800-613-01

SuperK
FIANIUM

Product Guide

Revision 1.6 09-2023

NKT Photonics

PRODUCT GUIDE

This guide includes information for the following NKT Photonics products:

SuperK FIANIUM

White Light Laser

CAUTION: Do not open the laser chassis. The laser is equipped with warranty labels (see Figure 73) on the covers of the laser chassis. The warranty is void if the system is opened.

CAUTION: The laser is heavy and weighs 18 to 19 kg. Use safe lifting procedures in compliance with regional regulations.

Manufactured by:

NKT Photonics A/S
Blokken 84, Birkerød-3460 Denmark

Guide overview

This product guide is intended to provide functional, operational and installation information for the SuperK FIANIUM laser systems and includes the following sections:

- **SuperK FIANIUM Description** – introduces the laser's theory and functionality, its features and interfaces, and describes the safety labels and their placement.
- **Installing the Laser** – includes the details on how to install the laser chassis and connect it to the management platform and your application systems.
- **Operating the Laser** – provides information and procedures on how to configure communications with the laser and manage its operation.

For information on how to safely deploy and operate the laser refer to the following documents:

- *SuperK FIANIUM Safety, Handling and Regulatory Information*

CAUTION: Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

Target Audience

This guide is for technical personnel involved in the selection, planning and deployment of lasers in laboratory and industrial settings. The guide assumes a reasonable knowledge level of lasers, photonic principles and electrical interface connectivity.

Chapters Inside

This guide includes the following chapters:

- Chapter I "Laser Description" — Describes the SuperK FIANIUM laser series including its general operational principles, management and interfaces.
- Chapter 2 "Mechanical Installation" — Includes information and procedures on how to correctly install the laser chassis. Procedures within this chapter focus on ensuring adequate temperature regulation.
- Chapter 3 "Connecting the Laser" — This chapter provides information on how to physically connect the safety interlock, power, the optical collimator, and the synchronization interfaces.
- Chapter 4 "Connecting External Control" — This chapter includes details on how to implement external signals to modulate the output, enhance power stability and gate the output pulses.
- Chapter 5 "Front Panel Controls" — Describes the laser's front panel menu and controls to directly operate the laser without a PC.

- Chapter 6 “Using CONTROL to Turn ON the Laser” — Provides information and procedures on how to connect to the laser’s PC-based management software and use it to turn the laser emission ON and OFF.
- Chapter 7 “CONTROL Interface” — Includes descriptions and procedures of all other CONTROL menu and panel items.
- Appendices — The guide includes multiple appendices including laser specifications, support contact details, pinout information, accessory descriptions and miscellaneous procedures supporting the laser operation and installation.

Added information and Safety Notices

Lasers are highly dangerous devices that can cause serious injury and property damage. This guide use the following symbols to either highlight important safety information or provide further information in relation to a specific topic.

NOTE: Highlights additional information related to the associated topic and/or provides links or the name of the NKT guides describing the additional information.

CAUTION: Alerts you to a potential hazard that could cause loss of data, or damage the system or equipment.

WARNING: The laser safety warning alerts you to potential serious injury when using the laser.

Revision

The section records the document revision details.

Release datev	Version and changes
2020-September	1.0 first release
2020-October	1.1 Updated External feedback feedback description
2020-October	1.2 Updated Interlock descriptions and added additional synchronization and gate cabling specifications throughout.
2020-December	1.3 The following changes were made: Updated power button usage descriptions. Added Appendix C External Bus Pinout.
2021-January	1.4 The following changes were made: Updated support contact details in Appendix B. Rearranged paragraph order of Appendix D.
2021-April	1.0 Revision rolled back to 1.0 due to internal system requirements.

