Photonics for Innovation

An Excelitas Technologies Company

iFLEX-iRIS™

OPERATING MANUAL

PREFACE

The Qioptiq iFLEX-iRIS™ delivers a single wavelength either via one singlemode 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 Box. Contact Qioptiq technical support if you believe that your system may have developed a fault.

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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 your 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 Class3B 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 Electromagnetic Compatibility

The iFLEX-iRIS™ product range of lasers are compliant with the standards listed in the table below.

Type	*Description*	*General Standard*	*Referenced Standard*
Emission	Radiated Disturbance	EN 61326-1:2013	IEC 61326-1-2:2012
Immunity	Electrostatic Discharge	EN 61326-1:2013	IEC 61000-4-2:2008
	Radiated RF Interference		IEC 61000-4-3:2006

Table 1-1: Electromagnetic Compatibility compliance

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.

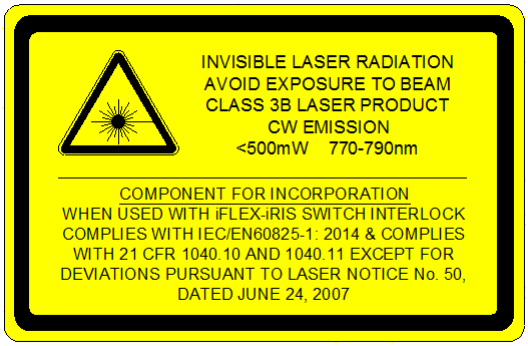
	**Laser Safety Warning Label:** Incorporates the elements required by IEC 60825-1:2014, specifically:- • Laser warning triangle • Laser product classification label • Maximum optical output parameters of the laser
	**Laser Aperture**

Table 1-2: Laser Safety Labels

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

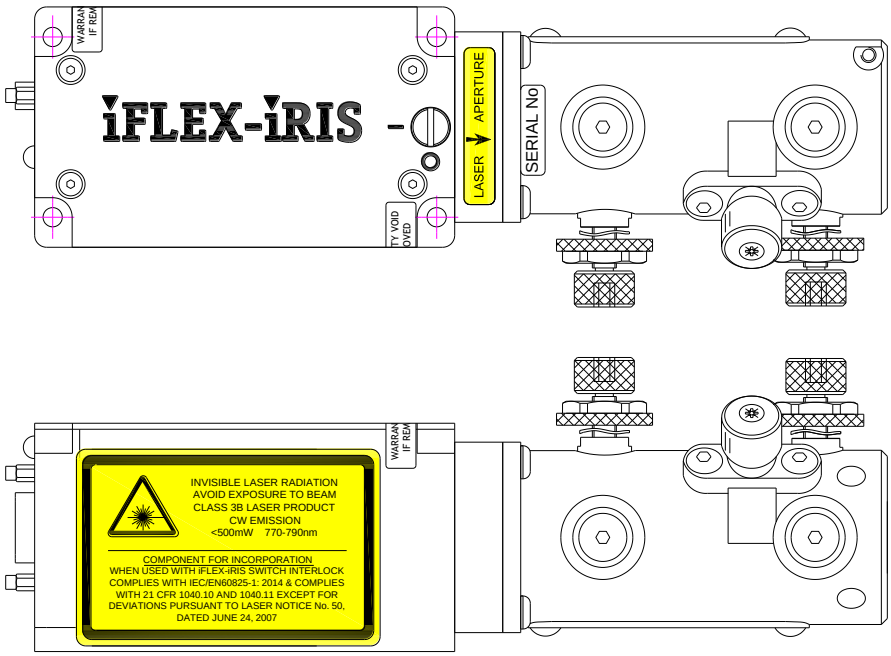


Figure 1-1: Laser safety warning label and aperture label position on the fiber coupled iFLEX-iRIS™ with kineMATIX® manipulator

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.

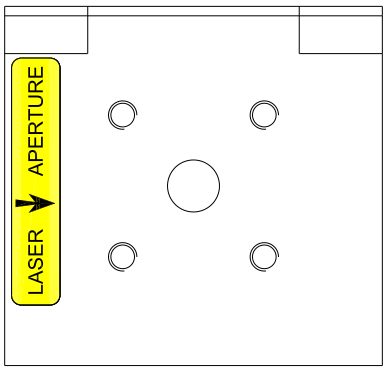


Figure 1-2: Aperture label position on the free space iFLEX-iRIS™ laser without kineMATIX® manipulator

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.

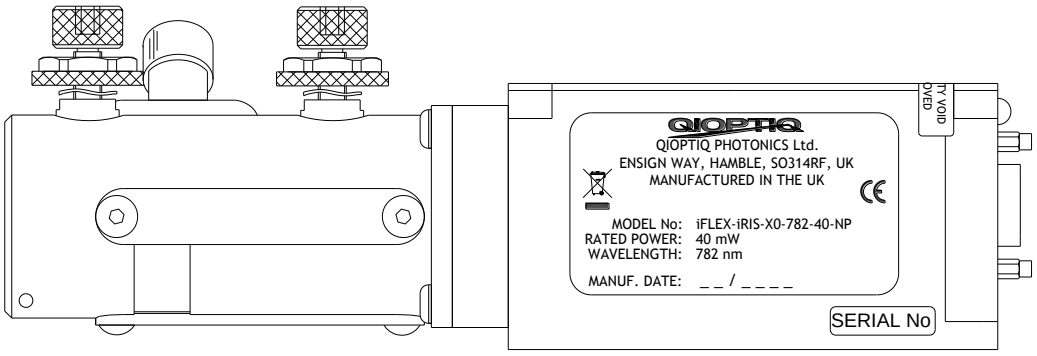


Figure 1-3: Example and location of the laser identification label on the fiber coupled iFLEX-iRIS™ laser with kineMATIX® manipulator

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 box (014450). If the product is not used with Qioptiq's iFLEX-iRIS™ interlock control box, 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 indicator LED located on the back panel of the laser. This indicator illuminates blue as soon as power is supplied to the laser, and remains blue as the laser internally stabilizes its temperature control system during the warm-up period. After the laser is warmed-up and as soon as the Laser Enable signal has been applied then a red LED indicator on the back panel of the laser also illuminates, and the resulting illumination seen is a purple colour (red + blue LEDs).

Blue LED	= Laser Ready, it is powered, warming-up, ready to emit
Purple (Red & Blue) LED	= Laser Enabled and Emission beam on

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 box is seen through all laser safety eyewear. It is recommended for bench-top use.

▶ 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, the shutter is open. With the shutter closed (screw slot perpendicular to the aperture), no emission from the laser is possible.

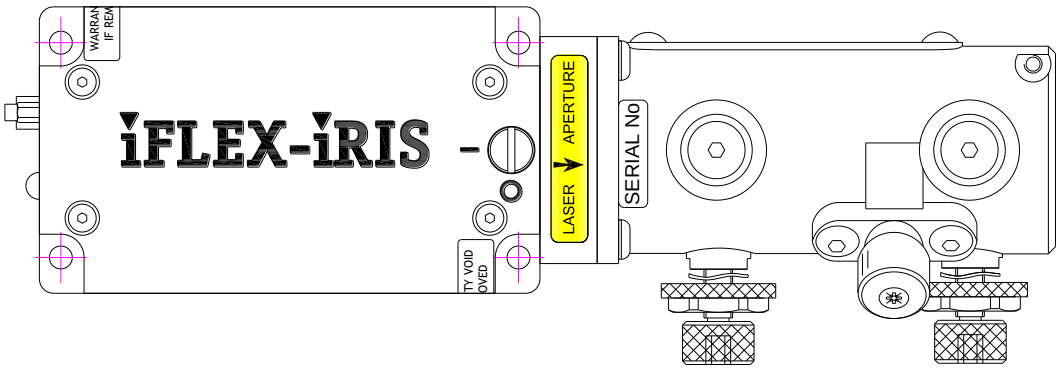


Figure 1-4: Fiber coupled laser with the shutter in the closed position

- **Interlock Control box**

The iFLEX-iRIS™ interlock control box contains: a key switch which cannot be withdrawn once turned to the ‘ON’ position; a manual Reset switch which needs to be pressed after the unit has been switched on or after any interlock interruption; 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
- Miniaturized size for low impact on instrument design
- Integrated electronics and TEC temperature stabilized control
- Conductively cooled through baseplate
- Plug and Play modular fiber optic coupling with the kineFLEX®

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 in CW mode by monitoring the laser power which is fed back into a closed loop system in the control electronics. 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 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.

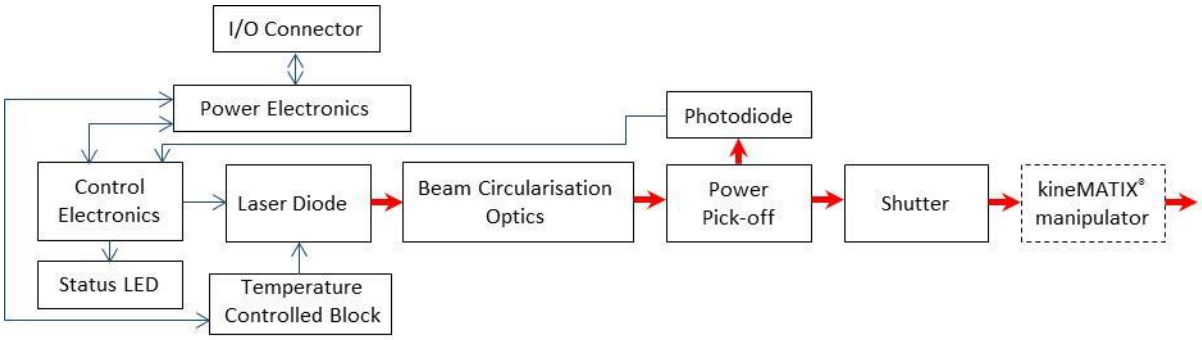


Figure 2-1: iFLEX-iRIS™ schematic

2.4 Specifications

Laser Specifications																					***Units***
Wavelength	375	405	445	458	473	488	505	515	520	532	561	594	633	637	642	660	670	730	780	830	852	nm
Central Wavelength	± 5								-5 +10	± 2			± 3	-5 +6	-7 +5	-6 +4	± 10		-5 +15	+0 -12	± 5	nm
Power from laser	20 40 50	50 100 200 220	20 50 75	20 70	75	20 40 100 140	50	20 50 60	30	20 40	20 40	30 50	30 70	20 100	20 40 100	80	10	20	70	100	35	mW
Power after fiber output	12 24 30	30 60 120 132	12 30 45	12 42	45	12 24 60 84	30	40	18	12 24	12 24	18 30	18 42	12 60	12 24 60	48	6	12	42	60	21	mW
Power Stability (8 hours)	< 2																					%
Optical Noise (20Hz – 2MHz)	< 0.1[1]																					% RMS
Beam Diameter	0.7																					mm
Polarisation Ratio	< -20																					dB

Table 2-1: Laser Specifications

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

[1] Model specific please contact Qioptiq for details

Fiber Parameters		*Units*
Output termination	0.7mm collimated, FCP, FCP8, APC	-
M squared	typ 1.1	-
Pointing stability	≤ 1	µrad/°C
Mechanical dimensions	Ø12 x 50	mm
Beam position (collimated)	< ± 0.15	mm
Beam angle (collimated)	< ± 0.5	mrad
Fiber length	1 to 3	m
Fiber protective jacket	Stainless steel, 5mm OD	-
Electrical		
Power supply	10-14V DC, 1A	-
Max. base plate temp.	40	°C
Max. heat dissipation	12	W
Environmental conditions		
Storage temperature	10 to 50	°C
Operating pressure	Atmospheric	-
Operating temperature	10 to 40	°C
Operating humidity	0-90%, Non-condensing, dew point <23°C	-
Operation modes		
CW with power adjustment	0 - 100% power adjustment with 0-5V input signal	-
Digital Modulation Rise time (10% to 90%) Fall time (90% to 10%) Modulation bandwidth	TTL Signal < 1 < 1 DC to 500	- µsec µsec kHz

Table 2-2: Laser Specifications Continued

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 black line in the figure below, are conditions where condensation could occur and should be avoided.

