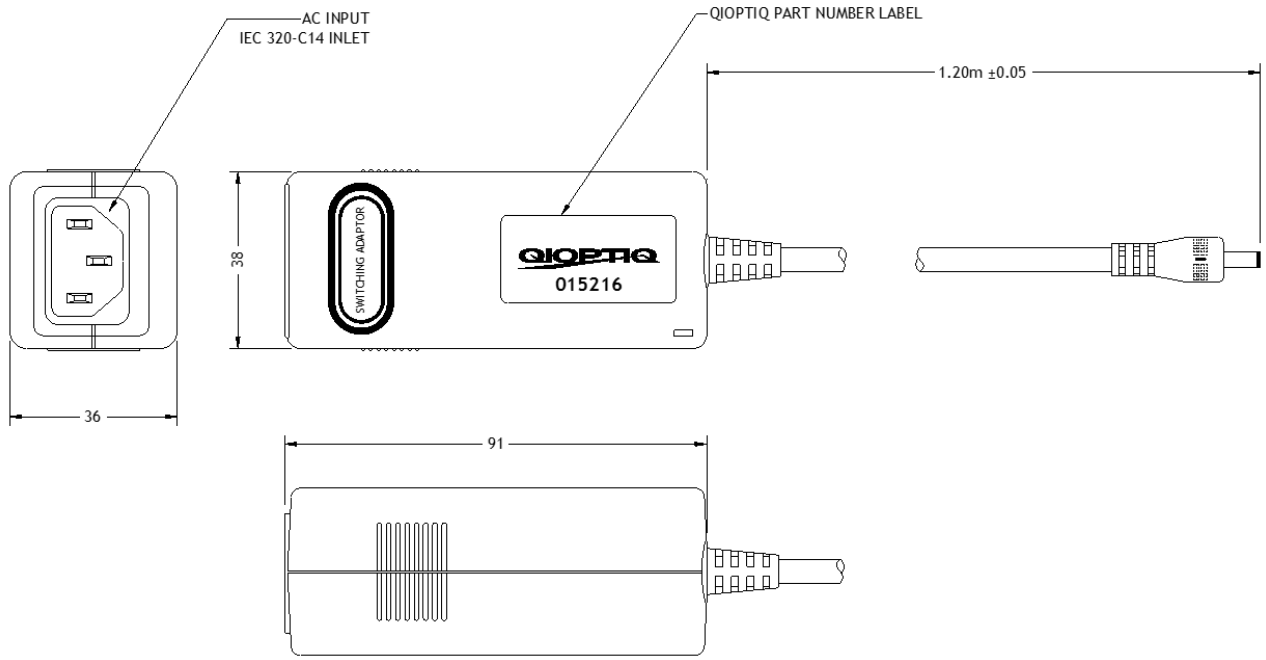

Figure 4-7: Power supply 015216

015216 Power Supply		
Dimensions	91 (L) x 38 (W) x 36 (H)	mm
Weight	0.17	kg

Table 4-5: Power Supply Physical Specifications

The electrical characteristics of the power supply are shown below.

Input		Output	
Input Voltage:	90-264Vac	Output Voltage:	12Vdc
Input Current:	0.3A	Output Current:	1.2A
Input Frequency:	47 – 63 Hz	Total Regulation:	±5%
		Max Output Power:	15W

Table 4-6: Power Supply Electrical Specifications

This PSU also forms the basis of the other power supply options that can be purchased with the iFLEX iRIS™.

4.2.2 OEM Power Supply with Breakout Cable (015208)

Power supply 015208 is a 015216 with a 15-way Micro D-type connector on the output which directly interfaces with the laser. It also has a breakout cable which comes out of the back of the 15-way Micro D-type connector and provides access to most of the laser control and monitoring lines; Table 4-7 provides details of cable colours and function. The breakout cable used is a 4 pair twisted cable. This is to provide the best possible interface for the Analogue Modulation. Only use the WHITE cable paired with the RED cable for the analogue modulation 0V reference, to reduce any noise coupling from the other signals.

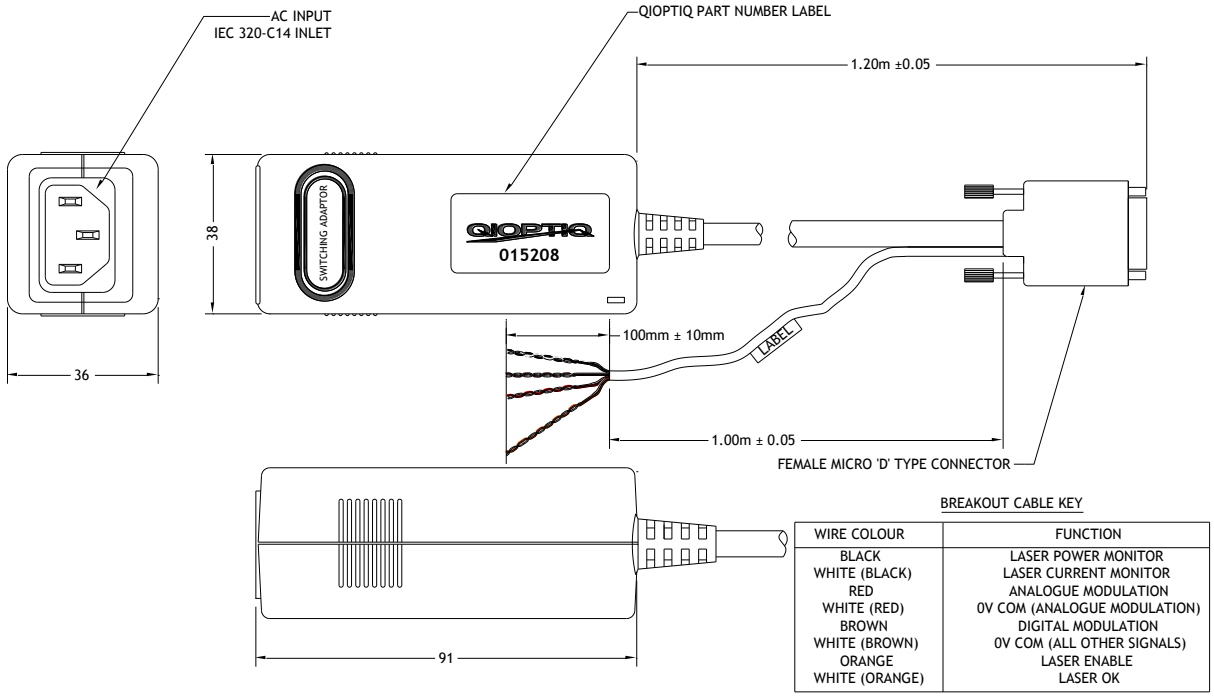

Figure 4-8: Power supply 015208

Wire Colour	Micro D Pin#	Function
Black	1	Laser Power Monitor
White(Black)	2	Laser Current Monitor
Orange	4	Laser Enable
White(Orange)	5	Laser OK
Red	3	Analogue Modulation Input
White(Red)	10	0V (Analogue Modulation Return)
Brown	12	Digital Modulation Input
White(Brown)	11	0V (All other signal return)

Table 4-7: PSU 015208 Breakout Cable description

Warning! Power supply 015208 is not designed to operate with Qioptiq's Interlock Control Unit 015227. It is the system integrator's responsibility to provide compliance with IEC/EN60825-1:2014 and 21 CFR1040 requirements.

Power supply 015208 will operate with any of the iFLEX-iRIS™ configuration codes; see section 9 for the different code options. Depending on the configuration code, laser enable, digital modulation and analogue modulation might need applying to the breakout cable to operate the laser. Ensure that you are familiar with the control requirements of the particular model that you have before applying power to the laser.

4.2.3 OEM Power Supply (014986)

Power supply 014986 is a 015216 with a 15-way Micro D-type connector on the output which directly interfaces with the laser. The Laser Enable Input (Pin 4) is hardwired to the Laser OK output (Pin 5) within the Micro D-Type connector so as soon as the AC power is supplied to the power supply (via AC input port, IEC320/C14), radiation could be emitted from the iFLEX-iRIS™.

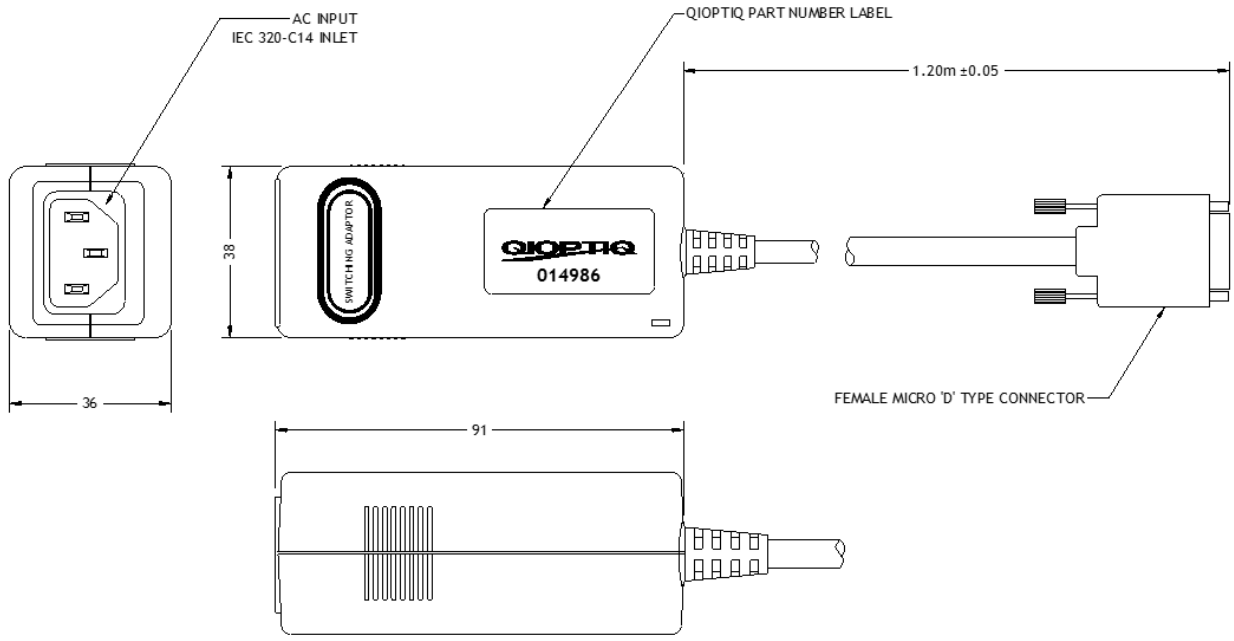

Figure 4-9: Power supply 014986

Warning! Power supply 014986 will only operator with lasers which have an order code ending in D012 or D013; see section 9 for explanation of order codes.

Warning! Power supply 014986 is not designed to operate with Qioptiq's Interlock Control Unit 015227. It is the system integrator's responsibility to provide compliance with IEC/EN60825-1:2014 and 21 CFR1040 requirements.

This power supply option will only operate with iFLEX iRIS™ lasers with part numbers which end in D012 or D013; see section 9 for explanation of order codes. The laser will only operate in CW mode since there is no access to the modulation lines. The output power of the laser can be controlled through the software commands; see section 6.

4.2.4 Power Supply Requirements for OEM customers

If an OEM customer decides not to use any of Qioptiq's power supply options then the following requirements MUST be adhered to which will ensure the correct performance and safety of the iFLEX iRIS™ laser.

The following is the minimum specification recommended for the 12V laser supply:

Parameter	Value	Comments
Output Voltage Range	11-16Vdc	
Max continuous current	1A	This is the max current it must supply for >1min
Output Ripple	<1%	The lower the better.
Load Regulation	4-5%	
Switching Frequency	>50kHz	For a switched PSU, the higher it is the less impact on optical noise.
Start-up time	3sec	Recommended to reduce inrush current when directly connected to laser.