Release datev	Version and changes
2021-June	1.1 The following changes were made: Removed the incorrect note describing *External mode* on page 59. Corrected the description of *External mode* under Figure 24. Changed the text description and cross-references in section "External Feedback mode" on page 94.
2022--January	1.2 The following changes were made: • Added OCT versions to Table 1 on page 22. • Updated Figure 3 on page 23. • Updated Figure 13 on page 46. • Updated Figure 14 on page 47. • Added "Grouping connections" on page 75. • Added "Ethernet" on page 86. • Added "External Feedback" on page 88. • Updated Procedure 18 on page 119 to Windows 10. • Updated language throughout to improve clarity. • Changed the figure arrows and other figure highlights throughout.
2022-March	1.3 revision – updated the following: • Added section "Termination necessary" on page 52.
2022-March	1.4 revision – updated the following: • Updated text and figures in section "Connecting the safety interlock" on page 42 and its subsections.
2022-May	1.5 revision Updated the following: • Table 13 on page 56 and Table 14 on page 57 removed incorrect RG59 cable specification and changed to RG58. Added the following: • Added section "Shipping the laser" on page 104.
2023-September	1.6 revision • Front and back covers replaced. • Reformatted the entire manual using updated style and figure types. • Corrected existing grammar, naming errors and reworded some text for clarity. • Updated Table 1 on page 22. • Removed extended spectrum modification from section "Accessories" on page 22. • Updated Figure 2 on page 23. • Removed the table in section "Beam diameter" on page 24 and listed new beam diameters. • Updated Procedure 16 on page 104 and Procedure 17 on page 107 to show the laser with correct red paint. • Removed the FD specifications from "SuperK Connect and Fiber Deliver System" on page 117.

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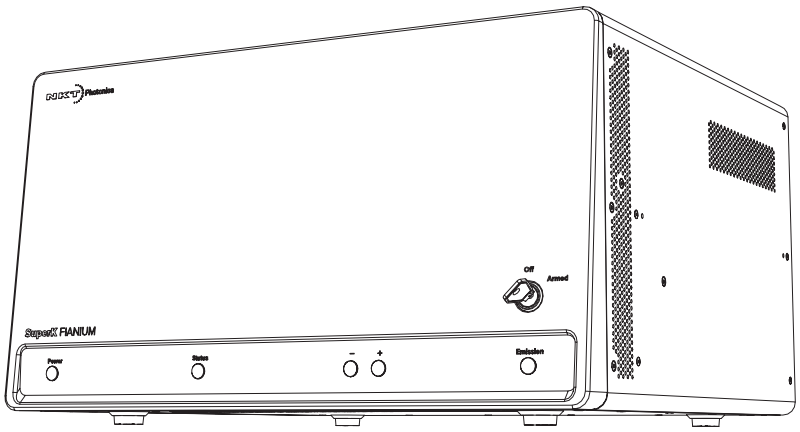
Section 1 Description

This section describes the laser and its features and includes the following:

1 Laser Description

SuperK FIANIUM lasers are a series of Class 4 white light lasers (WLL) systems that generate a pulsed supercontinuum. Light frequencies from 390 to 2400 nanometers (typical) are emitted in a single spatially coherent beam with a pulse rate that is customizable to suit the intended application. To synchronize external equipment with either the seed or output pulse repetition rate, the laser includes synchronization output ports that can transmit pre or post pulse picker signals with standard industry voltage levels.

Figure 1 SuperK FIANIUM general view



Terminology

The SuperK FIANIUM series includes the models listed under “PRODUCT GUIDE” on page 2. This guide uses the term, “laser” to refer to all SuperK FIANIUM laser variants. When information related to any specific variant is noted, the model name is specified.

Front panel controls

The front panel of the laser is equipped with display and control buttons. The buttons provide basic laser control functions and the display shows the: output emission level, emission status and system errors and notifications. For a full description, see “Front Panel Controls” on page 61.

CONTROL

The laser and its accessories can be operated and configured remotely from a PC using NKT Photonics CONTROL software. The PC connects to the laser over either RS232, USB, or Ethernet links. To configure accessories using the same PC, the laser is equipped with an external bus port which connects up to eight accessories in a daisy chain. Connecting and managing the laser with CONTROL is described in “Using CONTROL to Turn ON the Laser” on page 71.

Temperature regulation The temperature of the laser is regulated by the use of cooling fans. To dissipate generated heat, the fans draw cool air into the laser from the vents on the left and right panels of the laser. The heated air is then blown out through the rear exhaust vents. The fan speed is automatically adjusted to maintain a stable laser temperature. To maintain proper airflow, install the laser with adequate clearance as described in "Mechanical Installation" on page 39.

Accessories Optional accessories combined with the laser can modify the output beam. Depending on the accessory, the laser's beam can be modified to achieve a narrow or wide band. An overview of accessories is found in Appendix D.

Optical output

Supercontinuum Supercontinuum is a term used to describe a collection of non-linear effects that cause a considerable widening of the spectral range of optical pulses. This broadening phenomenon arises from the interaction between the seed pulses and a medium. As the power of the input pulses increases, the extent of spectral broadening also intensifies. Consequently, the spectral output becomes wider in direct proportion to the output power.