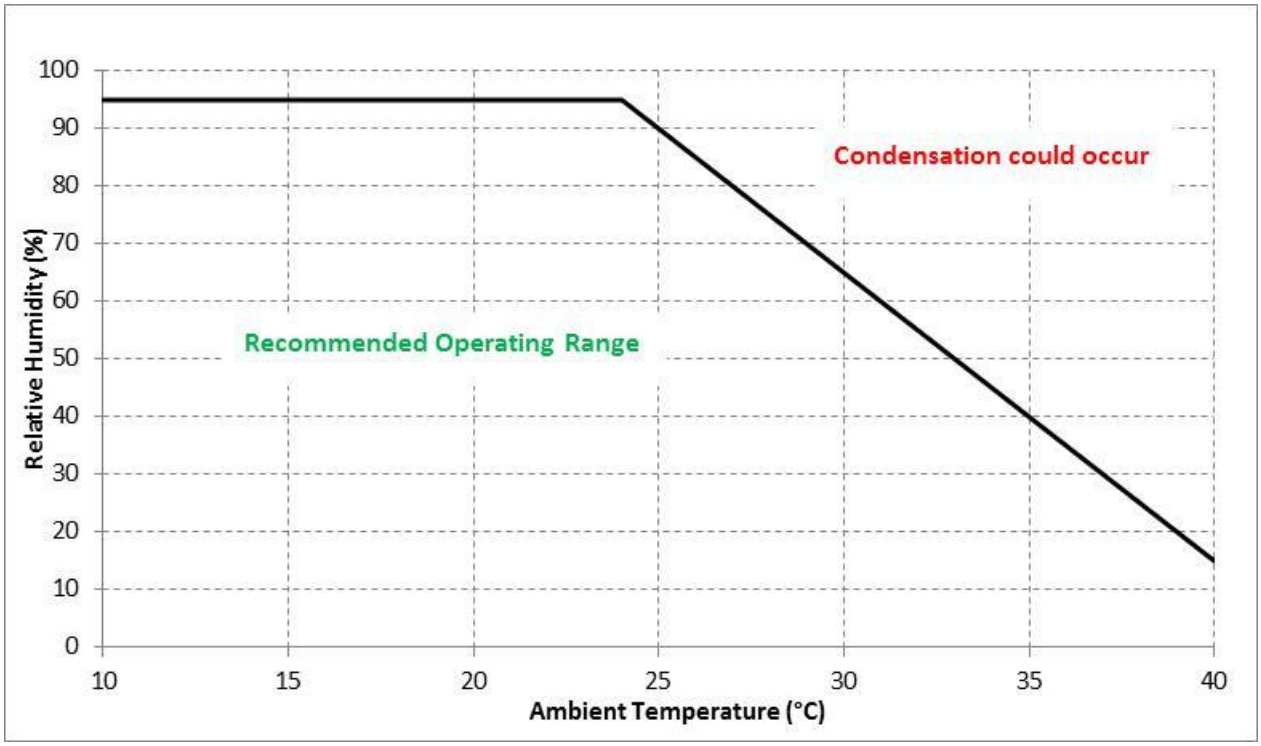


Figure 2-2: Potential condensation points for the iFLEX-iRIS™

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[2] (W) x 51[2] (H)	mm
Mass	<1	kg

Table 2-3: Laser Dimensions

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

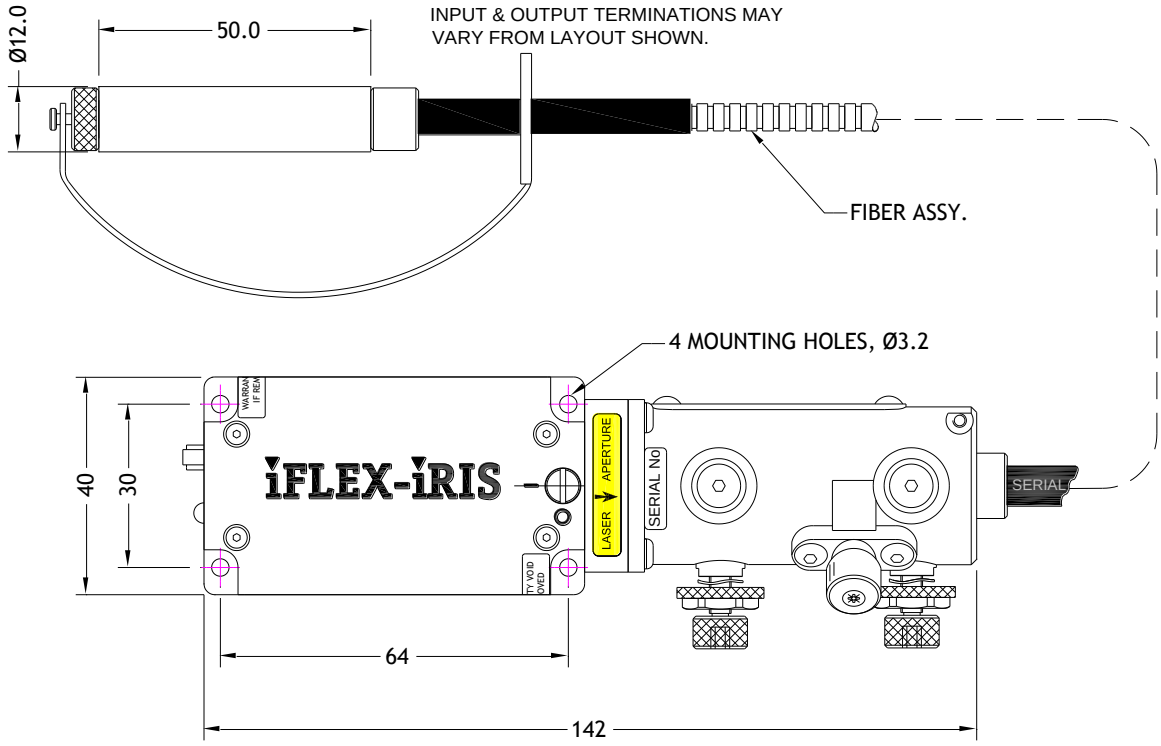


Figure 2-3: Top view of the laser with kineMATIX® manipulator and fiber assembly (other output terminations available – see section 2.6)

The iFLEX-iRIS™ is available in three different formats; the designation in brackets corresponds to the order code format detailed in section 8.

- 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.

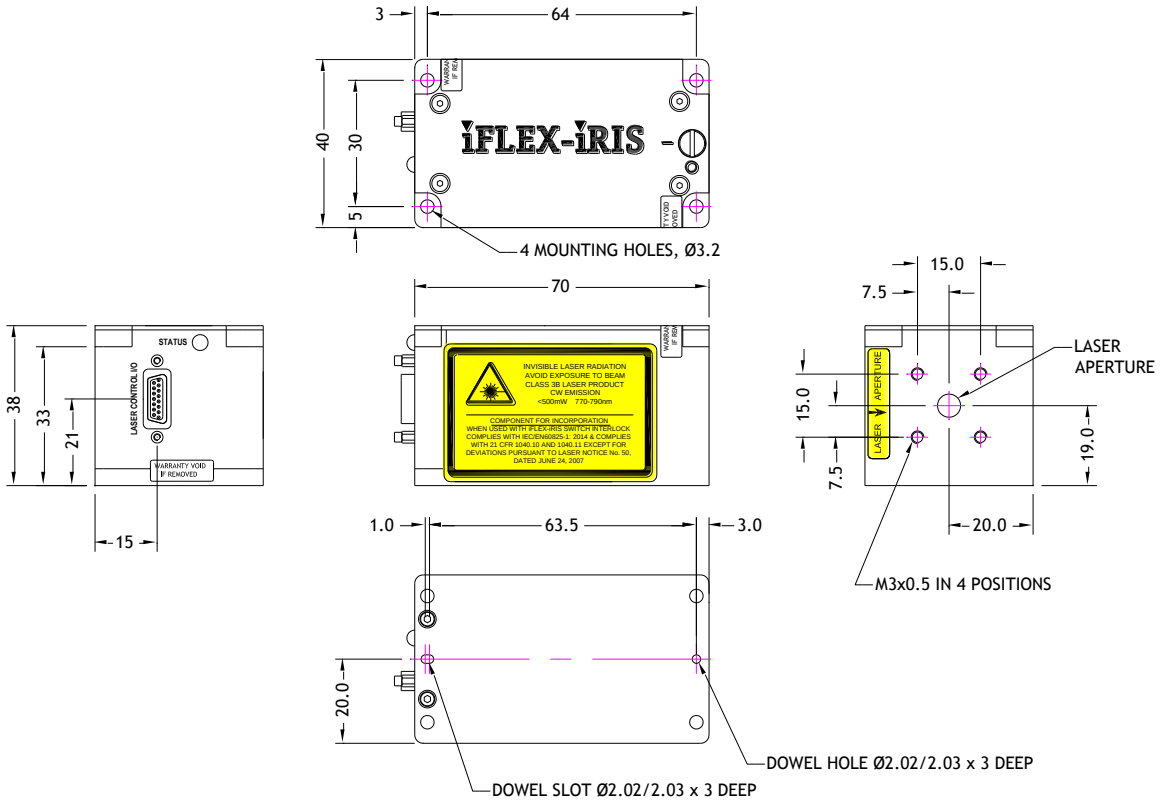


Figure 2-4: Free space laser with centralized output beam (X0)

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.

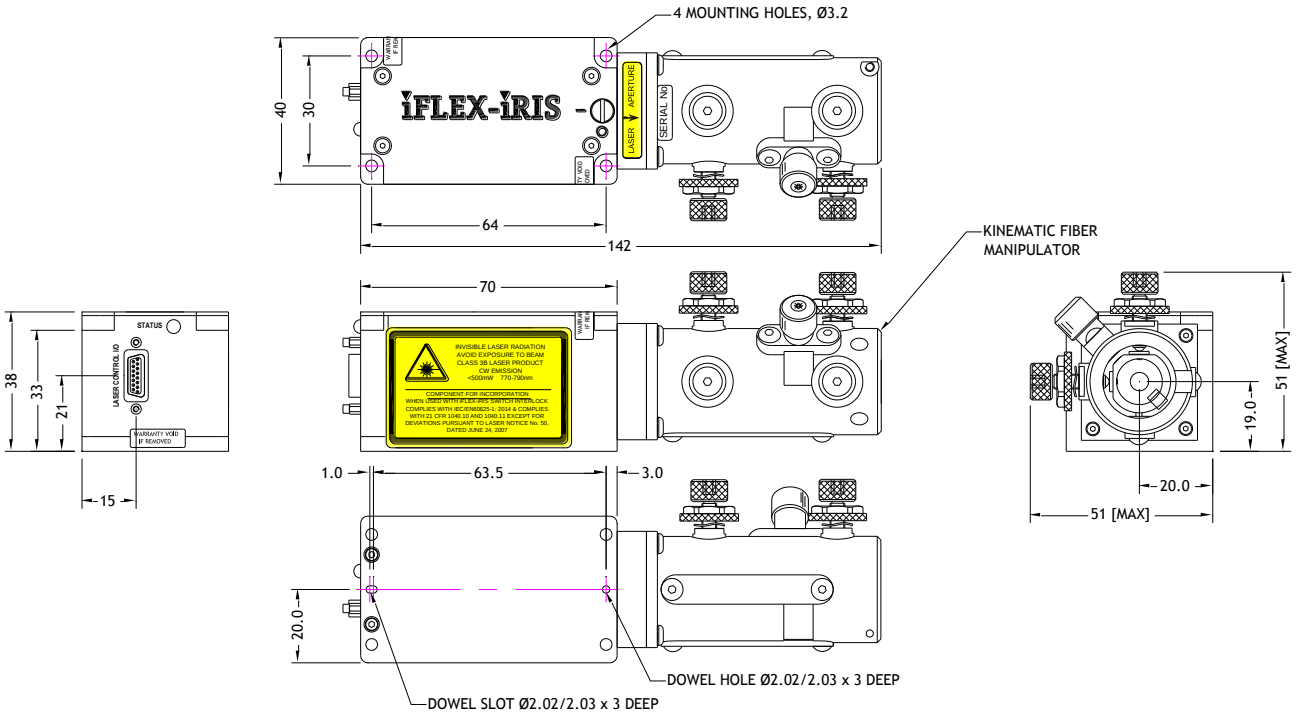


Figure 2-5: Fiber coupled laser using the kineMATIX® manipulator (X1)

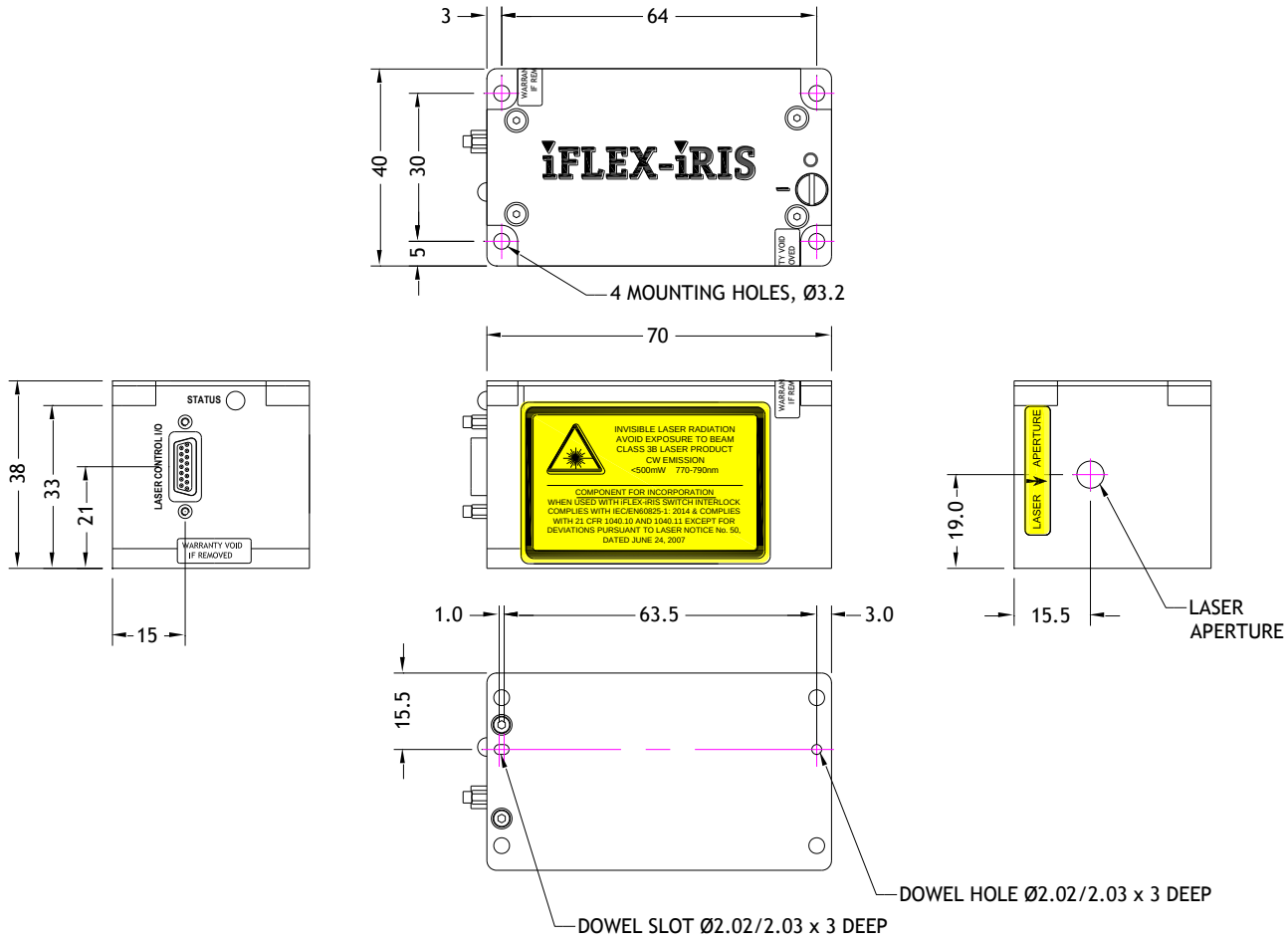


Figure 2-6: Free space laser space output with offset output beam (X2)