Table 4-8: Specification for OEM laser supply.

4.2.4.1 Inrush Current Considerations:

When power is switched to the laser there is an initial inrush current. The level of this inrush current is dependent on how the 12V supply is applied to the laser. When a toggle switch is used to switch in 12V from a pre-energized power rail there is a large inrush current spike of approximately 7A. The inrush current trace is illustrated below in Figure 4-10.

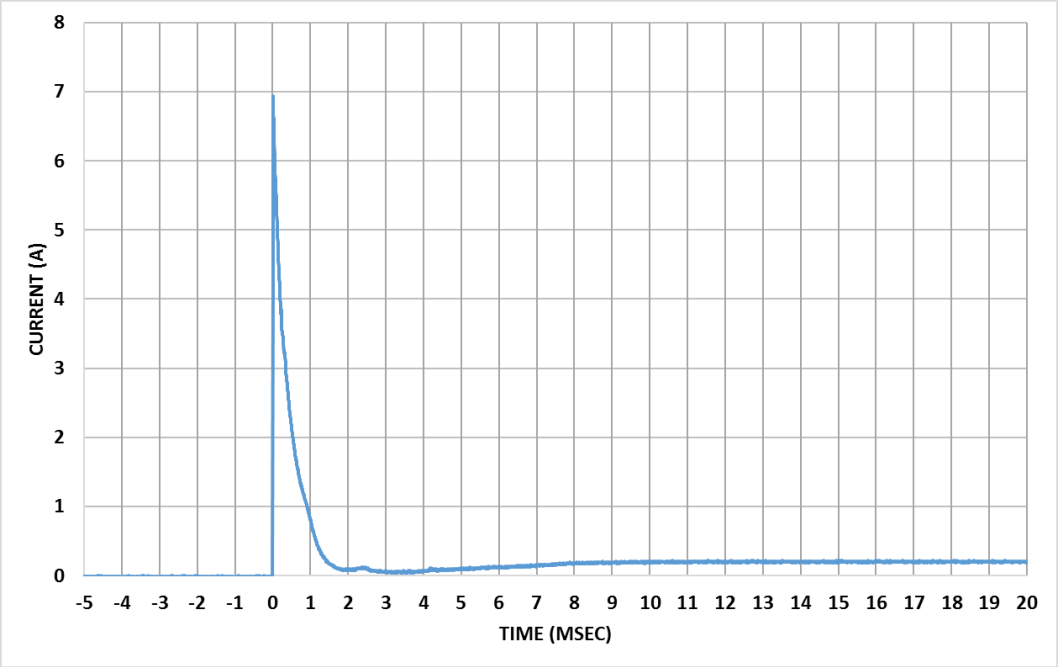

Figure 4-10: Direct Switch inrush current

This inrush current can be reduced by connecting suitable inductors into the power rails. These are generally large devices and cannot be incorporated into the laser. Figure 4-11 shows how a 47uH 35A wire wound toroid limits the inrush to 4.2A.

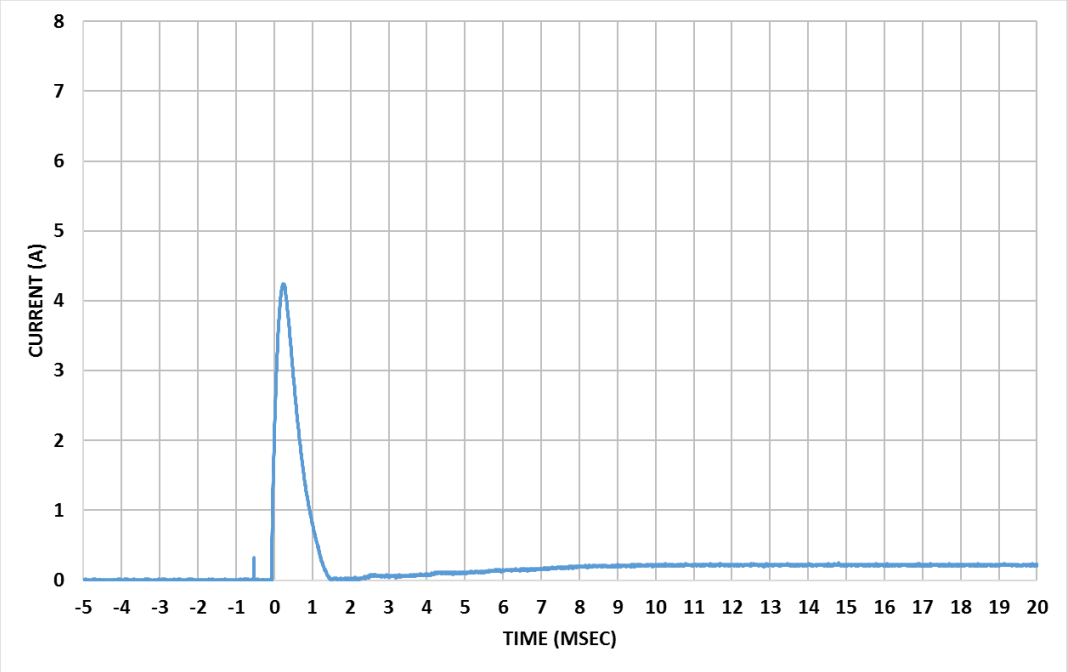

Figure 4-11: Inductor used to reduce inrush current

Another option to reduce the inrush current is to connect the laser directly to a supply and then switching the supply on. Below is an example where the OEM Supply 014986 is used.

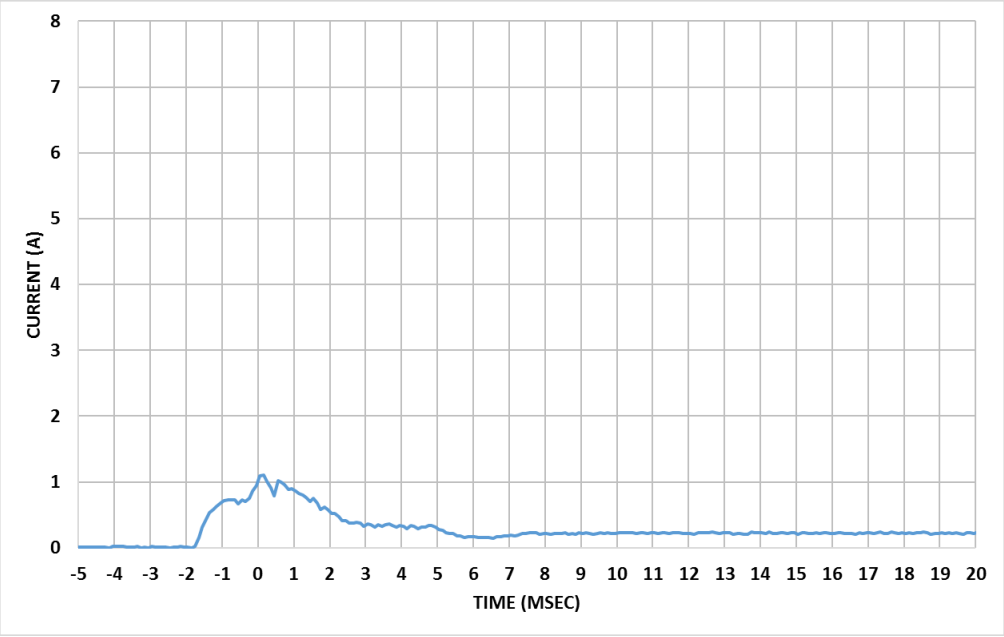

Figure 4-12: Reduced inrush current with PSU 014986

If the iFLEX-iRIS™ is integrated into a system it is the system engineers responsibility to be aware of these issues and design a suitable power supply arrangement.

4.2.5 Adapter Cables for iFLEX2000™ to iFLEX iRIS™

To ensure that the iFLEX-iRIS™ product range is backward compatible or interchangeable with the old iFLEX2000™ product range, Qioptiq can provide, on request, an adapter cable which converts the micro sub 15 way connector to the standard 9-way sub D pin out arrangement used on the iFLEX2000™. It is designed to match old PSU's already in use or existing cable looms in OEM customer equipment that cannot be changed.

There are two options available. One for CW(-NP) iFLEX2000™ lasers and one for Modulation (-A) iFLEX2000™ lasers making use of the SMC modulation input.

The adaptor cable, 014451, is to be used when replacing CW(-NP) iFLEX2000™ lasers with iFLEX-iRIS™ lasers.

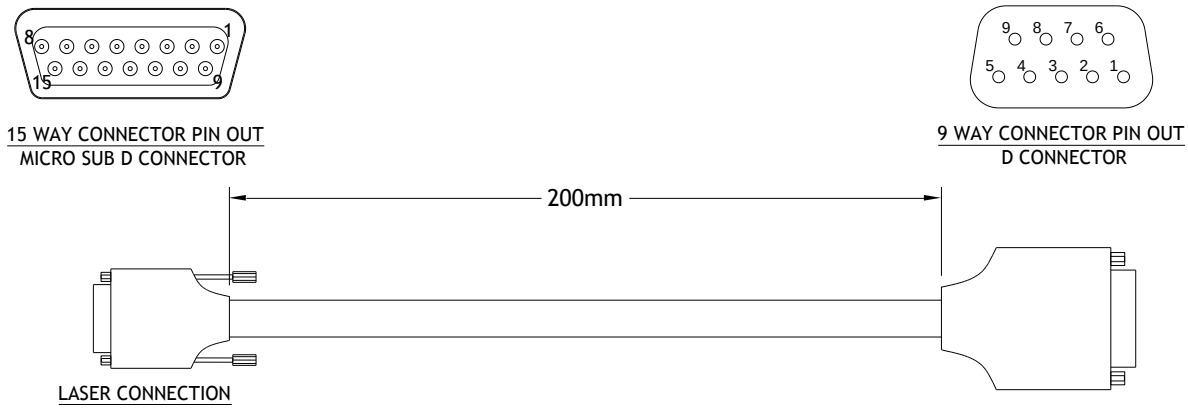

Figure 4-13: Adapter cable 014451 converting the micro sub D 15 –way connector to a 9-way D-type connector

15-way connector	9-way Connector	
Pin	**Pin**	**Function**
12	1	Digital Modulation Input[6]
7	2	Laser Supply Voltage
4	3	Laser Enable
5	4	Laser OK Signal
3	5	External Power Control
10	6	0V Signal Return
14	7	0V Laser Supply
2	8	Operating Current Output
1	9	Monitor Photodiode Output

Table 4-9: Pin to Pin connection table for adaptor cable 014451

[6] Laser will need to be configured to ensure Digital Modulation set to 5V = ON. The 5V form the 5V power supply rail will be applied to this input.

The adaptor cable, 015215, is to be used for replacing -A iFLEX2000™ (SMC input) modulation lasers with iFLEX-iRIS™ lasers.