Optical specifications Table 1 lists the optical specifications for the SuperK FIANIUM models.

Table 1 Optical specifications

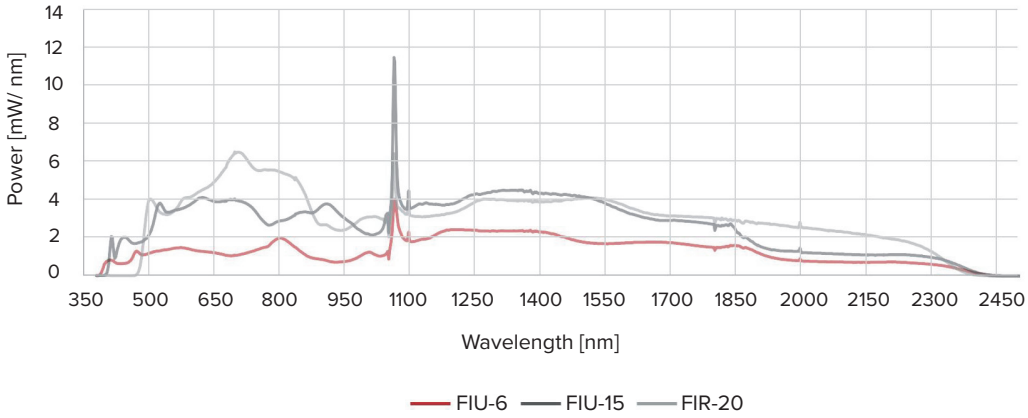
	Standard versions			OCT versions	
Model	**FIU-6**	**FIU-15**	**FIR-20**	**FIR-9**	**FIU-6**
Repetition rate [MHz]	78	78	78	312 ±3	312 ±3
Variable repetition rate [MHz][i]	0.15 to 78	0.15 to 78	0.15 to 78	-	-
Spectral power density [mW/nm]	0.6 @ 450 nm	2.0 @ 450 nm	N.A	N.A	0.5 @ 450 nm
	1.3 @ 532 nm	4.0 @ 532 nm	3.2 @ 532 nm	N.A	0.9 @ 532 nm
	1.2 @ 650 nm	4.0 @ 650 nm	4.7 @ 650 nm	0.6 @ 650 nm	1.2 @ 650 nm
	1.8 @ 780 nm	2.5 @ 780 nm	5.4 @ 780 nm	3.2 @ 780 nm	2.0 @ 780 nm
	2.0 @ 800 nm	2.8 @ 800 nm	5.2 @ 800 nm	3.5 @ 800 nm	1.6 @ 800 nm
Visible power (380-850 nm) [W]	≈ 0.6	≈ 1.5	≈ 2.0	> 0.9	> 0.6
Total power [W]	≈ 2.2	≈ 5.5	≈ 6.5	≈ 6.5	≈ 6.5
Power stability [%][ii]	± 0.5	± 0.5	± 0.5	± 0.5	± 0.5
Cut-in wavelength (>1 mW/nm) [nm]	400	415	475	< 640	< 425
Polarization	Random	Random	Random	Random	Random
Beam quality	M^2 < 1.1	M^2 < 1.12[iii]	M^2 < 1.1	Diffraction limited	Diffraction limited
Beam diameter [mm @ nm]	≈ 1 @ 532, ≈ 2 @ 1100, ≈ 3 @ 2000			≈ 1 @ 532, ≈ 2 @ 1100, ≈ 3 @ 2000	
Beam pointing accuracy [mrad][iv]	< 1	< 1	< 1	< 1	< 1

i. Rates only available when optional VRR (pulse picker) is included.
ii. Average of a 2-hour measurement of the visible spectrum. The note stability per filtered line may vary with wavelengths.
iii. Wavelengths greater than 450 nm.
iv. Measured relative to the mechanical axis running through the center of the collimator.

Spectral output

Figure 2 shows the typical output spectrum graphs of three SuperK FIANIUM series models.