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 2-4: Fiber output details

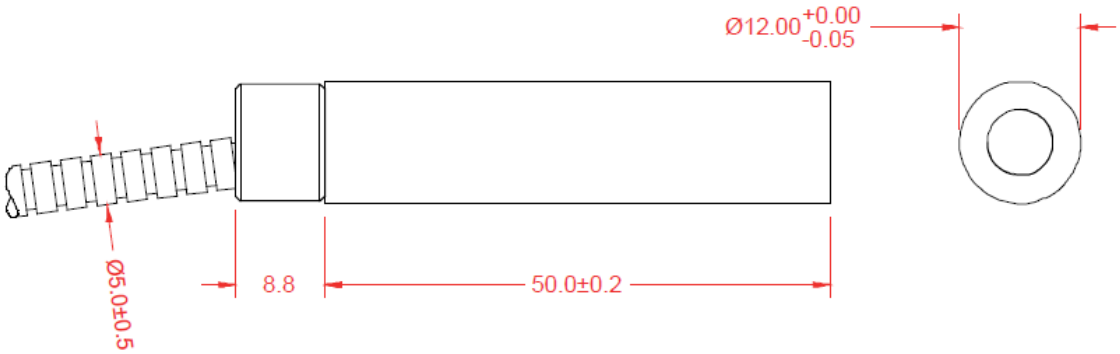


Figure 2-7: Standard output collimator Ø12 x 50mm

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:-

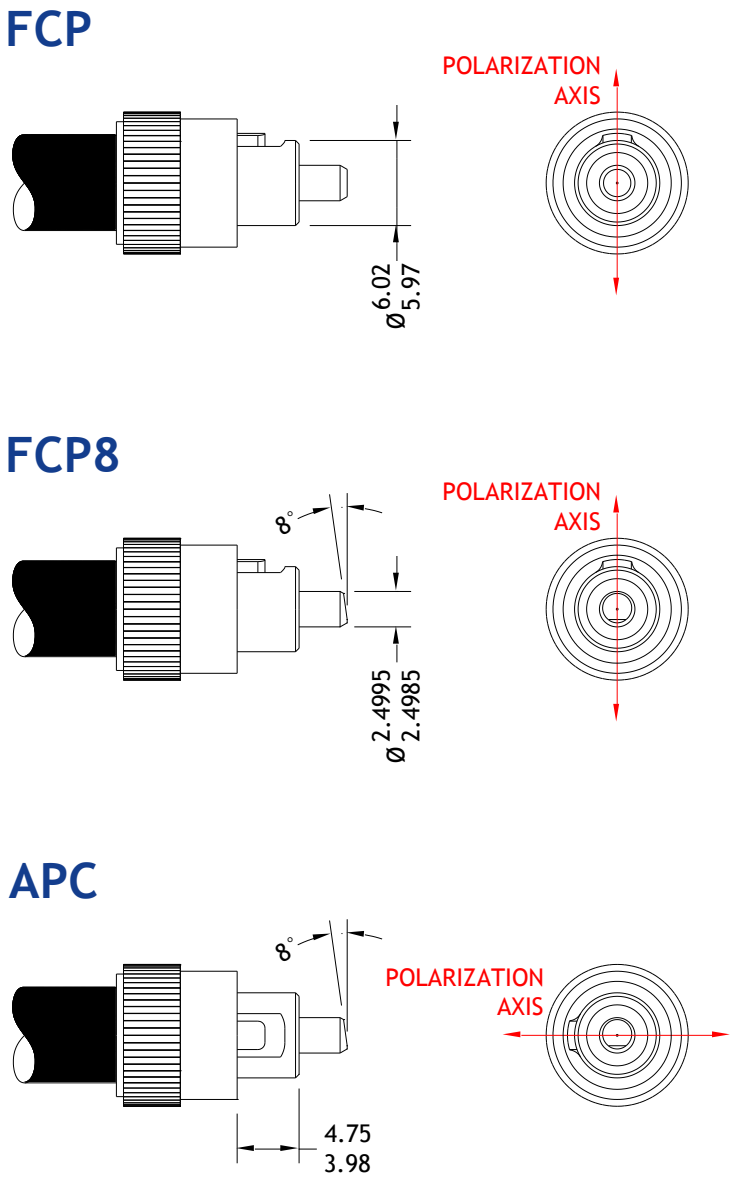


Figure 2-8: Connectorized fiber output options

2.7 Interlock Control Box (014450)

A diagram of the iFLEX-iRIS™ interlock control box is shown in Figure 2-9. It includes:

- An integrated cable to connect directly to the iFLEX-iRIS™
- A 9-way sub D-type connector (Power/Monitor) which interfaces with Qioptiq power supplies
- An interlock connector (see section 3.5 for details)
- A key-actuated power switch
- An emission indicator
- A Reset switch
- A BNC Power Control connector

The key-actuated power switch must be turned to Enabled for the interlock control box to operate. Once in the Enabled position, the key cannot be withdrawn.

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

The Reset switch must be pressed after the interlock control box has been switched on or after any interlock interruption before the laser will operate. Upon pressing the reset switch, power will be supplied to the laser and the Emission Indicator on the interlock control box will illuminate, along with the status LED on the back of the iFLEX-iRIS™ laser; see section 4 for operation of the status LED. Finally, the BNC Power Control connector is used to control the output power from the laser by applying a voltage signal between 0-5Vdc, where 5Vdc = 100% output power (see section 4).

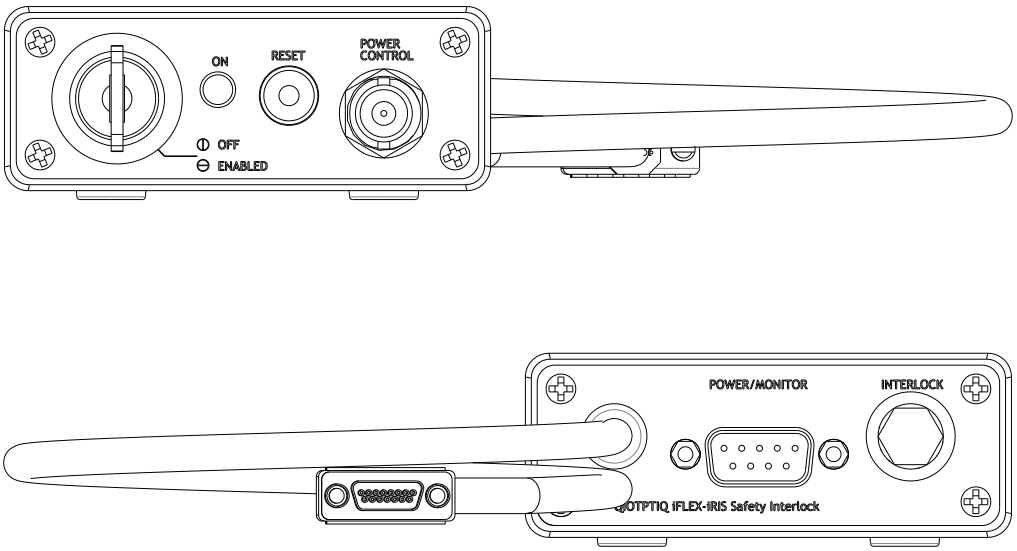


Figure 2-9: End panel views of the iFLEX-iRIS™ interlock control Box detailing the location of the different connectors and indicators

The dimensions of the interlock control box are shown in Figure 2-10.

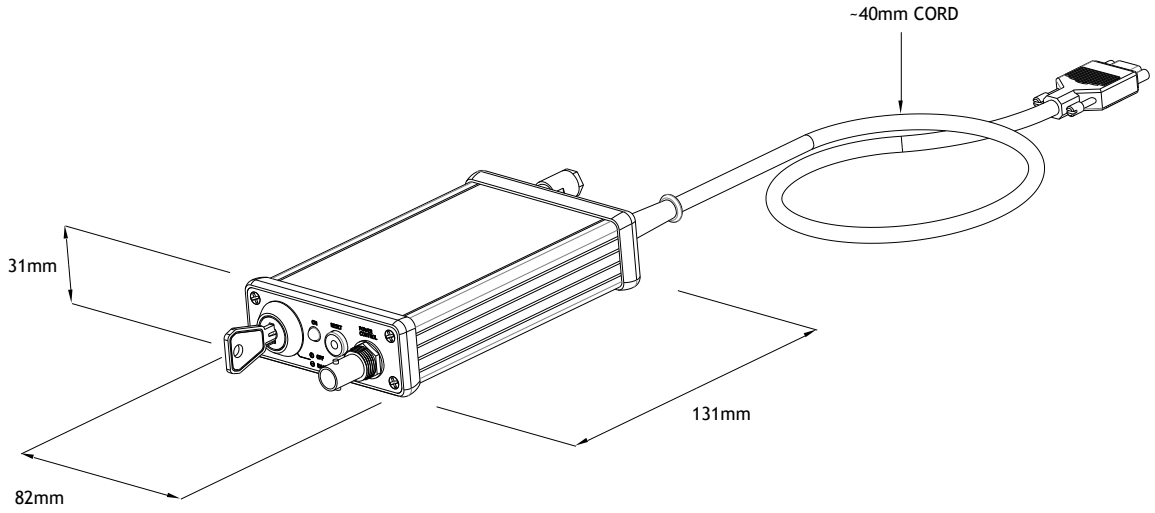


Figure 2-10: Dimensions of the iFLEX-iRIS™ interlock control Box

3 - INSTALLATION

3.1 Unpacking and Inspection

The iFLEX-iRIS™ will be shipped in specially designed package. 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 box and PSU	014609	●[3]	○
iFLEX-iRIS™ interlock box and PSU with breakout cable	014552		○
iFLEX-iRIS™ interlock box and PSU with TTL mod BNC	014661		○
iFLEX-iRIS™ PSU with Adapter cable	014472	-	○
iFLEX-iRIS™ PSU with breakout cable and adapter cable	014784	-	○
Interlock Box	014450	-	○
Interlock Plug (spare)	014455	○	○
Keys for Interlock Box (spare)	014456	○	○
Four M3x40 Mounting Screws	014688	✓	✓
Manual	PSB1051	✓	○
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] One of these three options will be supplied for End Users depending on the iFLEX-iRIS™ purchased and the customer requirements.

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.

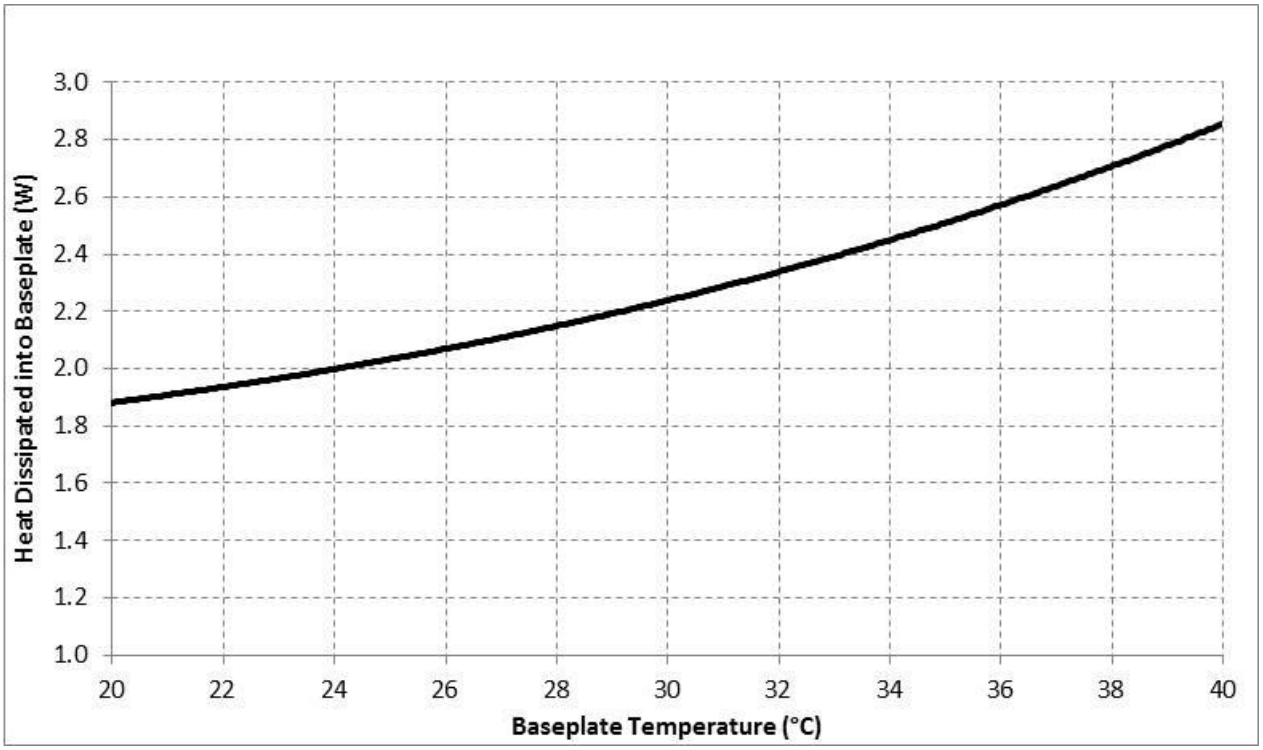


Figure 3-1: Estimated heat dissipation of the iFLEX-iRIS™ lasers. Note: the dissipation values of individual lasers will vary depending on the particular drive current of the laser diode

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 fiber is not in use.