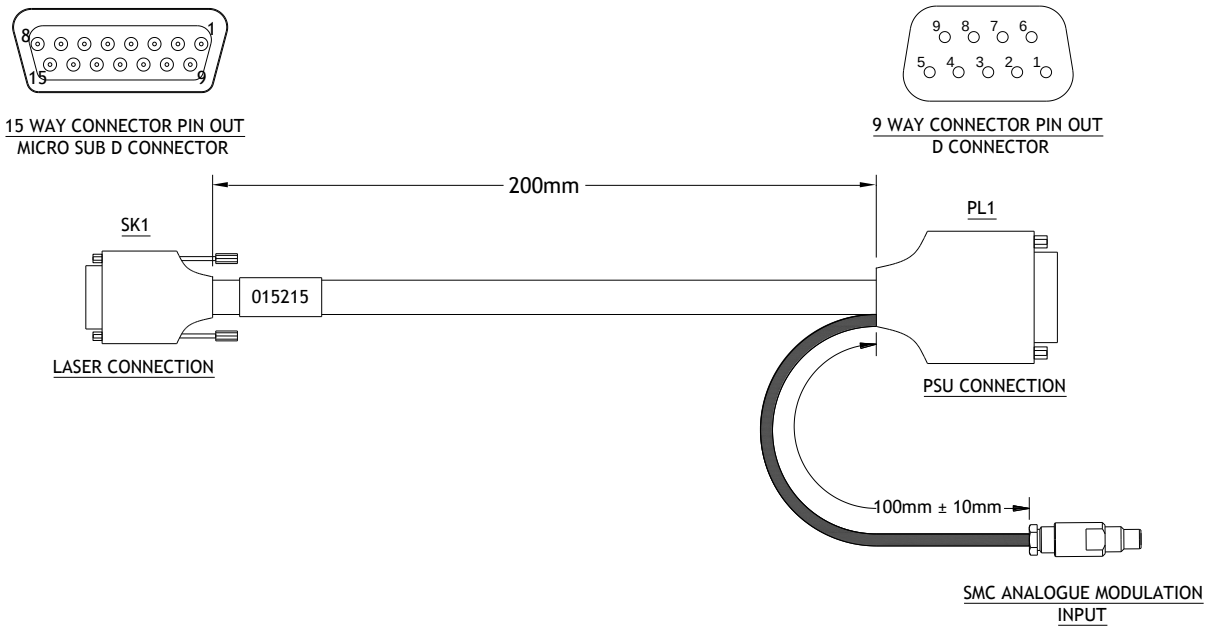

Figure 4-14: Adapter 015215 cable converting the micro sub D 15 –way connector to a 9-way D-type connector with SMC connector.

15-way connector	9-way Connector	
Pin	**Pin**	**Function**
12	1	Digital Modulation Input[7] (5V from the user will ensure laser turns ON)
7	2	Laser Supply Voltage (12V)
4	3	Laser Enable
5	4	Laser OK Signal
	5	NOT CONNECTED. No calibration Function on the iRIS)
10	6	0V Signal Return
14	7	0V Laser Supply
2	8	Operating Current Output
1	9	Monitor Photodiode Output
	SMC Connector	
3	Core	Analogue Modulation Input
15	Shield	0V Reference

Table 4-10: Pin to Pin connection table for adaptor cable 015215

[7] Laser will need to be configured to ensure Digital Modulation set to 5V = ON. The 5V form the 5V power supply rail will be applied to this input

5 - LASER OPERATION

Warning! Caution – use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

5.1 Introduction

The iFLEX-iRIS™ has two main control interface options, hardware control lines and software control. All hardware control and monitor lines are accessible via the rear interface connector, the details of which are covered in Table 4-1.

Software control is accessible via either the RS232 interface lines or the USB connector on the rear panel. Section 6 provides full details on the supplied interface software and commands.

The laser output power can be controlled from either the external Analogue Modulation input OR by Internal CW software control. The standard configuration is for the iFLEX-iRIS™ to be set to Internal CW software control with the power set to 100%. Consequently, when the laser is connected to the Interlock Control Unit and power is applied, the laser will emit without the need for external signals to be applied.

5.2 Performance of External Control Lines

The iFLEX-iRIS™ laser has three external control lines.

1- Laser Enable Line
2- Digital Modulation Line
3- Analogue Modulation Line

The physical details of these are covered in section 4.1. The operation of the inputs are as follows:

5.2.1 Laser Enable

This input enables or disables the laser emission. The standard product has this input configured as:
Low Logic (<0.8V) = OFF (Laser Disabled)
High Logic (>2.0V) = ON (Laser Enabled)
Lasers shipped with the Interlock Control Unit will be setup with the above logic operation.

For OEM customers, the logic of this input can be configured during manufacture to be:
Low Logic (<0.8V) = ON
High Logic (>2.0V) = OFF

The laser will only emit power if the TEC control circuitry is stabilized and internal software setup is complete. This can be established by monitoring the Laser OK signal on pin 5 of the I/O connector (See Table 4-1 for details). With the laser stabilized and the enable line switched on, the status LED on the iFLEX-iRIS™ Laser Head will be purple (both red and blue LEDs on together; see section 4.1.2).

5.2.2 Digital Modulation Line

This input modulates the laser output ON/OFF. The power level that the laser switches ON to is set by either Internal or External power control. The Digital Modulation input functions in **ALL** operating modes. Below is a representation of the Digital Modulation switching ON/OFF a sinusoidal Analogue Modulation input.

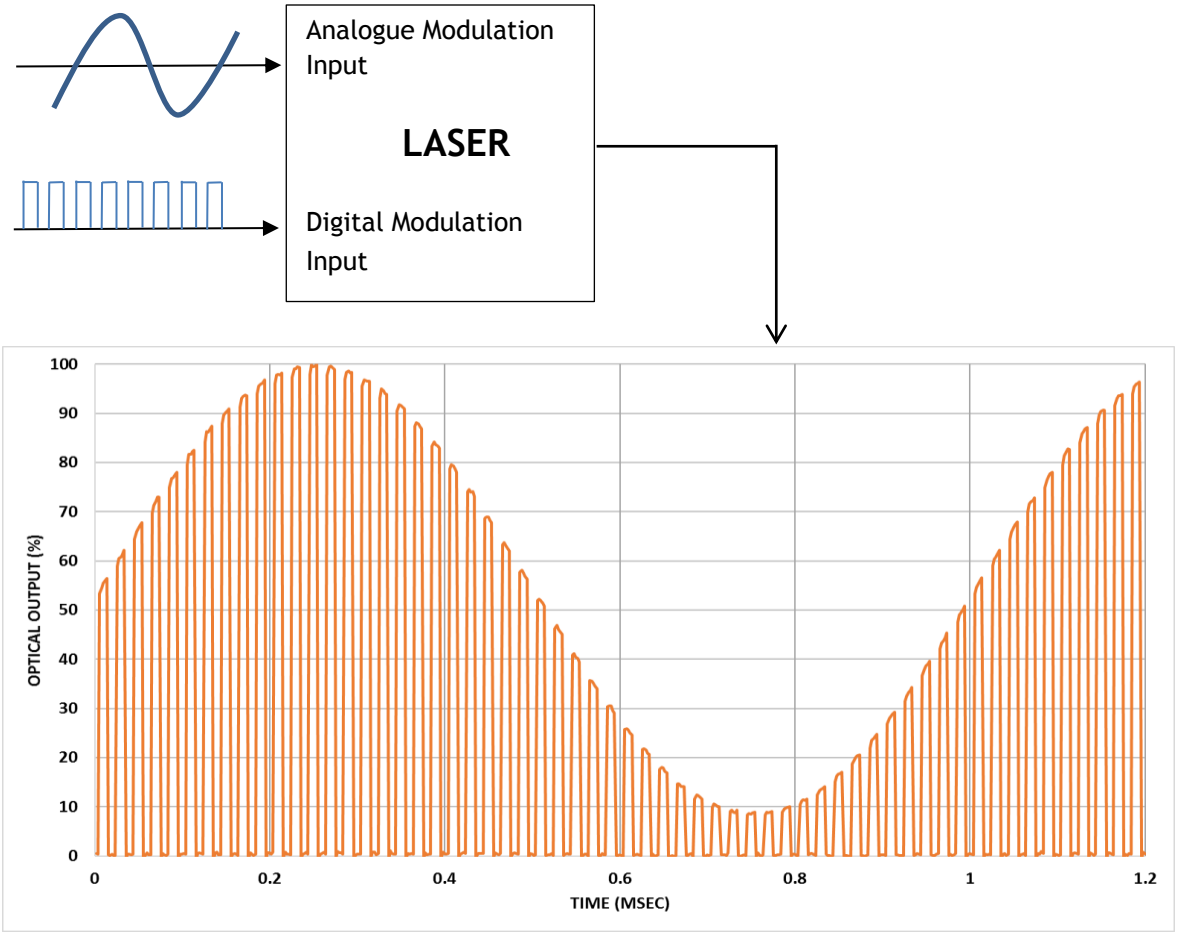

Figure 5-1: Example of 1KHz Analogue Power Control signal modulated with a 50KHz Digital Modulation signal

The Rise Time and Fall Time from ON→ OFF or OFF→ ON of the optical output will all be <100nsec.

The logic of this input can be configured during manufacture. The standard product has this input configured as:
Low Logic (<0.8V) = ON
High Logic (>2.0V) = OFF
Lasers shipped with the Interlock Control Unit will be setup with the above logic operation.

The logic of this input can be inverted using the graphical user interface (GUI) or appropriate software command to be:
Low Logic (<0.8V) = OFF
High Logic (>2.0V) = ON

See section 6 for details on software interfacing.

5.2.3 Analogue Modulation Line

When the laser is setup for external power control, the Analogue Modulation line adjusts the laser power. This is a very fast control with rise and fall times of <100nsec. As a result, the input BW on this input ranges between 5-10MHz depending on the laser wavelength and power. If the laser is setup for internal power control, the Analogue Modulation line is disabled and only CW laser emission is possible with the output power being adjustable through software commands only; see section 6.

Warning! Ensure that a very low noise control line is used. Any noise within the input bandwidth of the power control signal used by the customer will appear as noise on the optical output.

The Analogue Modulation Line is a fast power control allows a customer to adjust power levels quickly. The analogue input shown in Figure 5-1 is a slow AC signal. Figure 5-2 shows an example of switching output power from 12% to 85% power level using just the Analogue Modulation input.

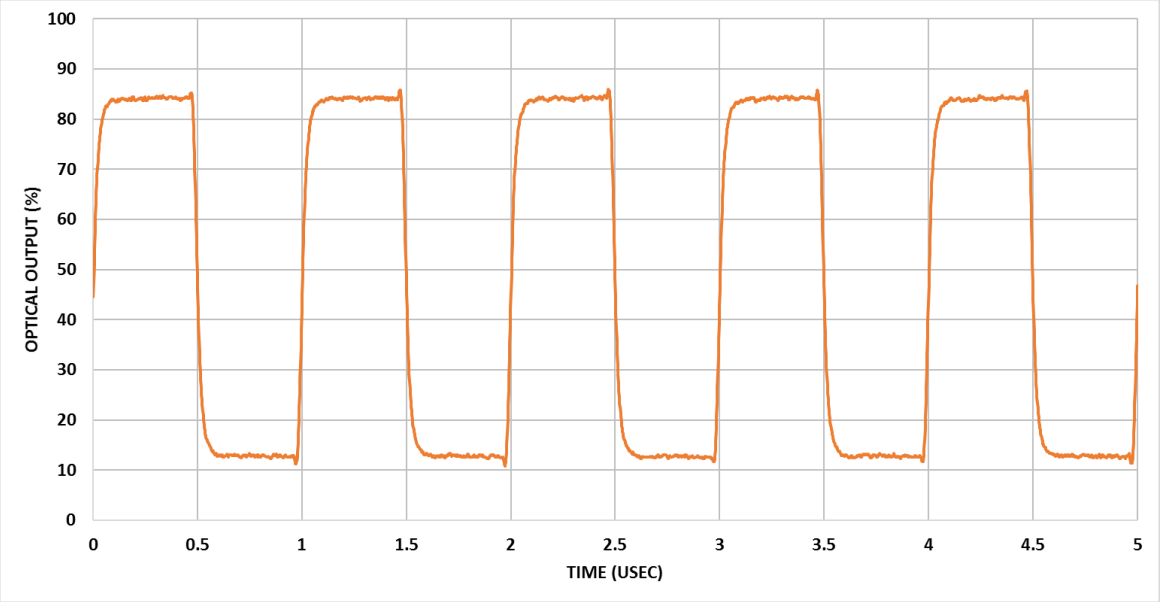

Figure 5-2: Example of a 1MHz Analogue Modulation input stepping output power from 12% to 85%. This shows repeatable fast power settle with minimal to zero % overshoot.