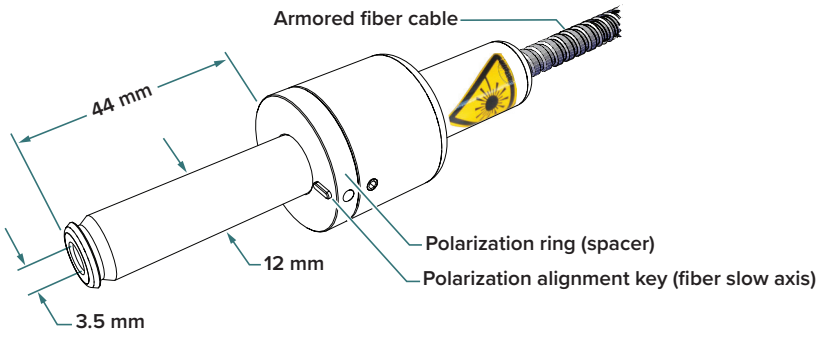
Figure 2 Typical output spectrum – SuperK FIANIUM



Collimator

The laser's optical output is delivered through an armored fiber cable, terminating with a collimator (shown in Figure 3). The collimator emits a tightly focused beam, which is directed out of a steel sleeve connector. This connector is specifically designed to be inserted into a receptacle of a target optical device, such as a SuperK accessory, holder, or other purpose-built optical device. Once inserted, the robust construction of the collimator ensures the continued alignment of the output beam.

Figure 3 SuperK FIANIUM collimator



CAUTION: Avoid scratching the collimator as this may prevent it from sliding into an input receptacle.

NOTE: It is recommended to fix the collimator using plastic screws instead of metal screws to minimize scratches or other damage to the collimator.

Collimator heat dissipation

A small fraction of the beam power is dumped within the collimator. If the thermal contact between the collimator and the mount or receptacle is inadequate, the collimator can become significantly warm. NKT Photonics recommends that you ensure there is thermal contact between the collimator and its mount/receptacle.

Beam diameter

To maximize the output light coupling with a single mode fiber, the output beam is collimated with an achromatic lens. The lens is designed so the coupling is optimized for maximum average coupling across the visible spectrum. Consequently, the beam is somewhat larger for infrared as compared to visible wavelengths. Approximate beam diameters for two wavelengths at the collimators are given below:

- Beam diameter @ 500nm ~ 1mm
- Beam diameter @ 1000nm ~ 2mm

Factory test report

SuperK FIANIUM laser systems are available in multiple configurations with different spectral and power performance. The system performance of each laser is described in a factory created test and measurement report. Refer to this report for the spectral performance of each individual SuperK FIANIUM system.

SuperK FIANIUM laser systems are offered in various configurations, each having distinct spectral and power characteristics. Detailed information regarding the performance of each laser system can be found in a dedicated test and measurement report prepared by the factory and included with the laser. Specific spectral performance details for each SuperK FIANIUM system are found in the report.

Output polarization

At low output power, the supercontinuum output is elliptically polarized and the direction of the polarization vector and the degree of polarization varies with time. When increasing the output power, the degree of polarization decreases; at maximum output, the light is nearly unpolarized.

Polarization ring

A polarization ring is always combined with the collimator as shown in Figure 3. The ring has an alignment pin to ensure the optical output is correctly polarized with an accessory or other application. When the collimator is inserted into an accessory input receptacle, the ring also acts as a spacer to correctly position the collimator.

CAUTION: Always ensure the collimator is fitted with a polarization ring when used with an NKT Photonics accessory such as a SELECT, VARIA, SPLIT or LL-TF.

Pulse picker – VRR (optional)

The optional factory-installed pulse picker or Variable Repetition Rate (VRR) module is capable of suppressing emission output pulses, reducing the repetition rate of the system. For systems without VRR, the output pulse frequency is fixed to 78 MHz for standard systems and 312 MHz for OCT systems.

Repetition rates

When using VRR, the output repetition rate can be lowered by a factor up to 512. Table 2 shows the repetition rates for a sample laser operating with a standard 78 MHz seed laser. Employing VRR or pulse picker operation reduces the output power level but not the pulse spectral shape. Reducing pulse power without using a pulse picker, the spectral shape of the output pulse is distorted.