3.5 Remote Interlock

For iFLEX-iRIS™ lasers supplied with the interlock control box, 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 rear of the interlock control box (see section 2.7) and is a Binder series 712, 2-way panel mounted socket. The remote interlock provides the final stage in the 12Vdc circuit to the safety interlock relay. Once the interlock circuit goes open circuit the relay supply is interrupted and turns off. This in turn switches off the power to the laser.

Interlock details:-

- The open-circuit voltage between the interlock terminals is 12Vdc.
- The short-circuit current between the terminals is 300mA
- 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 600mA.
    - Trip time max is 3 seconds at 1.5A.

- 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 box = 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 BOX. Doing so will invalidate the warranty.

An interlock shorting plug is provided with every iFLEX-iRIS™ interlock control box to directly short the remote interlock connection, provided that it is safe to do so in the users application or installation.

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 .

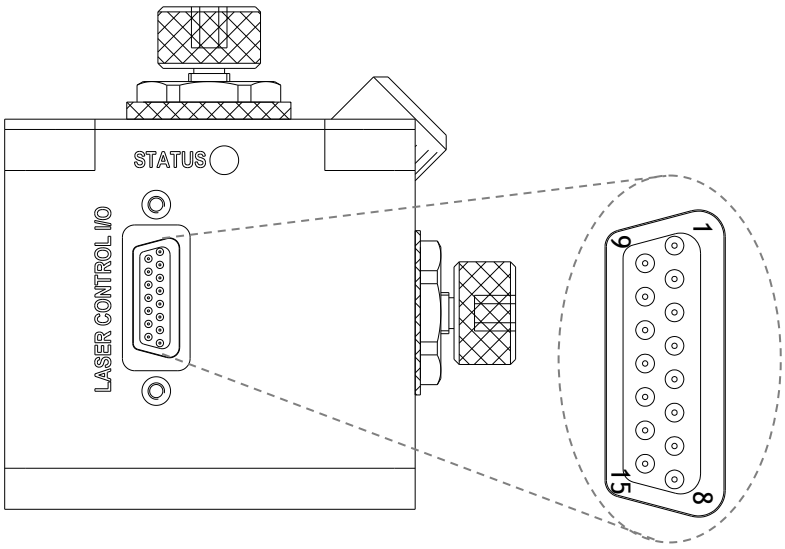


Figure 4-1: Location and pin out of the Laser Control I/O connector

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

Pin	*Function*	*Min (V)*	*Max (V)*	*Signal*	*Type*	*Operation*	*Description*
1	Monitor Photodiode Output (Vmon)	0	4.0	Output	Analogue	4V = max. output (Min. load impedance = 10k)	A voltage signal proportional to the output power of the laser
2	Operating Current Output (Vop)	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	External Power Control	0	5	Input	Analogue	5V = 100% output power[4]. 1k input impedance	Controls the output power level of the laser
4	Laser Enable	0	5	Input	Digital	On > 3.2V, Off <0.8V. 100k input impedance	Enables the laser
5	Temperature OK Signal	0	5	Output	Digital	5V = temp in range (under no load). Source impedance 1k	Provides a voltage signal when the TEC block has stabilized
6	Reserved						
7	Laser Supply Voltage	10	14	Input	Power	Up to 1A	Voltage supply for the laser
8	Reserved						
9	Reserved						
10	Reserved						
11	Chassis Ground						
12	TTL Modulation signal[5]	0	5	Input	Digital	High = max output power as defined by pin 3. 2k input impedance	Input modulation signal for the laser. If constant voltage applied, laser will run in CW operation.
13	Reserved						
14	0V Laser Supply	Return for pin 7		Input	Power		
15	0V Reference	Return for Monitoring signals		Input	Analogue		Return pin for laser monitor signals

Table 4-1: Interface connector details.

[4] On request by OEM users only, the laser can be configured to have 0V=100% output power, 5V = 0% output power (1k input impedance). Only possible on NP variant lasers; T variant lasers will only operate from 0-5V (5V=100% output power)

[5] Pin only active on digital modulation lasers. On CW variant lasers, this pin is reserved.

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.

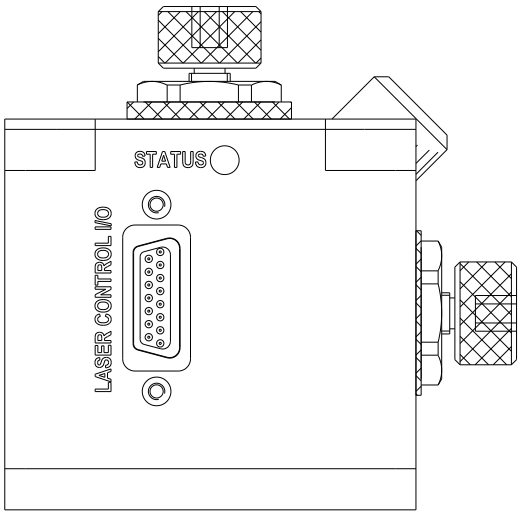


Figure 4-2: Position of the Status LED on the rear panel of the iFLEX-iRIS™.

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

LED Emission	***Operating Condition***		
	Power	***Internal Temperature***	***Laser Enable***
OFF	OFF	OFF	OFF
Blue	ON	STABILIZING	OFF
Blue	ON	LOCKED	OFF
Blue	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.

4.2 Control Systems

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 tables; please contact Qioptiq if you require a different control system.

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.

Part No:	*Description*	*Compatible Laser Models*	*Operation*	*PSU Part No:*	*Laser Enable signal required*	*Power Control Signal*	*Access to TTL modulation*
014609	iFLEX-iRIS™ interlock and PSU	CW (-NP)	Customer is required to provide a Power Control voltage. (5V=100% output power)	011626	No	BNC on interlock box	NA
014552	iFLEX-iRIS™ interlock and PSU with breakout cable	CW (-NP)	Customer is required to provide laser enable signal and Power Control voltage (5V=100% output power).	014454	Yes	BNC on interlock box	NA
014661	iFLEX-iRIS™ interlock and PSU with TTL mod BNC	Digital Modulation (-T)	Customer is required to a provide Power Control voltage (5V=100% output power) and TTL modulation signal.	014662	No	BNC on interlock box	BNC on power supply

Table 4-3: Table detailing the power supply options for End Users. System is compliant with CDRH requirements

Part No:	*Description*	*Compatible Laser Models*	*Operation*	*PSU Part No:*	*Laser Enable signal required*	*Power Control Signal*	*Access to TTL modulation*
Power Control operation 5-0V (0V =100% Output Power)							
014472	iFLEX-iRIS™ PSU with adapter cable (014451)	CW (-NP)	No input signals required for 100% output power.	011626	No	No	NA
014784	iFLEX-iRIS™ PSU with breakout cable and adapter cable (014451)	CW (-NP) [6]	Customer is required to provide all control signals.	014600	Yes	Yes	NA
014609	iFLEX-iRIS™ interlock and PSU	CW (-NP)	Customer is required to provide Power Control voltage to reduce the output power of the laser (0V=100% output power)	011626	No	BNC on interlock box	NA
Power Control operation 0-5V (5V =100% Output Power)							
014784	iFLEX-iRIS™ PSU with breakout cable and adapter cable (014451)	CW (-NP) or Digital Modulation (-T)	Customer is required to provide all control signals.	014600	Yes	Yes	On breakout cable
014609	iFLEX-iRIS™ interlock and PSU	CW (-NP)	Customer is required to provide a Power Control voltage. (5V=100% output power)	011626	No	BNC on interlock box	NA

Table 4-4: Table detailing the power supply options for OEM customers. Systems 014472 and 014784 are **NOT** compliant with IEC/EN60825-1:2014 and 21 CFR1040 requirements. It is the integrator's responsibility to ensure that their final system is compliant

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 description in section 4.2.5.

[6] Digital modulation lasers (-T) will only operate from 0-5Vdc (5Vdc=100% output power) on the power control line.

4.2.1 Power Supply (011626)

Power supply 011626 has a 9-way D-type connector on the output which directly interfaces with the Power/Monitor connector on the interlock control box (014450). The laser enable line is hardwired to 'ON' within the cable 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™.

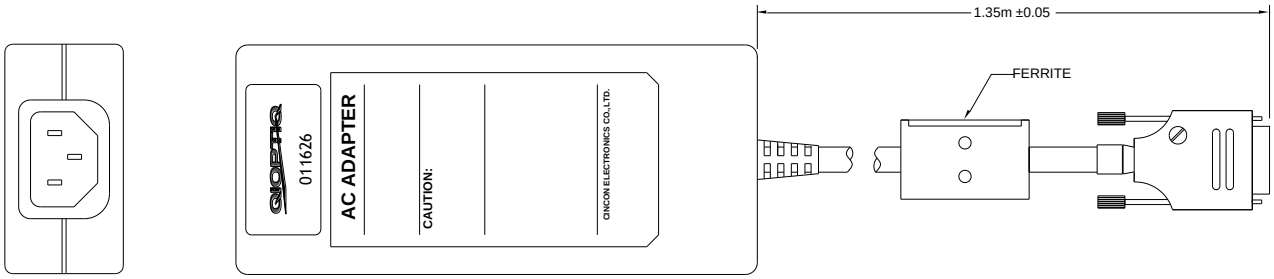


Figure 4-3: Power supply 011626

011626 Power Supply		
Dimensions	132 (L) x 58 (W) x 30 (H)	mm
Weight	0.35	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:	~0.6A	Max. Output Current:	2.0A
Input Frequency:	47 – 63 Hz	Total Regulation:	±5%
		Ripple (pk to pk):	120mV
		Max Output Power:	25W

Table 4-6: Power Supply Electrical Specifications

This power supply also contains a +5V output which is unused for the iFLEX-iRIS™ product range.

4.2.2 End User Power Supply with breakout cables (014454)

Power Supply 014454 has a 9-way D-type connector on the output which directly interfaces with the Power/Monitor connector on the interlock control box (014450). The power supply used in 011626 and 014454 is exactly the same. However, in 014454, flying leads are provided out of the back of the 9-way D-type connector which provide access to the Laser Enable line as well as the monitoring lines:-

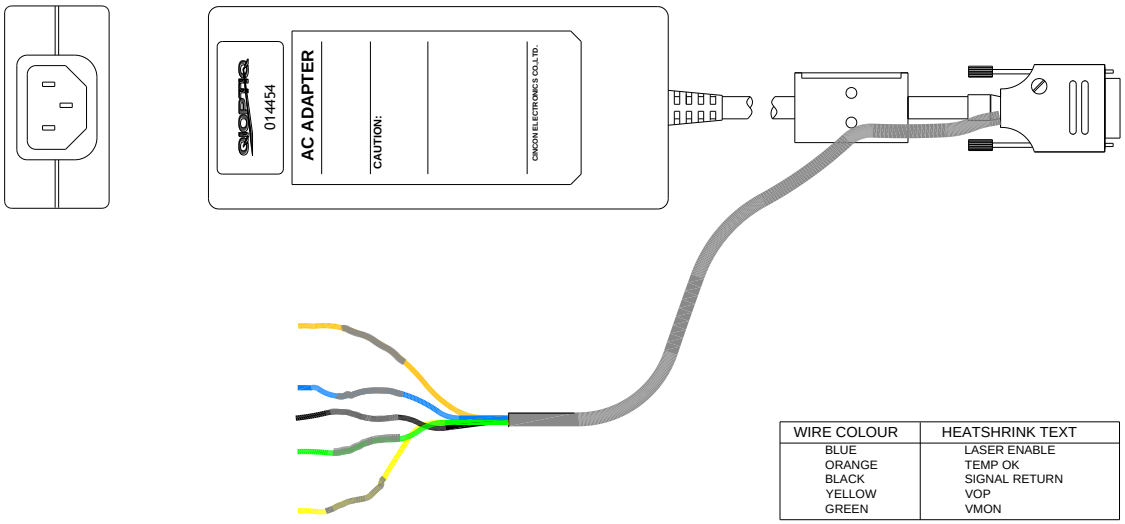


Figure 4-4: Power supply 014454

4.2.3 End User Power Supply with BNC cable (014662)

Power Supply 014662 has a 9-way D-type connector on the output which directly interfaces with the Power/Monitor connector on the interlock control box (014450). A BNC (Plug) cable is provided out of the back of the 9-way D-type connector which provides access to the TTL modulation input. The laser enable line is hardwired to 'ON' within the cable so as soon as the AC power is supplied to the power supply (via AC input port, IEC320/C14), radiation could be emitted for the iFLEX-iRIS™.