The logic of this input can be configured during manufacture. The standard product has this input configured as:
5V Input = 100% Optical Output
0V Input = 0% Optical Output
Lasers shipped with the Interlock Control Unit will be setup with the above logic operation **BUT** set to Internal Power Control and 100% output level.

For OEM customers the logic of this input can be configured during manufacture to be:
5V Input = 0% Optical Output
0V Input = 100% Optical Output

Figure 5-3 and Figure 5-4 show the percentage output power from the laser for different voltage levels on the Analogue Modulation line.

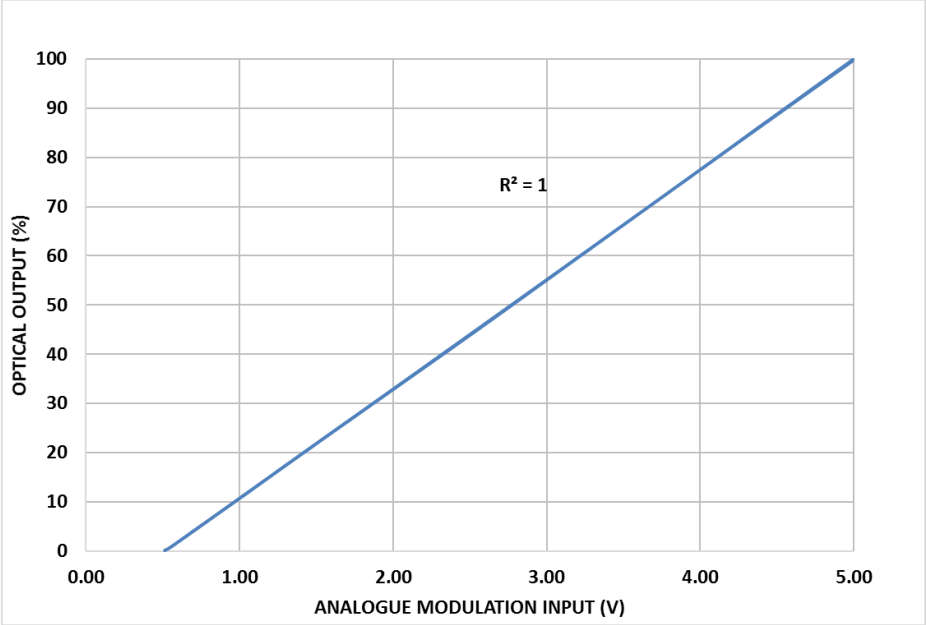

Figure 5-3: Typical Analogue Modulation Control line response from 1% to 100% power of the iFLEX- iRIS™ laser (default operation)

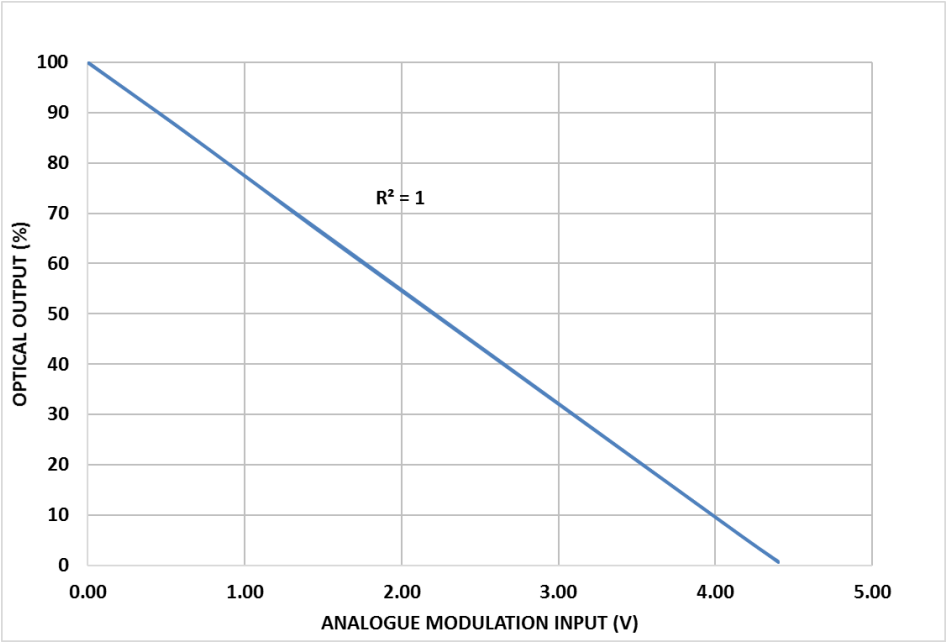

Figure 5-4: Typical Analogue Modulation Control line response from 1% to 100% power of the inverted control iFLEX-iRIS™ laser (OEM only available operation)

5.3 Power Control Source

The iFLEX-iRIS™ is configurable so that the output power of the laser can be controlled from either the Analogue Modulation Line (External Source) or via software commands (Internal Source).

With the laser in External Source mode, the output power of the laser is controlled via the voltage applied to the Analogue Modulation Line; see section 5.2.3 for operation. When the laser is in External mode, the laser output power cannot be adjusted through software commands.

When the laser is set to Internal Source mode, the output power of the laser is controlled via the software command set. If using the Qioptiq supplied Graphical User Interface (GUI), the output power can be controlled via the Laser Power Set slider on the left hand side of the screen; see section 6.3. If the user is using their own software interface, the output power can be controlled by using Command number 03; see section 6.4. When the laser is in Internal mode, the output power cannot be adjusted through the Analogue Modulation line and since there is no internal signal generator within the iFLEX-iRIS™, the laser can only provide CW laser emission.

The iFLEX-iRIS™ will be factory set to External or Internal power control source depending on the configuration code ordered. The configuration code at the end of the iFLEX-iRIS™ order code (-D0XX) defines how the Power Control source, Enable line, Digital Modulation line and Analogue Modulation line are configured; see section 9. However, it is possible for the user to change the Power Control source by using Software Command 28 or by selecting the relevant Radio Button under the title Power Ctrl Mode in the Qioptiq software GUI.

5.4 Initial Laser Setup Requirement

Before applying electrical power to the iFLEX-iRIS™, ensure that the following setup conditions are in place:-

- Ensure that the laser is securely mounted to an appropriate surface; see section 3 for installation details, heat sink and torque settings.
- If a free space iFLEX-iRIS™ laser is in use, ensure that the aperture of the laser housing is pointing in an appropriate direction to ensure a safe beam path once the laser is emitting.
- If a fiber coupled iFLEX-iRIS™ laser is in use, ensure that the fiber is routed to maintain the minimum bend diameter (Ø50mm diameter) or greater and that the output delivery end of the fiber is held securely and pointing in a safe direction.

- Ensure that appropriate measures are taken to avoid exposure to direct or reflected radiation.
- Ensure that the interlock circuitry is in place; see section 3.5.
- Ensure that the shutter is in the 'Closed' position – screw slot rotated to point at the '0'.

If using Qioptiq's Interlock Control Unit, ensure that all relevant connections are in place; see section 3.6 for connection details.

5.5 Operation of the iFLEX-iRIS™ using CDRH compliant system 015227

The following details the start-up and shutdown sequences for an iFLEX-iRIS™ laser using the CDRH compliant system 015227 which consists of Qioptiq's Interlock Control Unit (015218) and power supply (015216)

Danger! Following the start-up sequence will allow laser radiation to emit. Ensure that the laser is secured and the beam path of laser is known and safe. Only suitably trained and qualified personnel should be allowed to operate this equipment.

5.5.1 Start-up sequence

The following sequence details the startup sequence for iFLEX-iRIS™ lasers using 015227. See section 6.3 for further information on software control of the laser.

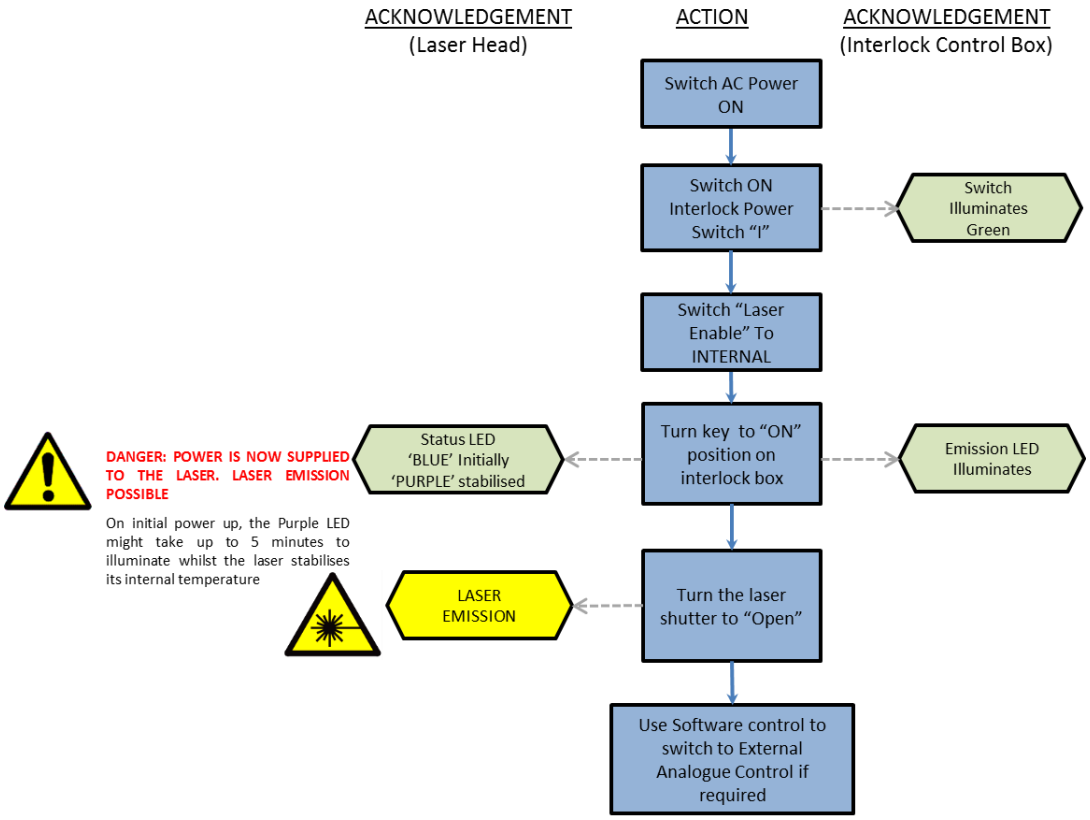

Figure 5-5: Recommended operational flow chart for the startup sequence of iFLEX-iRIS™ using Qioptiq's Interlock Control Unit and power supply combination 015227

As supplied, the Digital Modulation input will be operating in the Inverted Mode (<0.8V = ON) no signal needs to be applied to get laser emission. If the user wants to operate the Digital Modulation input in Normal Mode (>2V = ON) then the software GUI can be used to change the mode of operation.

5.5.2 Shutdown sequence

The following sequence details the shutdown sequence for iFLEX-iRIS™ lasers using 015227. See section 6.3 for further information on software control of the laser.

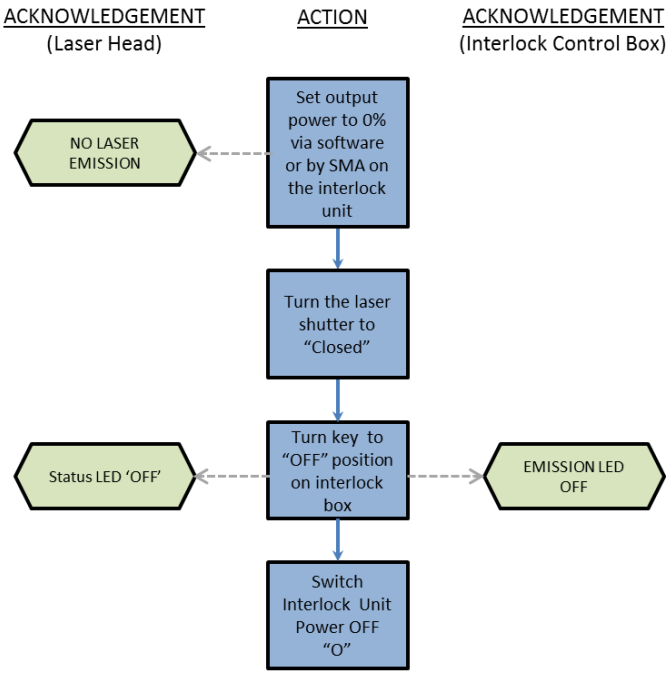

Figure 5-6: Recommended operational flow chart for the shutdown sequence of iFLEX-iRIS™ using Qioptiq's Interlock Control Unit and power supply combination 015227

5.6 Operation of the iFLEX-iRIS™ for OEM integrators

The following information details the general start-up and shutdown sequences for iFLEX-iRIS™ lasers with regards to OEM integrators.

5.6.1 Start-up sequence

The following sequence details the startup sequence for iFLEX-iRIS™ lasers for OEM integrators.

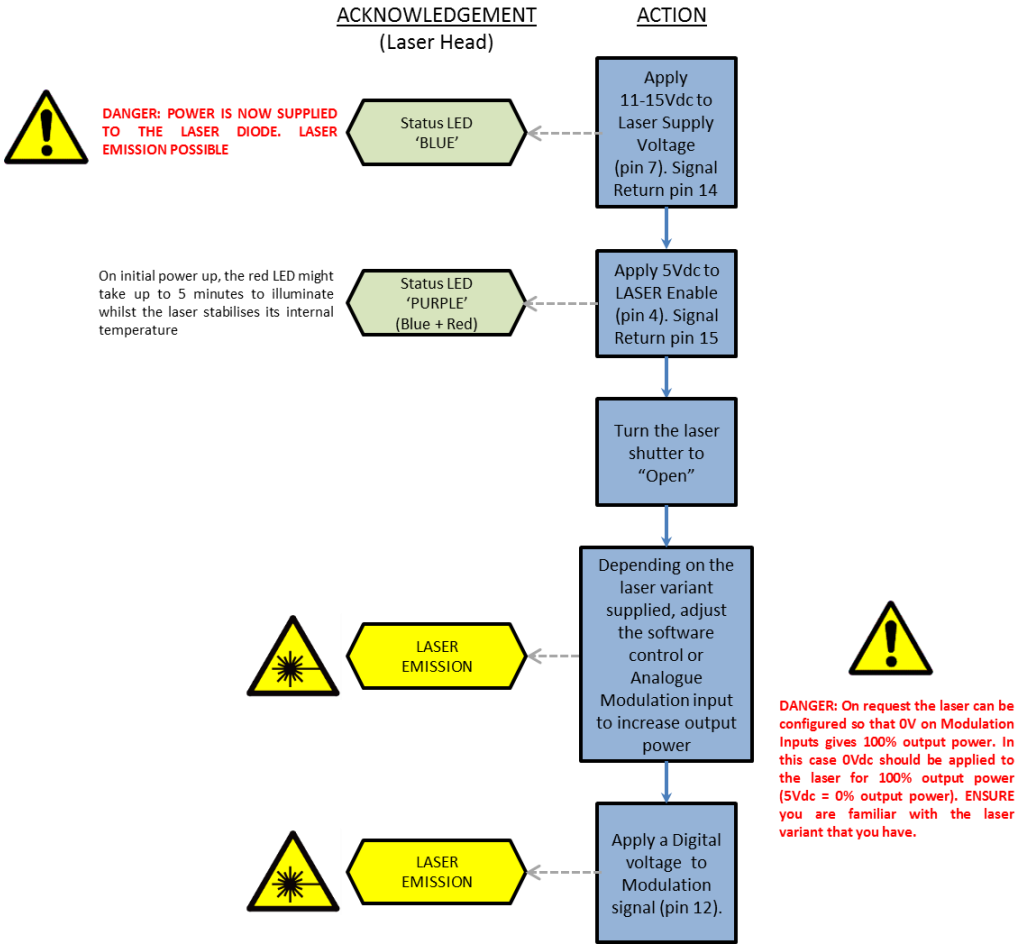

Figure 5-7: Recommended operational flow chart for the startup sequence of iFLEX-iRIS™ lasers for OEM integrators

5.6.2 Shutdown sequence

The following sequence details the shutdown sequence for iFLEX-iRIS™ lasers for OEM integrators.

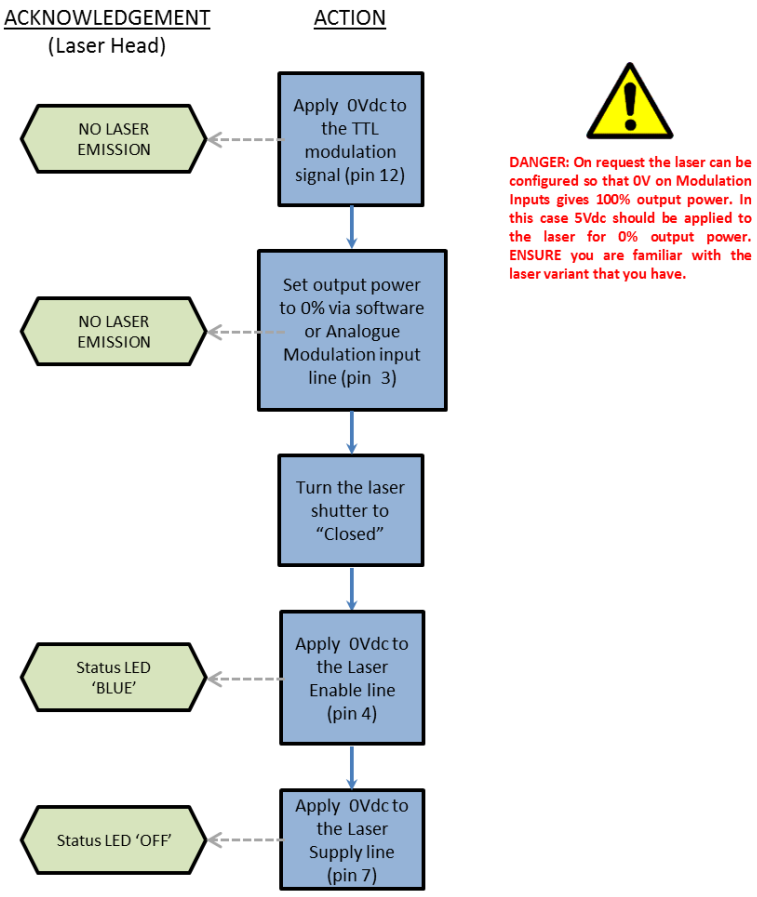

Figure 5-8: Recommended operational flow chart for the shutdown sequence of iFLEX-iRIS™ lasers for OEM integrators

6 – SOFTWARE

This section details the USB & RS232 software interface of the iFLEX-iRIS™.

6.1 Disclaimer

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6.2 Introduction

The iFLEX-iRIS™ USB interface is a USB CDC (Communication Device Class) type which emulates a RS-232 port (virtual port). It is USB connection compatible with both USB1.1 and USB 2.0 and is set as an USB Device (Peripheral/slave). As a result, the same command protocol and command set can be used over both the USB and RS232 hardware interfaces.

NB: *On first use of the laser, refer to Appendix B: Installing Drivers and Software, for details on software driver installation.*

Qioptiq have developed a basic graphical user interface (GUI) to allow the user to access most of the features and information available via the serial interfaces. The first part of this section details how to use this GUI.

The second part of this section provides details on the command protocol and the command set used. This can be accessed using a “hyper-terminal“ style GUI. This is to allow the user to create their own interface if required.

6.2.1 Minimum System Requirements

For the GUI to function, the following are the minimum PC requirements:

- CPU: Intel® I3
- System RAM: 2GB
- Operating System (32 or 64 bit) with 4.6 .NET framework or above.
  - Windows 7®
  - Windows 10®
- USB Port (2.0) port
- **NB: Legacy Direct RS232 ports not supported by the GUI.**
- USB to RS232 converter (Recommend FTDI part UC232R-10)

The CDC drivers will install on a Windows XP® machine but the GUI will not run. The user can make use of a generic terminal program to send and receive commands to the laser using the commands listed in section 6.4. This form of interface can also be used for legacy RS232 ports.

6.3 Graphical User Interface (GUI)

The GUI is a basic Windows program and consists of two viewing tabs. The first tab contains the most important information for the user on the laser operation and status. The second tab contains generic laser information.

NB: The information contained in the following sections is accurate for the issue of GUI: Version 1.0.0. This is subject to change. For the latest GUI release visit: www.qioptiq.com and navigate to the iFLEX-iRIS™ pages.

6.3.1 GUI Screen 1

Below is a screen shot of the main interface view of the GUI.

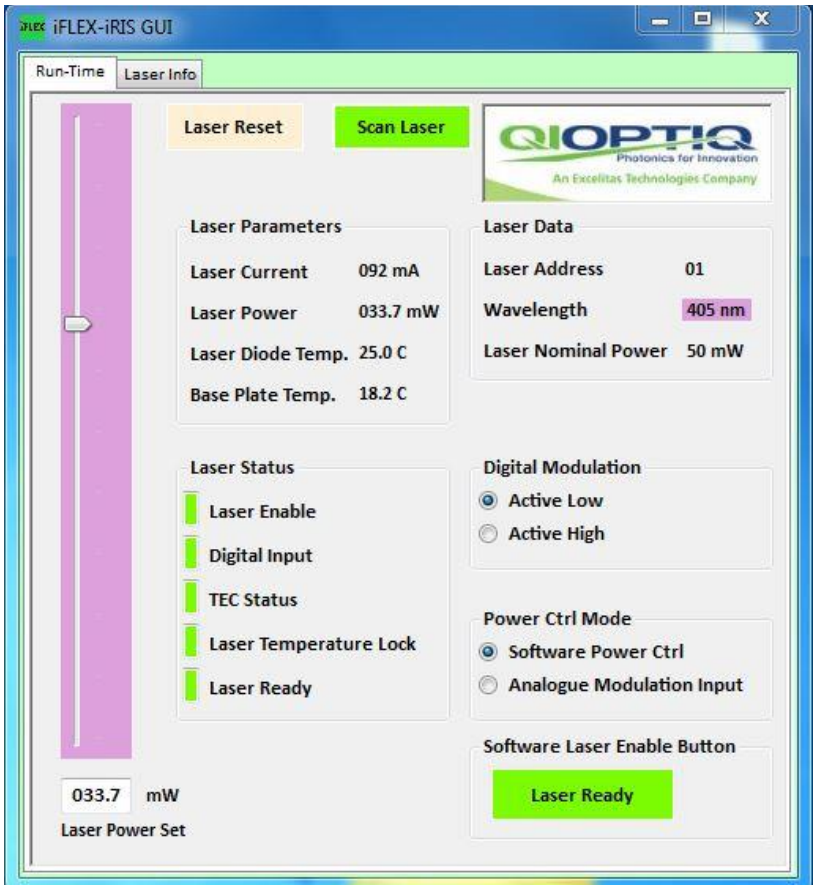

Figure 6-1: GUI Screen 1

6.3.1.1 Connecting to the laser

To start communications with the laser:

1) Ensure laser is powered and connected to the PC via either USB or RS232 to USB interface.
2) Wait for the laser Boot-loader start-up to complete.
3) Push the *"Scan Laser"* button
4) When a laser is found, this button will turn green and the Laser will start communicating with the GUI.
   (If a laser is not found immediately, try again. Windows can take up to a minute to fully initialize a COM port)