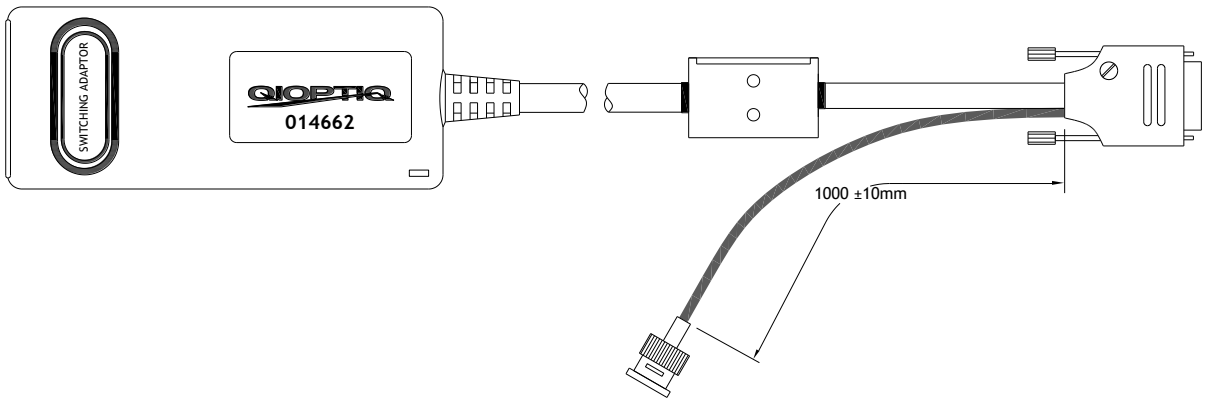


Figure 4-5: Power supply 014662

014662 Power Supply		
Dimensions	91 (L) x 38 (W) x 36 (H)	mm
Weight	0.17	kg

Table 4-7: Power Supply Physical Specifications

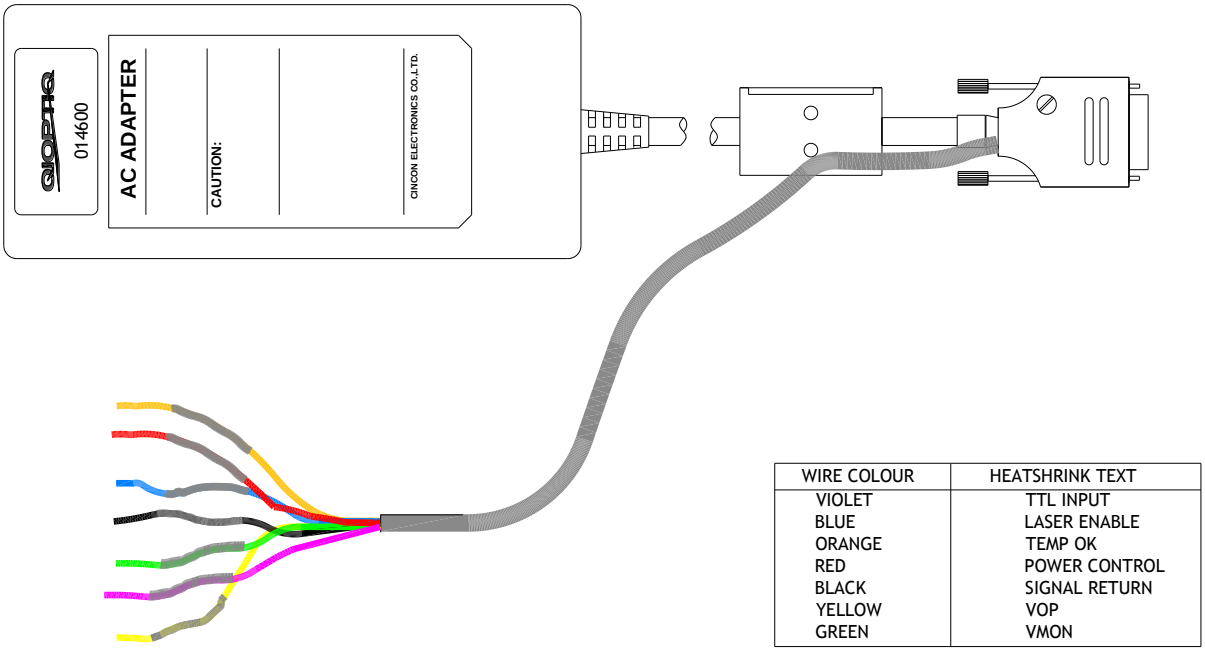
The electrical characteristics of the power supply are shown below.

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 4-8: Power Supply Electrical Specifications

4.2.4 OEM Power Supply with Breakout Cable (014600)

Power Supply 014600 is designed to directly interface with the adapter cable (014451). The power supply used in 011626, 014454 and 014660 is exactly the same. However, in 014600, flying leads are provided out of the back of the 9-way D-type connector which provides access to all the laser control and monitoring lines:-



WIRE COLOUR	HEATSHRINK TEXT
VIOLET	TTL INPUT
BLUE	LASER ENABLE
ORANGE	TEMP OK
RED	POWER CONTROL
BLACK	SIGNAL RETURN
YELLOW	VOP
GREEN	VMON

Figure 4-6: Power supply 014600

Warning!  Power supply 014600 is not designed to operate with Qioptiq's interlock control box 014450. It is the system integrator's responsibility to provide compliance with IEC/EN60825-1:2014 and 21 CFR1040 requirements.

4.2.5 Adapter Cable (014451)

To ensure that the iFLEX-iRIS™ product range is backward compatible or interchangeable with the existing 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. It is designed to match either of the power supplies detailed in this manual.

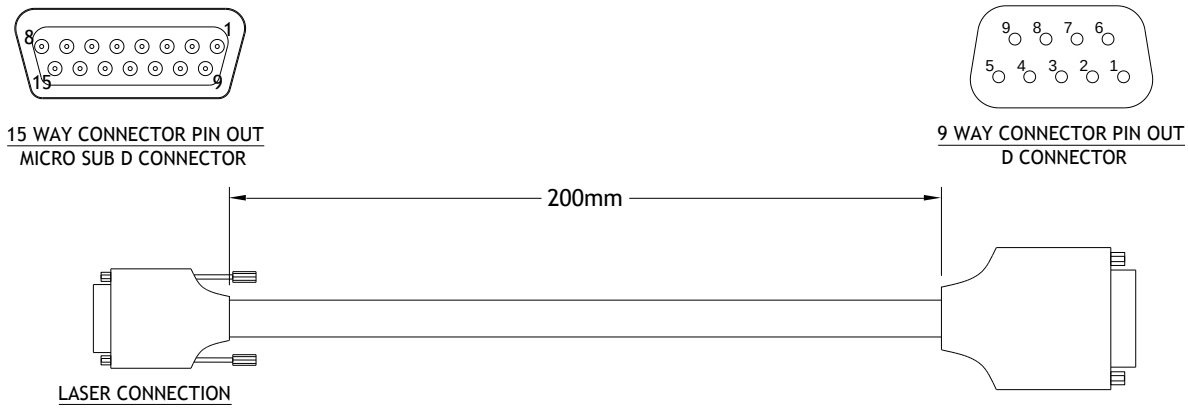


Figure 4-7: Adapter cable converting the micro sub D 15 –way connector to a 9-way D-type connector

15-way laser connector	*9-way Connector*	
Pin	***Pin***	***Function***
12	1	TTL input
7	2	Laser Supply Voltage
4	3	Laser Enable
5	4	Temperature OK Signal
3	5	External Power Control
10	6	Reserved
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

5 - LASER OPERATION

This section details the operation of the iFLEX-iRIS™.

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

5.1 Performance of Control Lines

The typical performance of the laser control lines is detailed in this section.

5.1.1 External Power Control Line (Pin 3 on I/O Connector)

The external power control line determines the output power level of the laser. The default operation of this control line is 0-5V where 5V equals 100% output power. On request by OEM users only, this line can be configured so that it operates from 5-0V where 0V equals 100% output power. Typical response curves of both operations are shown below.

Warning!  Ensure that a regulated 5V supply line is used otherwise any voltage instability will translate to the output of the laser.

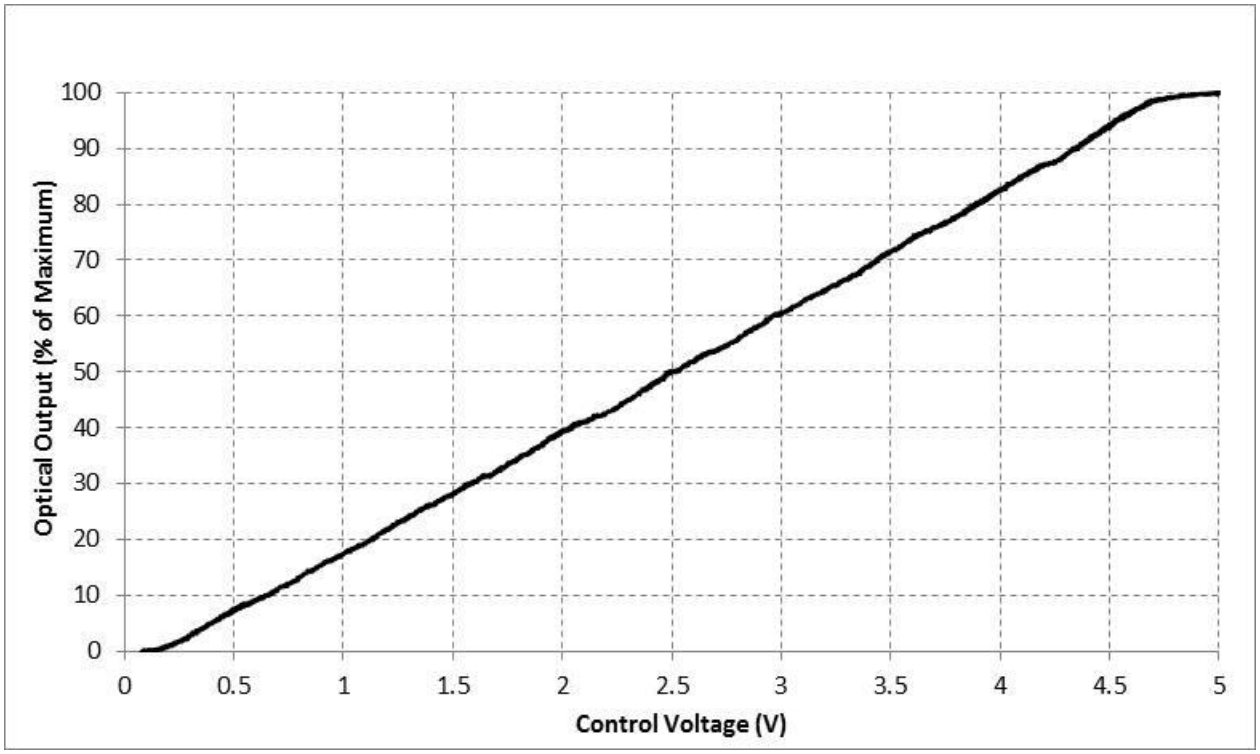


Figure 5-1: Typical External Power Control line response (0-5V – 5V=100%) of the iFLEX-iRIS™ laser (default operation)

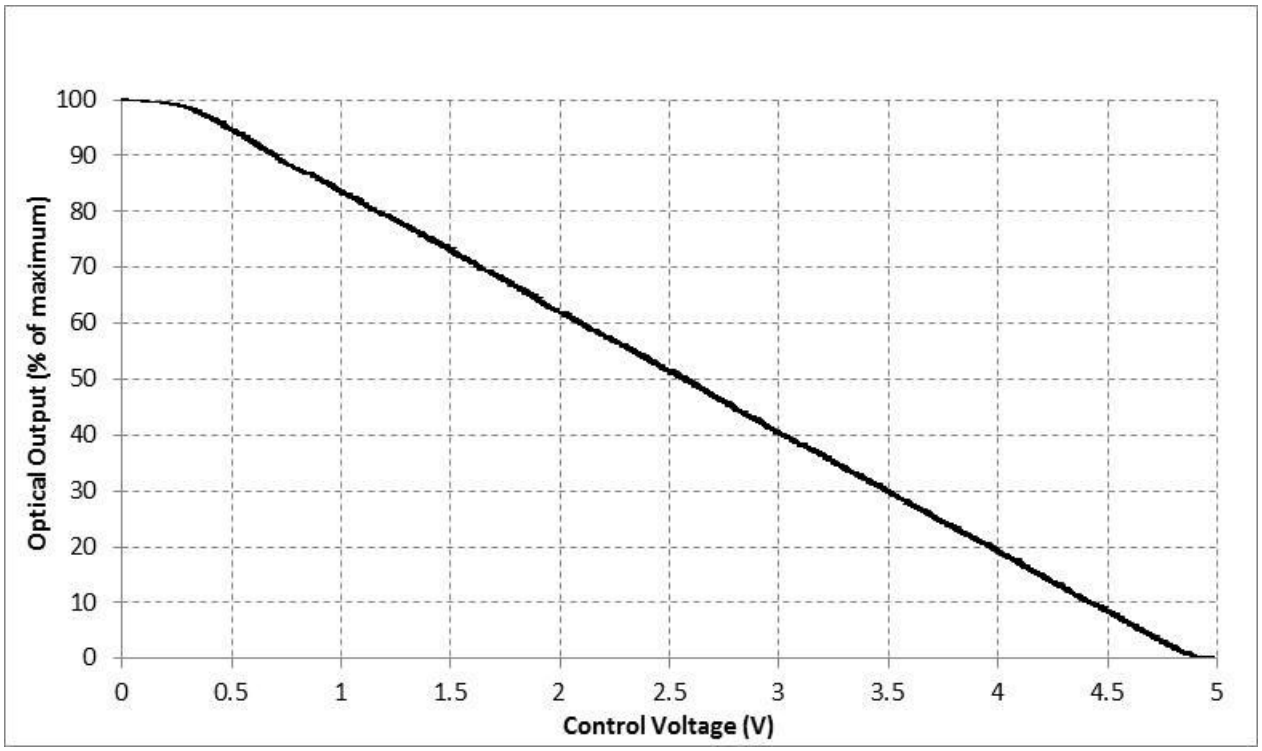


Figure 5-2: Typical External Power Control line response (5-0V – 0V=100%) of the inverted control iFLEX-iRIS™ laser (OEM only available operation)

5.1.2 Enable Line (Pin 4 on I/O Connector)

The enable line switches the output of the laser on. The level of the output power is determined by the voltage applied to the external control line (pin 3 on I/O Connector). The laser will only emit power if the TEC control circuitry is stabilized which can be established by monitoring the Temperature OK signal on pin 5 of the I/O connector (when temperature stable, pin 5 > 4.5V). With the laser stabilized and the enable line switched on, the status LED will be purple (both red and blue LEDs on together; see section 4.1.2).

5.2 Initial 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 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 box:-

- Attach the fixed cable from the interlock control box to the iFLEX-iRIS™ laser.
- Ensure that the key switch on the interlock control box is turned to the ‘OFF’ position
- With power off to the relevant power supply (see section 4.2), connect the 9-way D-type connector from the power supply to the ‘Power/Monitor’ connector on the interlock control box.