6.3.1.2 Screen 1 Details

Details of the information displayed are detailed in the table below:

Display:	Comment:
Software Laser Enable Button	This button enables and disables the laser from the GUI. GREEN = Laser Ready, RED = Laser OFF. When this button is in the "Laser Ready" state, laser emission is possible but depends on the status of the other control lines. This button is NOT a definitive laser status indicator and should not be relied upon as an indicator for laser emission.
Laser Reset	This resets the laser into a safe standby mode, i.e. Software Enable set to OFF, Power set to 0mW.
Laser Current	Displays the current through the laser diode (in mA). Accurate to ±2-4mA[8].
Laser Power	Displays the measured power from the internal photo detector in the laser. Calibrated in the factory (in mW). Accurate to ±0.2-0.5mW[9].
Laser Diode Temperature.	Displays the temperature of the laser diode (in °C) Accurate to ±2°C.
Base Plate Temperature	Displays the temperature of the laser body (in °C) Accurate to ±2°C.
Laser Enable	Displays the status of the Enable Line within the laser. GREEN = ON, RED = OFF
Digital Input	Displays the status of the Digital Modulation input. GREEN = ON, RED = OFF
TEC Status	Displays the status of an internal check on the temperature controller. GREEN = OK, RED = FAULT
Laser Temperature Lock	GREEN = Laser block temperature stable, RED = Laser block temperature still stabilizing.
Laser Ready	GREEN = All internal laser checks complete, RED = Laser fault
Digital Modulation	Radio button to change the polarity of operation of the Digital Modulation input. Active Low = <0.8V on Digital Modulation input = ON Active High = >2V on Digital Modulation input = ON
Power Ctrl Mode	Radio button to select the source of the laser power control Software Power Ctrl = Power controlled via GUI slider Analogue Modulation Input = Power controlled by the hardware Analogue Modulation input.
Slider	Adjust the laser output power when Power Ctrl Mode is set to Software. Colour coded to laser wavelength. Accurate to ±0.2-0.5mW[9].

[8] Accuracy is dependent on laser power range.

[9] Accuracy is dependent on laser power range. Laser calibration performed with calibrated power meters. Absolute power reading of power meters can vary by 5%.

Laser Power Set	This is a text box that both displays the power set by the slider as well as allowing the user to input the required value. User can click on text box and enter power to one decimal point. Push “Enter” to set the power.

Table 6-1: Details of information displayed on GUI screen 1

NB: There is a possibility that the set power entered on the slider could differ from the reported power from the laser. The two features are calibrated separately from each other and so each will have their own error in accuracy.

6.3.2 GUI Screen 2

Below is a screen shot of the GUI screen 2.

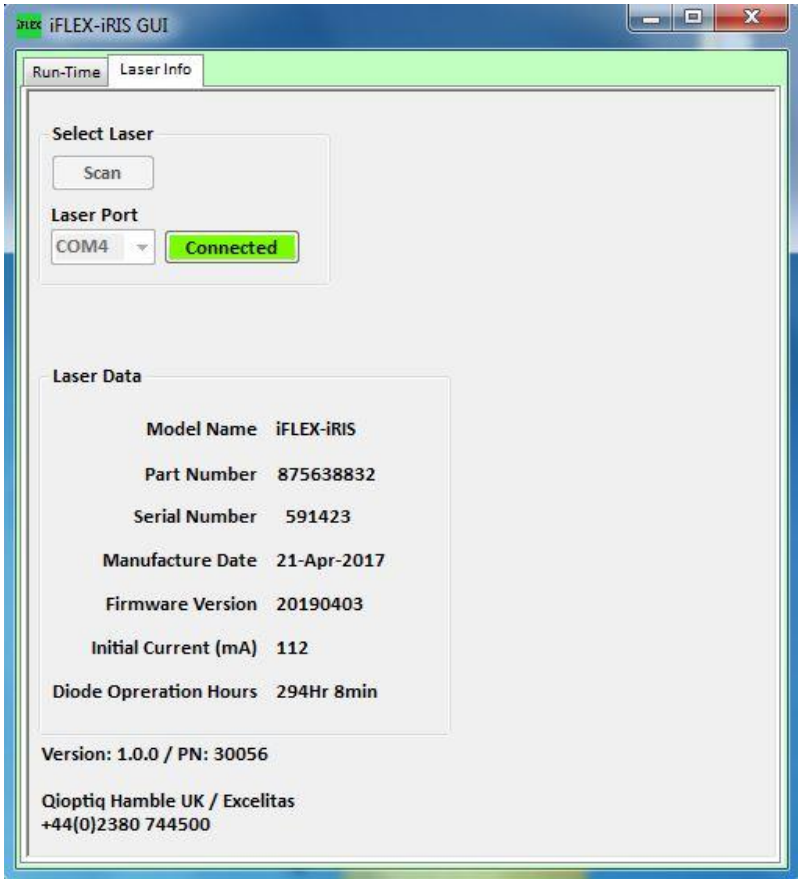

Figure 6-2: GUI Screen 2

6.3.2.1 Screen 2 Details

Display:	**Comment:**
Select Laser	This interface allows the user to manually select the COM Port to connect to.
Laser Data	Displays the laser parameters

Table 6-2: Details of information displayed on GUI screen 2

6.3.2.2 GUI Stability

This GUI has been developed as an aid only. At date of release there is one minor known bug.

BUG: Configuration: When using a Windows 7 operating system and the GUI is communicating with the laser. If the USB cable is disconnected windows displays an error message and closes the GUI.
The same problem occurs when the GUI is communicating to the laser and the laser is powered OFF.

SOLUTION: Do not power OFF the laser while the GUI is connected. Do not to remove the USB cable while the GUI is communicating with the laser.

6.4 Host Communication Structure

6.4.1 Command Protocol

The serial communication between the host and device (laser) is either via USB based on RS-232 emulation, or a dedicated RS232 interface.
The serial port settings are:-

115200 Baud Rate
8 Bits data size
No Parity
No Handshake

Table 6-3: RS232 Host communication settings

The communication protocol makes use of ASCII characters transmitted over the USB/COM connection. This can allow communication from a basic terminal if required for test and setup if needed.
Each communication packet will consist of the following construction:

Start Byte	Unit Address	Command	Data/Response	Terminator
Defines the start of a packet: # ASCII: 0x23 DATA LENGTH: 1 Byte	Unit Address: 01-99 DATA LENGTH: 2 Bytes	Command Number: 01-99 DATA LENGTH: 2 Bytes	Contains data to set the parameter, contains the requested data or echo back confirmation of data set. DATA LENGTH: 0-16 Bytes	Packet terminator is carriage return + line feed. (CRLF) ASCII: 0x0D0A DATA LENGTH: 2 Bytes

Table 6-4: Serial Protocol Table

Information flow:

1. User/Host will issue a packet with start byte, address, command and data if relevant.
2. Device Laser will respond with an echo back of parameter and either requested data or confirmation of parameter set point.

The start byte is used to ensure that bytes of data cannot be mistaken for an address and command.

An address is used to ensure multiple lasers connected to a controller cannot get their commands confused. The address will be pre-programmed into the unit. By default this will be 01[10].

6.4.2 iFLEX-iRIS™ Serial Command List

The following table lists the laser parameters that can be controlled or interrogated via the USB or RS232 ports as well as the command details for these parameters.

Command	Description	Read/ Write Data	Data parameter information
02	Enable/Disable laser	W	*Default set to* Enable (1). Disable = 0.
03	Set laser output power.[11]	W	Data range: 0-9999 in 1/10 of a mW. (435 = 43.5mW) (Absolute accuracy ±0.2-0.5mW) [12]
04	Laser Serial Number Query	R	Retrieve the serial number of the laser.
06	System Firmware Version Query	R	Retrieve the current firmware version. Data Format: BxxxVrVrBlBl B = Bootloader number Xxx = Firmware number (019) VrVr = Version BlBl = Build number
07	Base plate Temperature	R	Data Range: 0000 - 0999 = 1/10 Deg. C (230 = 23.0ºC) (Accurate to ±2ºC)
08	System Wavelength Query	R	Retrieve laser's wavelength (nanometers) Data Range: 0000 - 9999
12	Set Laser Address (EEPROM)	W	01-99
14	Laser Status Query	R	Retrieve status bits on laser. Returned data is an 8 bit byte: Bit 0 = For Engineering Use Bit 1 = For Engineering Use Bit 2 = Baseplate Temp Error (1 = Baseplate temp > 50°C) Bit 3 = Laser Block Temp Error (1 = Laser block not stable) Bit 4 = Laser Boot OK

[10] The Laser's unit address can be changed by the user with command 12
[11] Only operational when laser setup for Internal Power Control (Command 28). Actual allowed range is limited to the nominal power level.
[12] Reported power is the power from the Laser Head only, not the power delivered by an optical fiber, if attached. Accuracy is dependent on laser power range. Laser calibration performed with calibrated power meters. Absolute power reading of power meters can vary by 5%.

			Bit 5 = Laser Software Enable Status (1 = Software Enable is SET)
15	Laser Diode Temperature Query	R	Data Range: 0000-0999 = 1/10 Deg. C (230 = 23.0ºC) (Accurate to ±2ºC)
17	Invert the Digital Modulation Input	W	1 = Inverted Input (<0.8V = ON) 0 = Non-inverted input (>2V = ON)
20	Input Mode Status	R	Retrieve status bits on laser. Returned data is an 8 bit byte with the following association: Bit 0 = Digital Modulation Input Logic (1 = Inverted) Bit 1 = Enable Input Logic (1 = Inverted) Bit 2 = Analogue Modulation Logic (1 = Inverted) Bit 3-6 = Engineering Use Bit 7 = Analogue Power Control Source (1 = Internal Software Control Selected)
26	Retrieve Laser Diode operating time	R	Laser run time in minutes. Data Range: (0-99999999)
28	Select source of power control	W	1 = Internal Software CW power control 0 = External Analogue Modulation input active
40	Manufacture Date	R	Date format: YYYYMMDD
42	Laser current at setup for max power.	R	Range 0-9999mA. This is a fixed value programmed during setup.
43	Laser Model Name	R	Data is a string of 16 characters.
44	Laser Power	R	Retrieve laser's output power in 1/10mW. Accurate only in CW mode. Data Range: 0000 – 9999 (234 = 23.4mW) Accuracy of ±0.2-0.5mW[12].
45	Laser Part Number	R	Data is an 8 digit number. Data Range: (0-99999999)
47	Laser Nominal power query	R	Data Range: 0000-9999 = 1/10mW (0 to 999.9mW). This is a fixed value programmed during setup.
56	Laser Current Query	R	Retrieve laser current, accurate only in CW mode. (Accuracy of ±2-5mA) Data range: 0-9999 (99 = 99mA)
99	Laser Address Query	R	00-99

Table 6-5: List of Firmware Commands

Examples of the firmware commands and their returns (xx = laser's unit address which is default to 01 from factory)

Command	Command Sent	Return
Enable/Disable laser	#xx020001CRLF	#xx020001CRLF (laser enabled. To disable the laser = #xx020000CRLF.)
Set Laser Power	#xx030182CRLF	#xx030182CRLF. (Laser power set to 18.2mW)
Laser Diode Output Power Query	#xx440000CRLF	#xx440182CRLF (laser output measured is 18.2mW)
Laser Diode Output Current Query	#xx560000CRLF	#xx560067CRLF (laser current = 67mA)
Baseplate Temperature	#xx070000CRLF	#xx070251CRLF (TEC temperature = 25.1°C)
Laser Serial Number	#xx040000CRLF	#xx0400581245CRLF (Laser serial no = 00581245)
Laser Wavelength Query	#xx080000CRLF	#xx080642CRLF (Laser wavelength 642nm)
Set Laser Address	#00120078CRLF	#78120000CRLF (Laser address changed to 78)
Laser Operational Time	#xx260000CRLF	#00260600CRLF (Operational Time = 10hrs[13])
Laser Module nominal power query	#xx470000CRLF	#xx470200CRLF (Laser nominal output power 20.0mW)
Read Laser Address	#00990000CRLF	#xx990000CRLF (xx laser's unit address – default 01)

Table 6-6: Examples of the responses from a selection of the Firmware Commands

[13] The laser reports 1min intervals.