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.

5.3 Operation of the iFLEX-iRIS™ using CDRH compliant system 014609

The following details the startup and shutdown sequences for a CW (-NP) iFLEX-iRIS™ laser using the CDRH compliant system 014609 which consists of Qioptiq's interlock control box (014450) and power supply 011626.

5.3.1 Startup sequence for CW iFLEX-iRIS™ lasers using 014609

The following sequence details the startup sequence for CW (-NP) iFLEX-iRIS™ lasers using 014609.

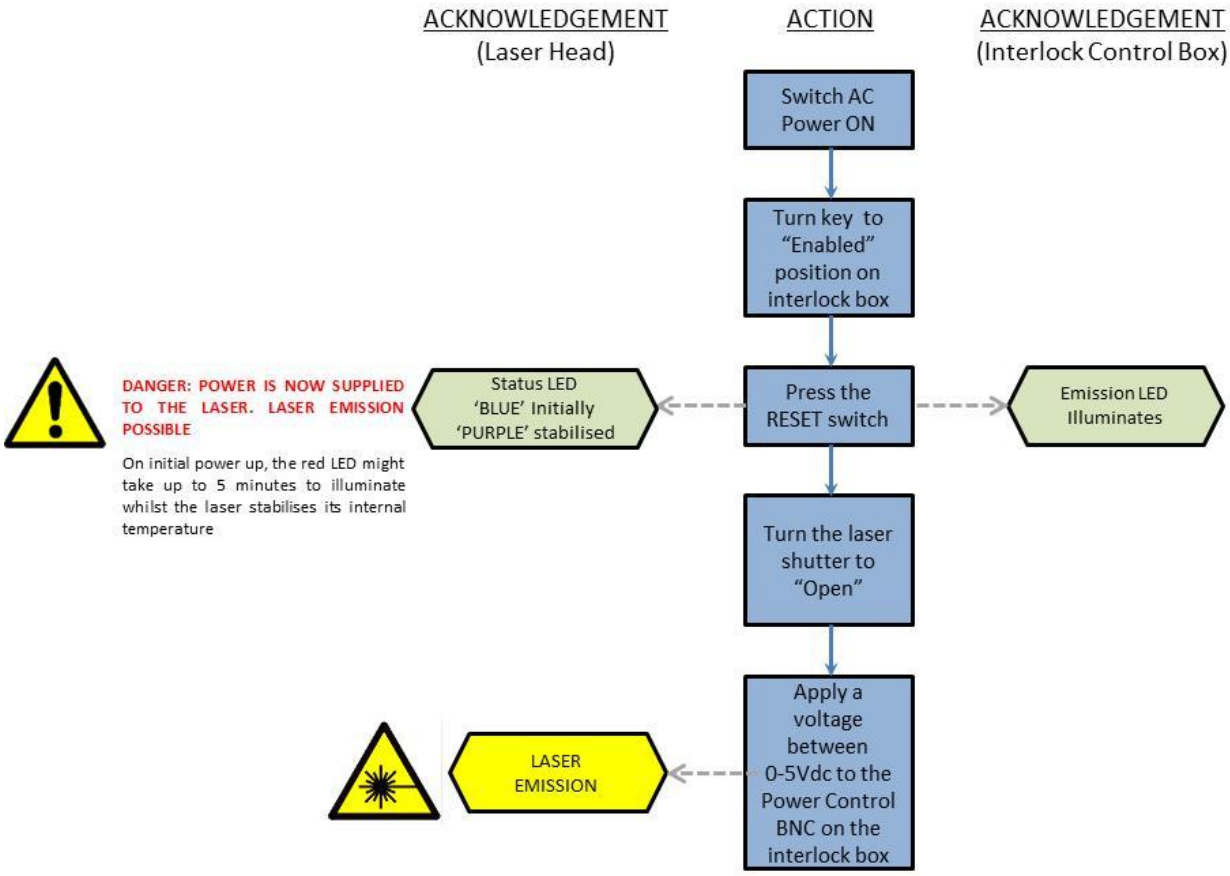


Figure 5-3: Recommended operational flow chart for the startup sequence of CW iFLEX-iRIS™ using Qioptiq's interlock control box and power supply combination 014609

Applying a 5V signal onto the Power Control BNC on the interlock box (014450) will result in 100% output power. Applying a voltage lower than 5Vdc, will reduce the output power of the laser.

5.3.2 Shutdown sequence for CW iFLEX-iRIS™ lasers using 014609

The following sequence details the shutdown sequence for CW (-NP) iFLEX-iRIS™ lasers using 014609.

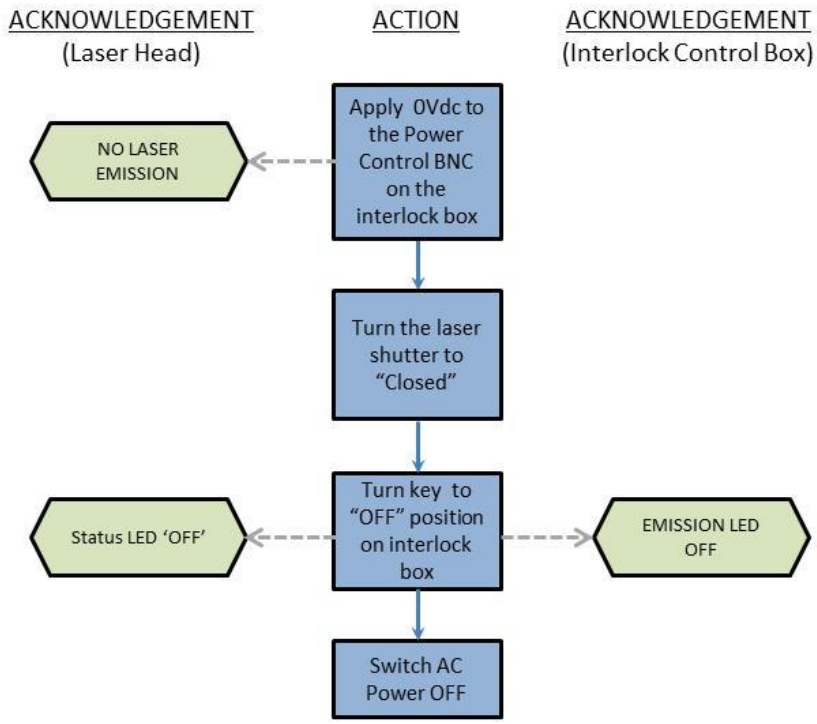


Figure 5-4: Recommended operational flow chart for the shutdown sequence of CW iFLEX-iRIS™ using Qioptiq's interlock control box and power supply combination 014609

5.4 Operation of the iFLEX-iRIS™ using CDRH compliant system 014552

The following details the startup and shutdown sequences for a CW (-NP) iFLEX-iRIS™ laser using the CDRH compliant system 014552 which consists of Qioptiq's interlock control box (014450) and power supply 014454.

5.4.1 Startup sequence for CW iFLEX-iRIS™ lasers using 014552

The following sequence details the startup sequence for CW (-NP) iFLEX-iRIS™ lasers using 014552.

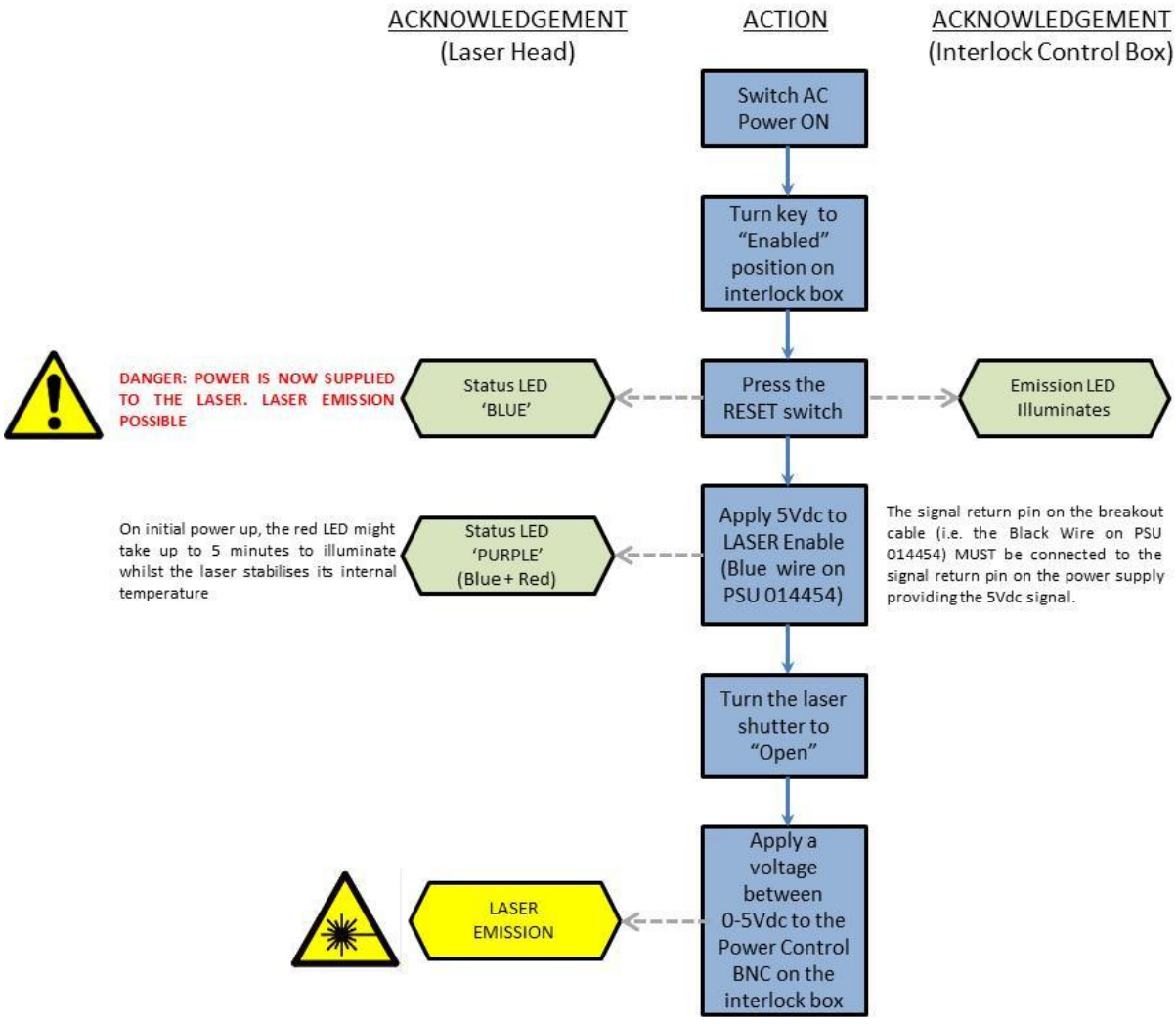


Figure 5-5: Recommended operational flow chart for the startup sequence of CW iFLEX-iRIS™ using Qioptiq's interlock control box and power supply combination 014552

Applying a 5V signal onto the power control BNC on the interlock box (014450) will result in 100% output power. Applying a voltage lower than 5V, will reduce the output power of the laser.

5.4.2 Shutdown sequence for CW iFLEX-iRIS™ lasers using 014552

The following sequence details the shutdown sequence for CW (-NP) iFLEX-iRIS™ lasers using 014552.

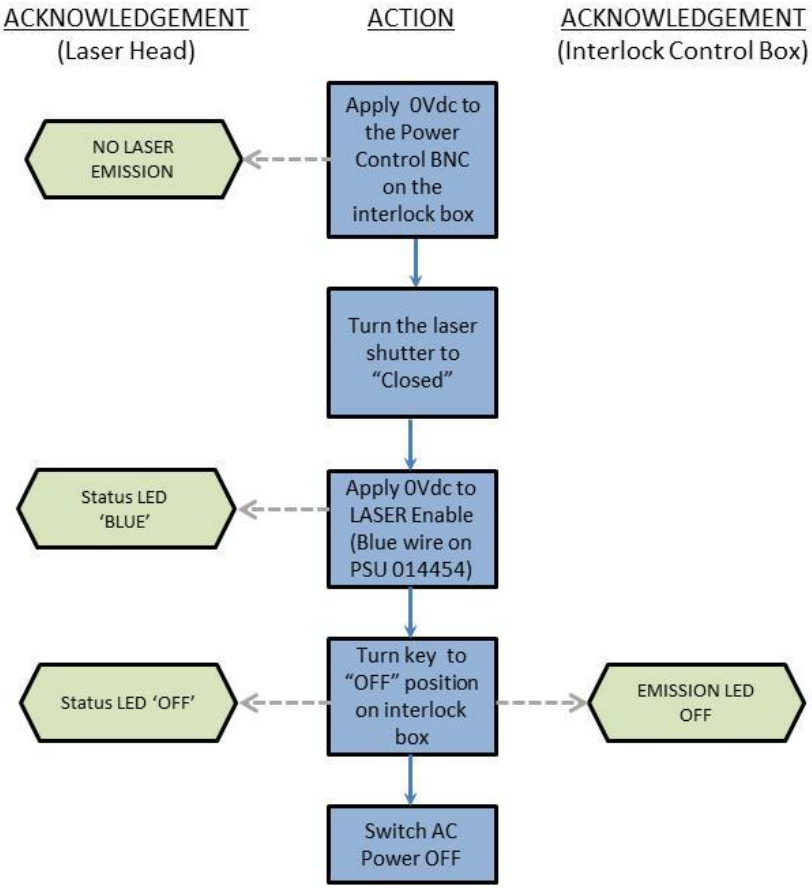


Figure 5-6: Recommended operational flow chart for the shutdown sequence of CW iFLEX-iRIS™ using Qioptiq's interlock control box and power supply combination 014552

5.5 Operation of the iFLEX-iRIS™ using CDRH compliant system 014661

The following details the startup and shutdown sequences for a digital modulation (-T) iFLEX-iRIS™ laser using the CDRH compliant system 014661 which consists of Qioptiq's interlock control box (014450) and power supply 014662.

5.5.1 Startup sequence for digital modulated iFLEX-iRIS™ using 014661

A diagram showing the various subcomponents of the CDRH compliant system connected together is shown in Figure 5-7.

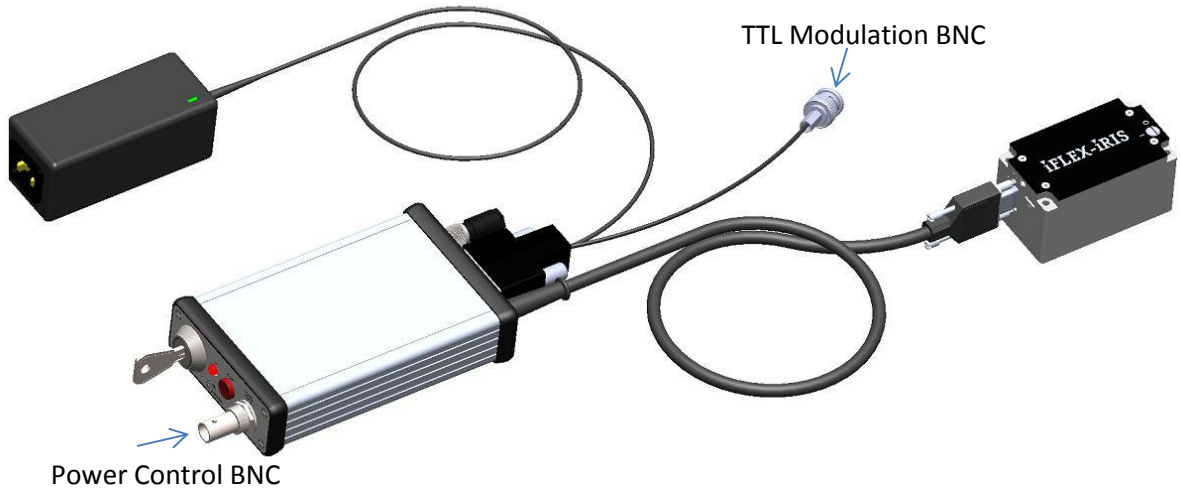


Figure 5-7: Connection of the iFLEX-iRIS™ CDRH compliant system for digital modulation iFLEX-iRIS™ lasers

The following sequence details the startup sequence for digital modulation (-T) iFLEX-iRIS™ lasers using Qioptiq's interlock control box (014450) and power supply 014662.

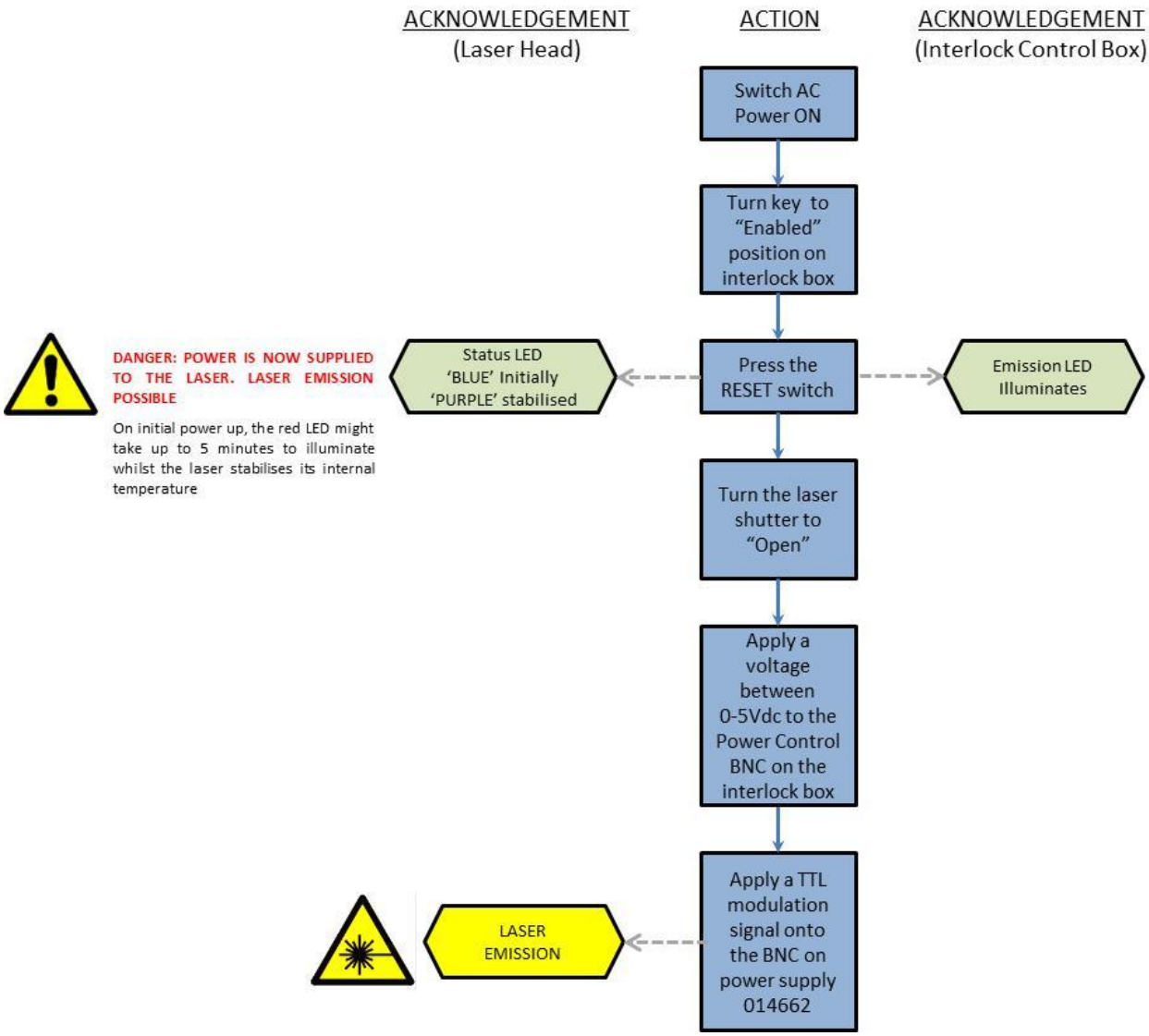


Figure 5-8: Recommended operational flow chart for the startup sequence of digital modulation iFLEX-iRIS™ using Qioptiq's interlock control box and power supply combination 014661

A voltage is always required on both BNCs for the laser to emit power, the Power Control BNC defines the output power of the laser (5dVC=100% output power) and the signal applied to the TTL modulation BNC defines the modulation rate of the laser. If CW operation is required, apply a constant 5Vdc onto the TTL modulation BNC and a constant voltage onto the Power Control BNC relative to the required output power level.

5.5.2 Shutdown sequence for digital modulated iFLEX-iRIS™ lasers using 014661

The following sequence details the shutdown sequence for digital modulation (-T) iFLEX-iRIS™ lasers using 014661.

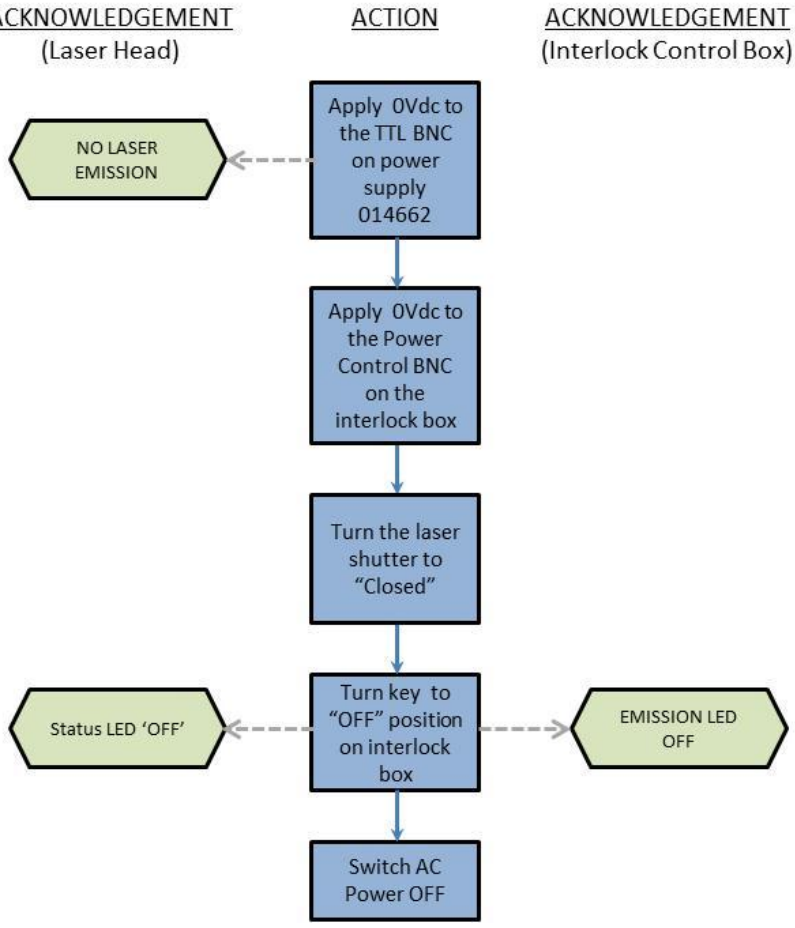


Figure 5-9: Recommended operational flow chart for the shutdown sequence of digital modulation iFLEX-iRIS™ using Qioptiq's interlock control box and power supply combination 014661

5.6 Operation of the iFLEX-iRIS™ for OEM integrators

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

5.6.1 Startup sequence for iFLEX-iRIS™ lasers

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

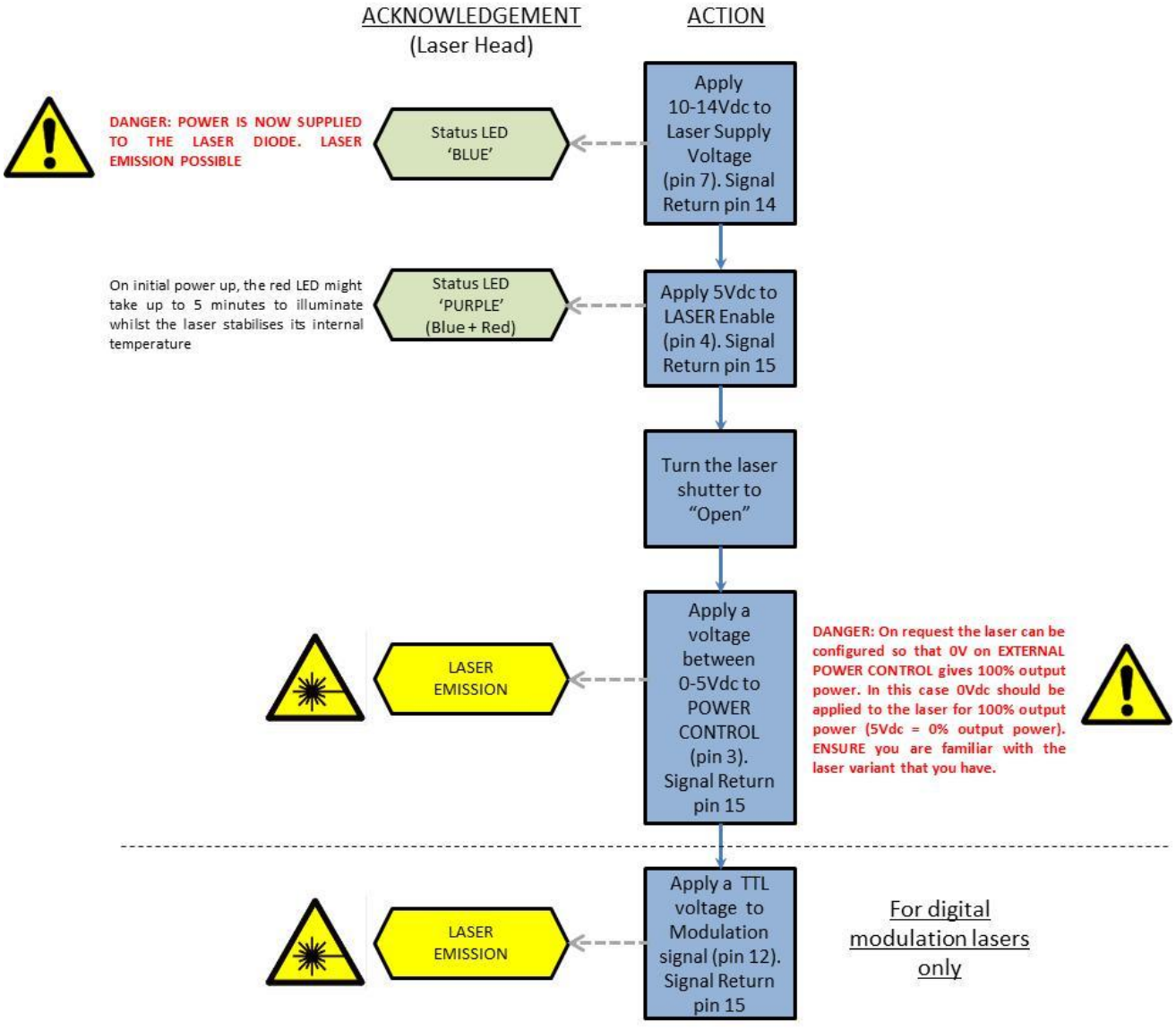


Figure 5-10: Recommended operational flow chart for the startup sequence of iFLEX-iRIS™ lasers for OEM integrators