7 - CARE AND MAINTENANCE

7.1 iFLEX-iRIS™ Laser

The iFLEX-iRIS™ laser does not require any routine cleaning.

- The recommended operating base plate temperature is 10˚C to 40˚C. If this temperature is exceeded damage could occur to the laser.
- Ensure that a dew point less than 23˚C is maintained.
- Keep the laser free from dust and other contaminants.
- Do not use thermal heat sink grease between the Laser Head and the base plate that the laser is mounted on.

7.2 kineFLEX® (Fiber Delivery)

General Fiber Care:-

- Ensure that the minimum bend diameter of the fiber (Ø50mm diameter) is not exceeded.
- Ensure that no objects are placed or enter the fiber delivery tubes since this could damage the lenses used to collimate the input/output beam of the fiber.
- Always remove the protective metallic dust caps from the output of the fiber delivery cable before applying power to the laser.
- Do not trap the fiber delivery cable since this could break the fiber.
- Do not drop or knock the fiber delivery tubes on hard surface since this could damage the alignment of the lenses used to collimate the input/output of the fiber delivery cable.
- Always replace the protective metallic dust cap at the output of the fiber when it is not in use.

Extra care needs to be taken for fibers with connectorized outputs. Fiber optic connectors can be damaged by:-

- Airborne particles
- Humidity/moisture
- Oils from the human body
- Debris inside any mounting connectors that they plug into

Please comply with the following guidelines when handling the connectors.

- Ensure that the laser power is turned off and no laser radiation is being transmitted through the fiber before performing any maintenance on the connector.
- When connectors are disconnected, ensure that the supplied dust caps are fitted to protect the ends of the fiber.
- Before using the fiber, ensure that the connector tips and any used in-line connectors are clean.
- Clean in-line connectors with moisture-free compressed air before attaching to the fiber connector.

If using commercially available fiber optic cleaning kits, ensure that the kit utilizes:-

- Lint-free pads and swabs which do not deposit any threads or other materials on the connector as a result of their use.
- Undiluted isopropyl alcohol and that no residue is deposited as a result of the cleaning process.

8 - SERVICING

Do not attempt to perform any form of servicing or maintenance on the system. In the event of technical problems or for service and repair, contact Qioptiq at the contact numbers shown at the end of this manual.

9 - ORDER CODES

An explanation of the iFLEX-iRIS™ laser order code structures can be seen below for the Free Space and Fiber Coupled variants.

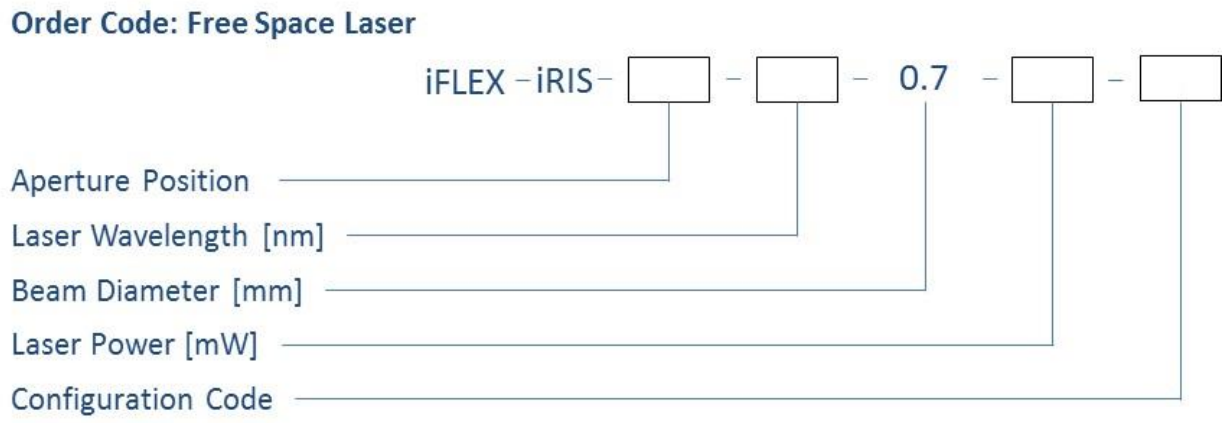

Figure 9-1: Order code structure for the iFLEX-iRIS™ free space lasers

The available output powers are defined by the wavelength of the laser required. Consequently, a table detailing the selectable laser performance is shown below.

Category	Options	Units
Aperture Position	X0 = centralized output beam X1 = centralized output beam with kineMATIX® manipulator fitted X2 = offset output beam	-
Wavelength	See Table 2-1 for available options	nm
Output Power (free space)	See Table 2-1 for available options	mW
Configuration Code	-Dxxx (see Tables below for numeric details)	-

Table 9-1: Selectable fields in the order code structure for the iFLEX-iRIS™ free space lasers

End Users that are ordering an Interlock Unit with their laser can ONLY use the following configuration code:

Configuration Code	Power Control Source	Enable Line	Digital Modulation	Analogue Modulation
D012	Internal	Norm	Inverted	Norm

Table 9-2: Table showing the configuration code of the D012 variant which pairs with the Interlock Control Unit

For OEM customers, there are four laser parameters that can affect the configuration code, these are:

- Power Control Source (This is adjustable by the user between Internal and External). This will be setup according to Table 9-3 in the factory.
- Enable Line (Norm → >2V = ON; Inverted <0.8V = ON)
- Digital Modulation (Norm → >2V = ON; Inverted <0.8V = ON)
- Analogue Modulation (Norm → 5V = 100% output; Inverted 0V = 100% output)

Configuration Code	Power Control Source	Enable Line	Digital Modulation	Analogue Modulation
D010	Internal	Norm	Norm	Norm
D011	Internal	Norm	Norm	Inverted
D013	Internal	Norm	Inverted	Inverted
D014	Internal	Inverted	Norm	Norm
D015	Internal	Inverted	Norm	Inverted
D016	Internal	Inverted	Inverted	Norm
D017	Internal	Inverted	Inverted	Inverted
D018	External	Norm	Norm	Norm
D019	External	Norm	Norm	Inverted
D020	External	Norm	Inverted	Norm
D021	External	Norm	Inverted	Inverted
D022	External	Inverted	Norm	Norm
D023	External	Inverted	Norm	Inverted
D024	External	Inverted	Inverted	Norm
D025	External	Inverted	Inverted	Inverted

Table 9-3 Laser Input Configuration Codes

For example, the code: iFLEX-iRIS-X0-405-0.7-50-D020 would represent a free space 405nm laser with a centralized 0.7mm output beam, an output power of 50mW, power control set to external, Analogue Modulation with 5V = 100% output, Enable Line operating in normal mode (>2V = ON) and Digital Modulation inverted (<0.8V = ON).

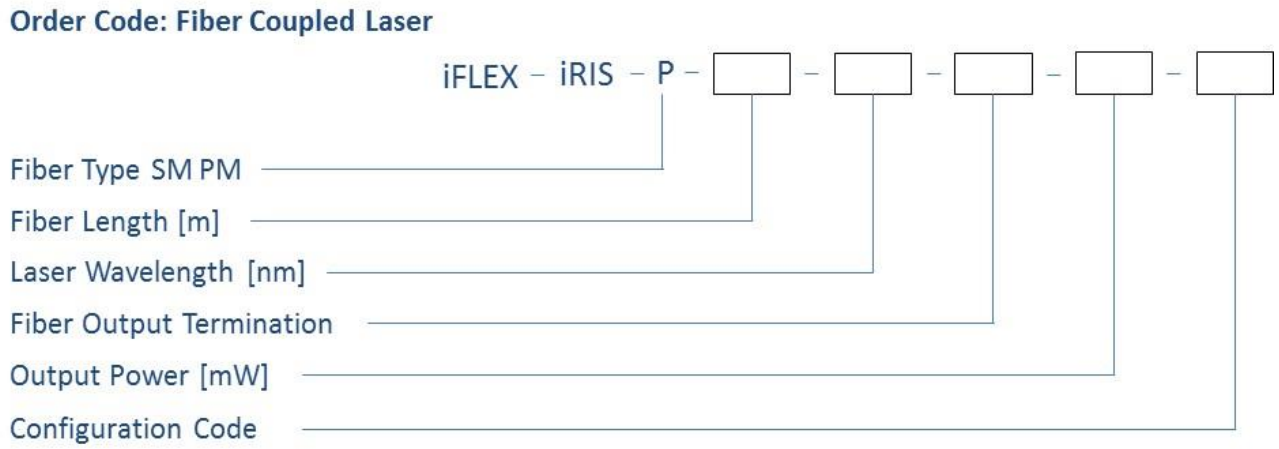

Figure 9-2: Order code structure for the iFLEX-iRIS™ fiber coupled lasers

The available output powers are defined by the wavelength of the laser required. Consequently, a table detailing the selectable laser performance is shown below.

Category	Options	Units
Fiber Length	1, 2, 3	m
Laser Wavelength	See Table 2-2 for available options	nm
Fiber Output Termination	0.7mm collimated, FCP, FCP8, APC	-
Output Power (Fiber)	See Table 2-2 for available options	mW
Configuration Code	Dxxx (see Table 9-3)	-

Table 9-4: Selectable fields in the order code structure for the iFLEX-iRIS™ fiber coupled lasers

Order codes for fiber coupled lasers do not contain a X1 option (centralized output beam with kineMATIX® manipulator fitted) as they have to be this by default.

For example, the code: iFLEX-iRIS-P-2-640-FCP8-20-D016 would represent fiber coupled 640nm laser with a 2m long delivery fiber. The fiber output connector would be a FCP8 and the optical power out of the fiber would be 20mW. The power control is set to external, Analogue Modulation with 5V = 100% output, Enable Line is set to inverted mode (<0.8V = ON) and Digital Modulation is also inverted (<0.8V = ON).

The selectable options for both the free space and fiber coupled lasers define the standard default iFLEX-iRIS™ platform options. Qioptiq understands that customers might have other requirements different from those defined above and in Table 2-1 and so custom lasers are potentially available. Please contact Qioptiq directly to discuss potential opportunities; see section 13 for contact details.

10 - TROUBLESHOOTING

In the event that you experience any problems with your iFLEX-iRIS™ system, refer to the table below for potential causes and solutions. If the problem is not solved or your exact problem is not detailed, please contact Qioptiq for help and advice; see section 13 for contact details.