5.6.2 Shutdown sequence for iFLEX-iRIS™ lasers

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

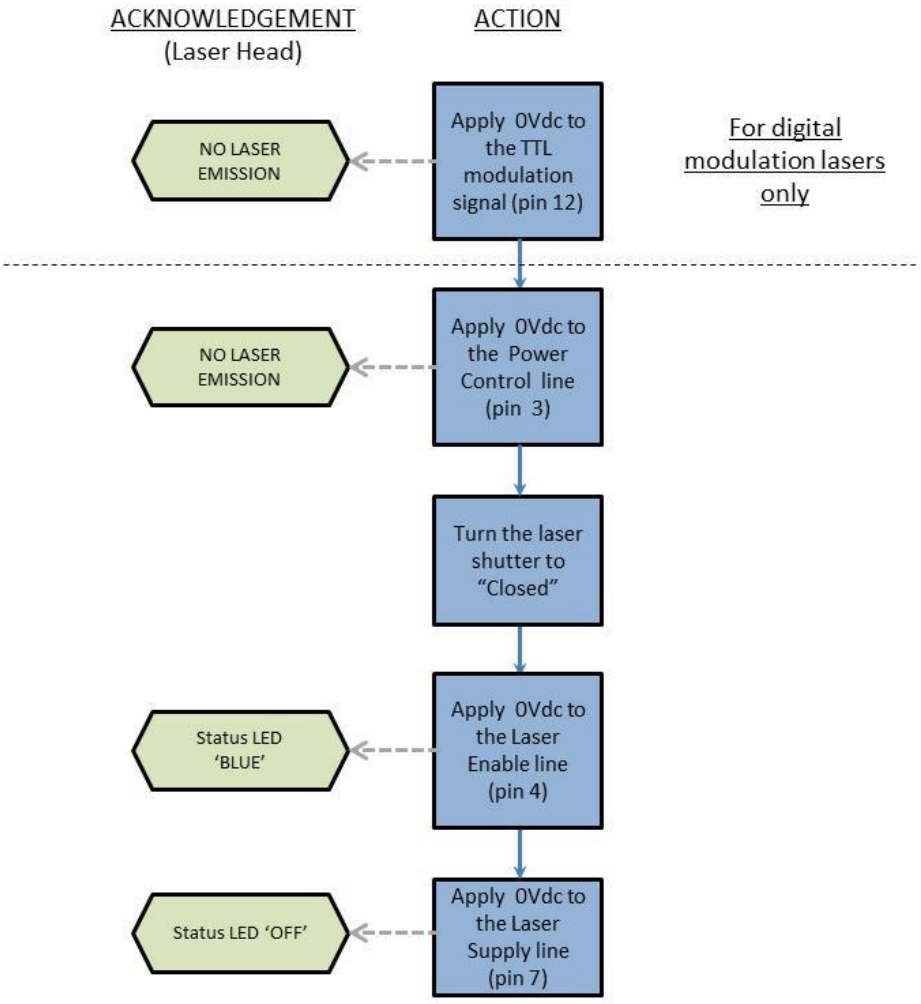


Figure 5-11: Recommended operational flow chart for the shutdown sequence of iFLEX-iRIS™ lasers for OEM integrators

6 - CARE AND MAINTENANCE

6.1 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.

6.2 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.

7 - 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.

8 - ORDER CODES

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

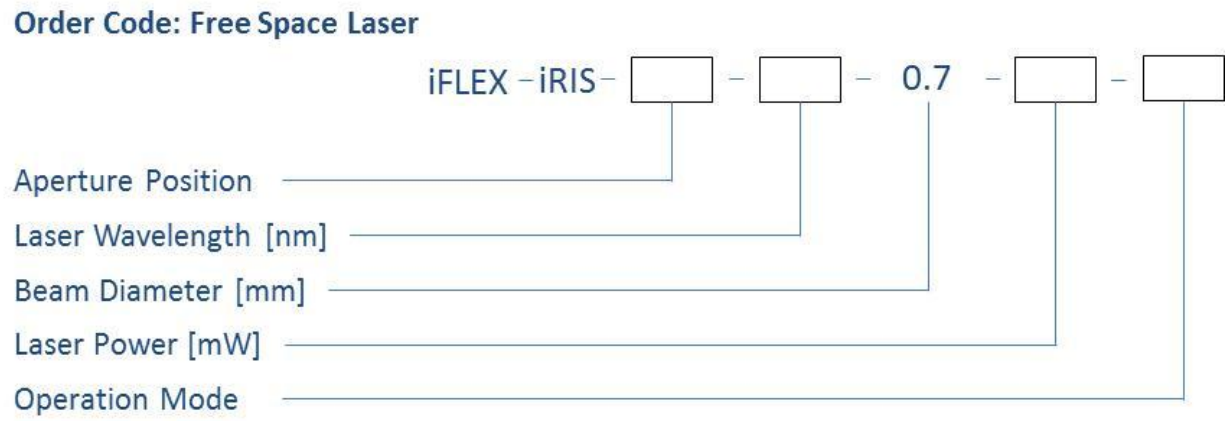


Figure 8-1: Order code structure for the iFLEX-iRIS™ free space lasers

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 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
Operation Mode	CW Operation Only = NP Digital Modulation = T	-

Table 8-1: Selectable fields in the order code structure for the iFLEX-iRIS™ free space lasers

For example, the code: iFLEX-iRIS-X0-405-0.7-50-NP would represent a free space 405nm laser with a centralized 0.7mm output beam, an output power of 50mW and the ability to change the CW output power from 0-100%.

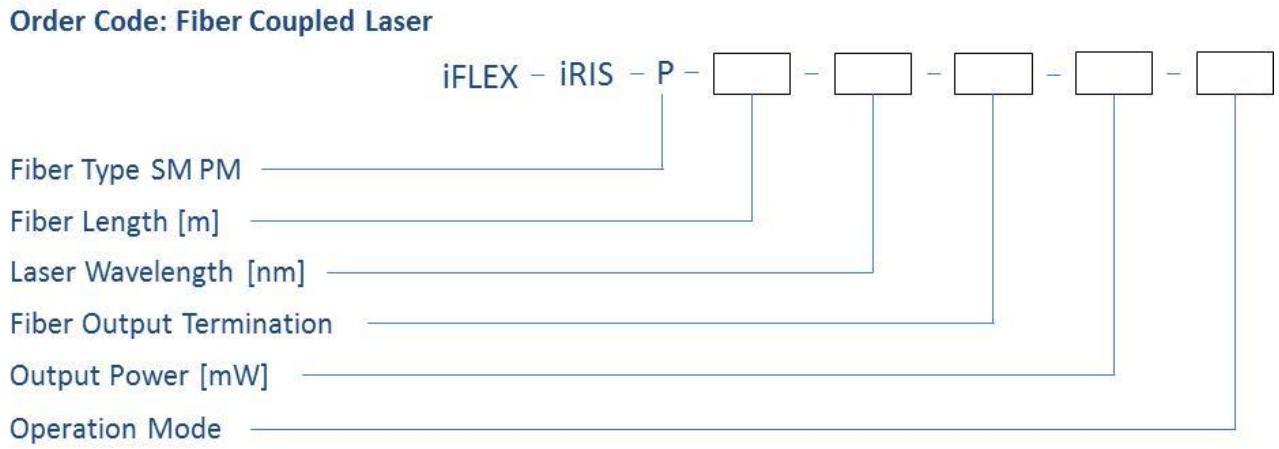


Figure 8-2: Order code structure for the iFLEX-iRIS™ fiber coupled lasers

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 2-1 for available options	nm
Fiber Output Termination	0.7mm collimated, FCP, FCP8, APC	-
Output Power (Fiber)	See Table 2-1 for available options	mW
Operation Mode	CW Operation Only = NP Digital Modulation = T	-

Table 8-2: Selectable fields in the order code structure for the iFLEX-iRIS™ fiber coupled lasers

For example, the order code: iFLEX-iRIS-P-2-640-FCP8-20-T would represent a 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 laser would be capable of digital modulation.

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 11 for contact details.

9 - 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 11 for contact details.

Fault	***Possible Cause***	***Remedy***
Emission Indicator not emitting on Interlock Control Box after the RESET button is pushed.	1. AC power not switched ON to the power supply. 2. Power supply not correctly connected to the interlock control box. 3. Key switch on interlock control box not in ON position. 4. Safety interlock circuit not closed. 5. RESET button not pushed.	1. Check AC mains supply to the power supply. 2. Check power supply securely connected to the interlock control box 3. Turn the key switch on the safety interlock box to the ON position. 4. Check the interlock circuit is closed circuit. Ensure all external safety circuits are closed. 5. Push the RESET button.
Status LED on laser = OFF but emission indicator on Interlock Control Box = ON.	1. Interlock Control Box is not properly connected to the laser. 2. Other.	1. Ensure that the interface lead from the interlock control box is securely fastened to the back of the laser. 2. Contact Qioptiq.
Status LED on laser = OFF. OEM users	1. 10-14Vdc power supply is not connected to the laser 2. 10-14Vdc power supply is not on. 3. 10-14Vdc power supply is not connected to pin 7 on the laser control I/O connector with the return pin connected to pin 14 4. Other.	1. Ensure the I/O connector is securely fastened to the back of the laser. 2. Check that the 10-14Vdc signal is present on the I/O connector 3. Check that the 10-14Vdc signal is on the correct pin on the I/O connector 4. Contact Qioptiq
No Emission ready indication (Status LED remains blue and does not turn purple)	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 at 5V and the signal return (pin 14) is connected to the return connection of the 5V power supply. 2. Check the voltage of the Temperature OK signal. If output is still low (< 4.5V) after the maximum warm up time (5min) contact Qioptiq.

Fault	*Possible Cause*	*Remedy*
No laser emission	1. Power control line is not set correctly. 2. For OEM users: power control line is not connected to Pin 3 on the I/O connector. 3. Shutter closed.	1. Confirm the power control logic of the laser you have purchased. (Default operation: 5Vdc = max. output) a. For 0-5V control, ensure Power Control input has 5V on the input signal. b. For 5-0V control, ensure Power Control input has 0V on the input signal. (Only available for OEM users) 2. For OEM users: Ensure power control signal is applied to Pin 3 on the I/O Connector. 3. Ensure that the shutter is in the Open condition – screw slot parallel to the direction of the laser light.
No Temperature Lock (signal < 4.5V on Temperature OK line)	1. The unit has not completed its warm up period. 2. An insufficient heat sink has been fitted.	1. Allow unit 5min to warm up. 2. Ref to section 3.2 for correct heat sink ratings.
Power control 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 power control input is not in the correct range.	1. Check the BNC cable used to interface with the safety interlock box for correct operation. 2. Ensure a good connection is made with the power control input pin. Ref to section 4 for pin-out of I/O connector. 3. Ensure the signal to the power control input is in the correct range of 0-5V.
Enable Line not working	1. Broken wire from user signal to the interlock control box. 2. Enable signal not connected to correct wire on power supply 014454. 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 signal to the interlock control box. 2. Ensure control line connected to blue wire (labeled Laser Enable) on power supply 014454 3. Ensure control line connected to pin 4 on I/O laser connector. 4. Check the Enable line voltage is between 3.2-5.1Vdc.

Fault	*Possible Cause*	*Remedy*
Operating current output signal (Vop) is zero	1. Laser not emitting 2. Broken wire to user monitoring unit. 3. Not connected to correct IO pin on interlock control box. 4. Not connected to correct IO pin on the laser I/O connector.	1. Ensure correct Enable line and power control are applied and enabled. See section 4 for details on signals. 2. Check continuity from the laser I/O connector to the monitoring point. 3. Ensure monitoring line connected to the yellow wire (Vop) on power supply 014454. 4. Ensure monitoring line connected to pin 2 on the laser I/O connector.
Monitor Photodiode Output (Vmon) signal is zero	1. Laser not emitting 2. Broken wire to user monitoring unit. 3. Not connected to correct IO pin on interlock control box. 4. Not connected to correct IO pin on the laser I/O connector.	1. Ensure correct Enable line and power control are applied and enabled. See section 4 for details on signals. 2. Check continuity from the laser I/O connector to the monitoring point. 3. Ensure monitoring line connected to the green wire (Vmon) on power supply 014454. 5. Ensure monitoring line connected to pin 1 on the laser I/O connector.
Low optical output power from free space laser	1. Power control 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 “Power 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. Power control 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 Appendix for correct kineMATIX® alignment procedure. 2. Refer to “Power 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.

10 - APPENDIX

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

10.1 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 10-1. 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

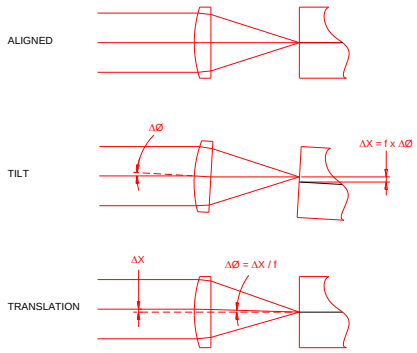


Figure 10-1: Principles of Operation

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 10-2) 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**.

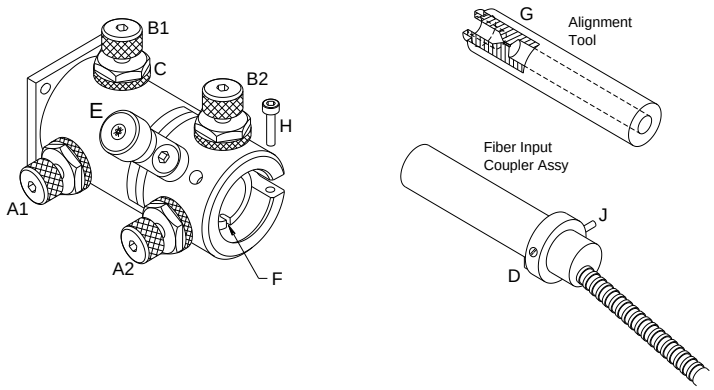


Figure 10-2: 3D exploded view of manipulator and fiber

11 - 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@qpl.qioptiq.com