Fault:	Possible Cause:	Remedy:
Laser Emit indicator not emitting on Safety Interlock Unit when key switch ON.	1. Mains power not switched ON. 2. Power supply not correctly connected to interlock unit. 3. Key switch on interlock not in ON position. 4. Safety interlock circuit not closed.	1. Check mains supply to laser interlock unit power supply. 2. Check power supply securely connected to safety interlock box 3. Turn the key switch on the interlock unit back OFF then ON. 4. Check the interlock circuit is closed circuit. Ensure all external safety circuits are closed.
No Power Indication (No Blue status indication)	1. For an end user: Safety interlock unit is not properly connected. 2. For an OEM user: Laser power supply is not properly connected. 3. Other.	1. Ensure the interface lead form the safety interlock box is securely fastened to the back of the laser. 2. Ensure the connector from the laser power supply is securely fastened to the back of the laser. 3. Contact Sales to return item.
No Emission ready indication (No “purple” status indication)	1. Laser Enable line is not active. 2. Laser has not completed its warm up period.	1. Check the signal into the Laser Enable IO pin is correct for the variant of laser; see section 9. 2. Check the level of the Laser OK output signal. If output is still low after the maximum warm up time (5min) contact your local sales department.
No laser emission	1. Either Digital and or Analogue Modulation control line is not set correctly. 2. Enable Line is not active.	1. Confirm the Modulation logic of the laser you have purchased.(See section 9 for options details) a. For Normal control, ensure Modulation input has 5V on the input signal. b. For Inverted control, ensure Modulation input has 0V on the input signal. 2. Check the signal into the Laser Enable IO pin is >2V. for Normal

		operation of <0.8V for inverted operation.
No LASER OK output signal	1. The unit has not completed its warm up period. 2. The incorrect heat sink has been fitted.	1. Allow unit 5min to warm up. 2. Ref to section 3.2 for correct heat sink ratings.
Analogue Modulation input not working	1. For an end user customer: The signal into the safety interlock box is not connected correctly. 2. For an OEM customer: The signal into the laser not connected correctly. 3. The signal level to the input is not in the correct range. 4. Power Control mode set to Internal Mode	1. Check the SMA cable used to interface with the safety interlock unit for correct operation. 2. Ensure a good connection is made with the Analogue input pin. Ref to 4.1.1 for pin-out of interface connector. 3. Ensure the signal to the Analogue input is in the correct range of 0-5V. 4. Using either the GUI or software commands, check that the laser is set to external mode; see section 6 for details.
Enable Line not working	1. Broken wire from user control unit. 2. Not connected to correct IO pin on safety interlock unit. 3. Not connected to correct IO pin on the laser interface connector. 4. Control signal is at the wrong level	1. Check continuity from the user control source to the safety interlock box. 2. Ensure control line connected to correct pin. Ref to 4.1.4 for safety interface unit pin-out. 3. Ensure control line connected to correct pin. Ref to 4.1.1 for laser interface pin-out. 4. Check the control level is in the correct range.
Laser current monitor signal is zero	1. Laser not emitting 2. Broken wire to user monitoring unit. 3. Not connected to correct IO pin on safety interlock unit. 4. Not connected to correct IO pin on the laser interface connector.	1. Ensure laser is setup correctly and enabled. See section 5.4 for details on laser setup. 2. Check continuity from the user monitoring unit to the safety interlock box. 3. Ensure monitoring line connected to correct pin. Ref to 4.1.4 for safety interface unit pin-out. 4. Ensure monitoring line connected to correct pin. Ref to 4.1.1 for laser interface pin-out.
Laser power monitor signal is zero	1. Laser not emitting 2. Broken wire to user monitoring unit. 3. Not connected to correct IO pin on safety interlock unit.	1. Ensure laser is setup correctly and enabled. See section 5.4 for details on laser setup.

	4. Not connected to correct IO pin on the laser interface connector.	2. Check continuity from the user monitoring unit to the safety interlock unit. 3. Ensure monitoring line connected to correct pin. Ref to 4.1.4 for safety interface unit pin-out. 4. Ensure monitoring line connected to correct pin. Ref to 4.1.1 for laser interface pin-out.
Laser overheating	1. Laser is not fitted with the correctly rated heat-sink. 2. Faulty temperature control.	1. Refer to section 3.2 for the correct heat-sink requirements at different ambient temperatures. 2. Monitor the Laser OK signal. If output is low after the 5min warm-up period then there is a possibility of a faulty temperature control. Make use of the user GUI to monitor the actual laser temperature.
Low optical output from free-space unit	1. Analogue Modulation signal not at the correct level. 2. Obstruction in the optical path. 3. Power meter not calibrated. 4. Power meter set to wrong wavelength.	1. Refer to “Analogue control not working” fault for diagnostic. 2. Clear the optical path of all obstructions. 3. Check calibration of power meter is within date. 4. Ensure correct wavelength has been selected on power meter.
Low optical output from fiber coupled unit.	1. Fiber is not correctly aligned in the kineMATIX. 2. Analogue Modulation signal not at the correct level. 3. Obstruction in the optical path. 4. Power meter not calibrated. 5. Power meter set to wrong wavelength.	1. Refer to section 11 on correct kineMATIX alignment procedure. 2. Refer to “Analogue control not working” fault for diagnostic. 3. Clear the optical path of all obstructions. 4. Check calibration of power meter is within date. 5. Ensure correct wavelength has been selected on power meter.
GUI Crashing with Windows 7 and direct USB connection	1. Known bug with Windows 7 operation. When USB cable is unplugged while GUI is connected the GUI will shut down.	1. Reopen GUI.

11 – APPENDIX A: Fiber Adjustment

If a fiber coupled iFLEX-iRIS™ has been purchased it will incorporate the kineFLEX® fiber delivery system. The following section details the alignment process.

Danger! The laser needs to be emitting to complete the following procedure. Ensure that all laser safety precautions are taken as highlighted in IEC60825.14 and ANSI Z136.1.

11.1 Fiber Manipulator Adjustment

The kineFLEX® features a high precision ultra-stable manipulator for coupling the fiber to the laser of your choice. Since the fiber has a pre-focused optical assembly, tilt of this assembly becomes translation in the focal plane and translation becomes tilt. Refer to Figure 11-1. As the fiber has a relatively large acceptance angle the system is less sensitive to translational motion provided by the manipulator. The manipulator thus requires only 2 degrees of freedom enabled by using a 4 point cradle design that is kinematic.

Principles of Operation

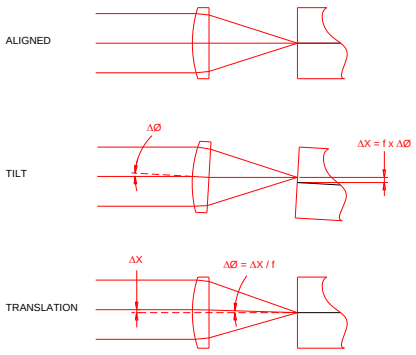

Figure 11-1: Principles of Operation

The manipulator is pre-aligned using an alignment tool with a pinhole aperture. The input fiber coupler and manipulator are keyway aligned such that the polarization alignment is instantaneous. Once optimized for coupling efficiency, locking mechanisms on the adjustment screws ensure long term stability of launch conditions. The kinematic design ensures maintenance of polarity on repeat connections.

Points of Note

Warning! To avoid damage to the end face of the fiber, the fiber manipulator alignment process must be performed at low powers, ideally less than 10mW. Ensure that adequate laser safety precautions are taken before proceeding.

Pre-alignment

1. Press locking mechanism **E** (see Figure 11-2) and insert alignment tool **G** with the pinhole (step) nearest to the laser. Release locking mechanism **E**.

The alignment tool is used to pre-position the adjusting screws relative to the position of the laser beam.

2. Align the tool by adjusting screws **A1** & **B1**, such that the pinhole aperture is causing minimal clipping of the beam.

Adjust each screw in turn to maximize the near field light transmitted through the pinhole.

3. Press locking mechanism **E**, reverse the tool and align screws **A2** & **B2**.

Repeat step 3 for these screws thus maximizing the far field transmitted light through the pin hole

4. Press locking mechanism **E**, remove and reverse the tool once more and repeat step 3 for adjusting screws **A1** & **B1**.

The mount is now pre-aligned and ready for the insertion of the fiber delivery system.

Launch Optimization

You will be required to monitor the transmitted power through the fiber.

5. Insert the fiber input coupler assembly into the carrier. **Important** - Ensure the polarizing key **D** locates into the keyway **F** on the fiber carrier. Monitor the transmitted light on the power meter.
6. Rapid adjustment is provided using screws **A1** & **B1**. *Tilt the fiber coupler using screws **A1** & **B1** in turn to achieve the highest transmission efficiency.* TIP – If low level light is transmitted along the fiber this is probably coupled into the cladding and only a minor adjustment should be required for the light to be coupled down the core at which moment the intensity from the output will become markedly brighter
7. Optimize the launch by ultra-fine adjustment using horizontal translation provided by screws **A1** & **A2.** Alternately turn screws **A1** & **A2** in the same direction in small steps whilst monitoring the output power. The fiber coupler can be translated in one direction axis by using this 'walking' motion and the point of maximum coupling efficiency detected.

8. Adjust screws **B1** & **B2** by vertical translation for final optimization. *Repeat step 8 for screws **B1** & **B2**.*

Fixing of launch

9. Lock down all adjustment screws. Tighten locking nuts C (@0.4-0.5Nm) whilst holding the adjustment screws in position using Allen wrench provided. Monitor the transmitted power whilst performing the lock-down process. It is important that this is done firmly as this will have a direct impact on the stability performance of the system over time. Torque Wrench (012130) is available for purchase on request.
10. Insert retaining screw H.

Qioptiq recommends fitting the retaining screw H to ensure that the fiber cannot accidentally be removed from the mount.

Repeat coupling

If the fiber is required to be repeatedly coupled and uncoupled from the laser, then only screw **H** needs to be removed before depressing locking mechanism **E**.

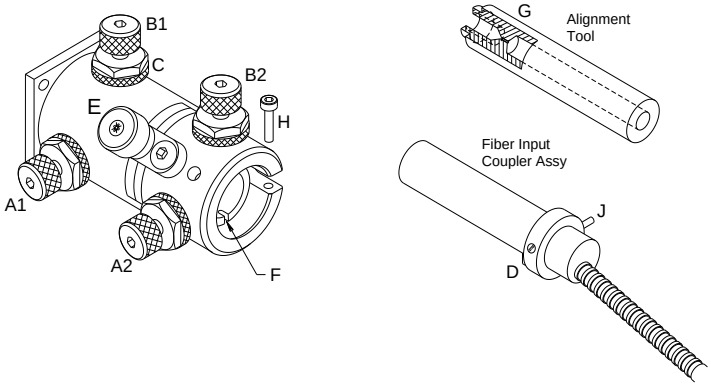

Figure 11-2: 3D exploded view of manipulator and fiber

12 Appendix B: Installing Drivers and Software

Depending on the version of windows installed on the host computer, drivers might need to be installed. If Windows does not detect the iFLEX-iRIS™ follow the instructions below.

12.1 Windows CDC drivers installation (host)

The following installation steps need to be followed to ensure that USB serial communication with the iFLEX-iRIS™ can be achieved. The USB drivers stack (API/DLL) for the host are supplied by Microchip™ and needs to be installed:

1) Connect the supplied USB stick and open.
2) Navigate to/open folder- *30-021 CDC Installer*
3) Run USBDriverInstaller.exe in CDC installer folder, this should install the correct *.inf file.
4) If the port is still not recognized, chose the correct *.inf file in the folder when prompted by Windows.

12.2 Laser Software Installation

For the latest version of the GUI please visit:
www.qioptiq.com , navigate to the iFLEX-iRIS™ pages and scroll down to find a link to the latest user GUI software.

With the correct drivers installed the user can open the GUI supplied on the USB stick and connect to the iFLEX-iRIS™ via the USB cable supplied.

1) Connect the supplied USB stick and open.
2) Copy the file *iFLEX_iRIS_GUI.exe* to the desktop or other suitable location on the host computer.
3) No further installation files are needed.
4) Run the program file *iFLEX_iRIS_GUI.exe*

12.3 Bootloader Functionality

The iFLEX-iRIS™ has been designed with a bootloader facility. This is to enable firmware updates to be applied to the laser by the customer, if required. Updating the laser firmware shall only be performed if instructed to do so by the manufacturer. The manufacturer will supply further information on how this is done.

13 - CONTACT DETAILS

Qioptiq Photonics Ltd.
Mitchell Point
Hamble
UK
S031 4RF

Technical Support

If you have any difficulty in following the enclosed instructions, or if you require any specific assistance then please call

US Toll Free: 1 800 898 6504

Europe: +44 23 8074 4500

Or e-mail

technical.support.ham@excelitas.com