Table 2 Frequency versus VRR factor

Seed frequency MHz	VRR factor	Seed frequency MHz	VRR factor
78	1:1	3.9	1:20
39	1:2	3.5	1:22
26	1:3	3.1	1:25
19.5	1:4	2.9	1:27
15.6	1:5	2.7	1:29
13	1:6	2.4	1:32
11.1	1:7	2.3	1:34
9.8	1:8	2.1	1:37
8.7	1:9	2.00	1:40
7.8	1:10	1.22	1:64
6.5	1:12	0.61 (or 610 kHz)	1:128
5.6	1:14	0.30 (or 300 kHz)	1:256
4.9	1:16	0.15 (or 150 kHz)	1:512
4.3	1:18		

NOTE: Other possible configurations of repetition rates may be available depending on the laser's specifications. Contact NKT Photonics for further information.

NOTE: The repetition rate can only be set using either NKT Photonics CONTROL management software or Software Development Kit (SDK).

Using VRR

If the repetition rate is changed while the system has emission on, the system momentarily disables emission, changes the repetition rate and then re-enables emission. The complete sequence takes only a fraction of a second. To set the rate, see "Setting the pulse repetition rate (pulse picker)" on page 95.

Output power

Increasing the repetition rate increases the output power level. For example, if the repetition rate is changed from 2 MHz to 78 MHz, the output power increases by a factor of 40 (80/2). This is due to the laser being calibrated for constant pulse energy and not for constant average power.

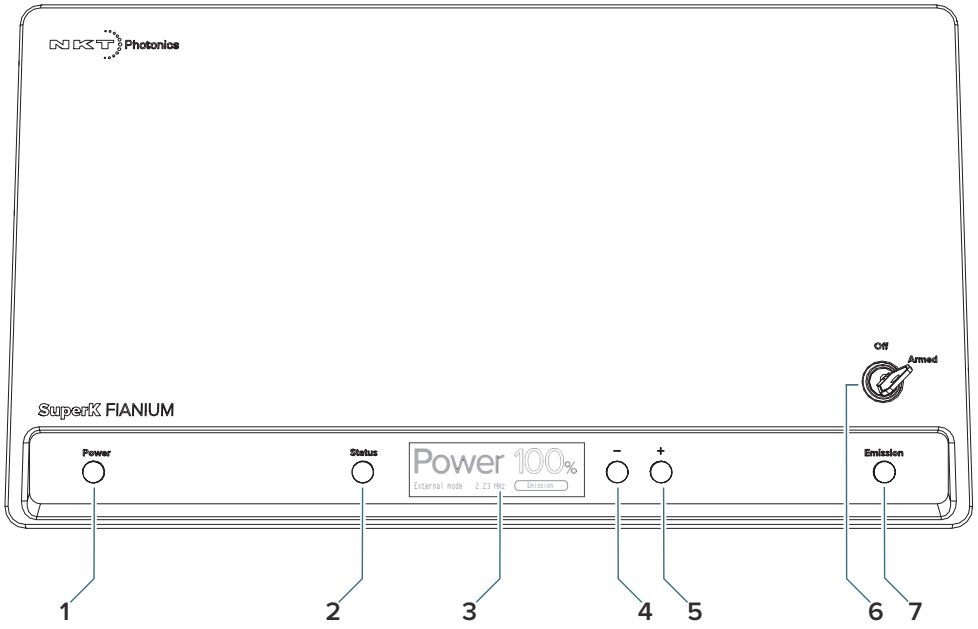
Reflection monitor

The SuperK FIANIUM is equipped with a reflection monitor to avoid damage from back reflections that can destroy the system. When the reflection monitor detects a back reflection that exceeds the limit, the laser shuts down and CONTROL software displays the error code: “Code 48, 5 0x65”. See “Error codes - CONTROL” on page 126.

Front panel controls

Front panel controls are highlighted in Figure 4. To directly operate the laser, the front panel provides both user controls and a display.

Figure 4 Front panel controls



1 Power button
2 Status button
3 Display panel
4 Power down button
5 Power up button
6 Key switch
7 Emission button

Power button Press this button to turn all system modules ON or OFF. The power button must be pressed for approximately 1 to 2 seconds to turn ON or OFF the system.

Status button Press this button to view the next page available in the display.

NOTE: If the screen is dimmed, press status once to brighten it.

Display panel OLED display panel showing system power, emission status, errors, notifications and more.

Power down button Press this button to reduce the configured emission power.

Power up button Press this button to increase the configured emission power.

Key switch Key control of laser emission:

- When turned to OFF, emission is disallowed.
- When turned to ARMED, emission is permitted.

NOTE: When the key switch is turned to OFF, emission is immediately disabled and cannot be re-enabled. When turned to the ARMED position, you can enable emission using emission controls.

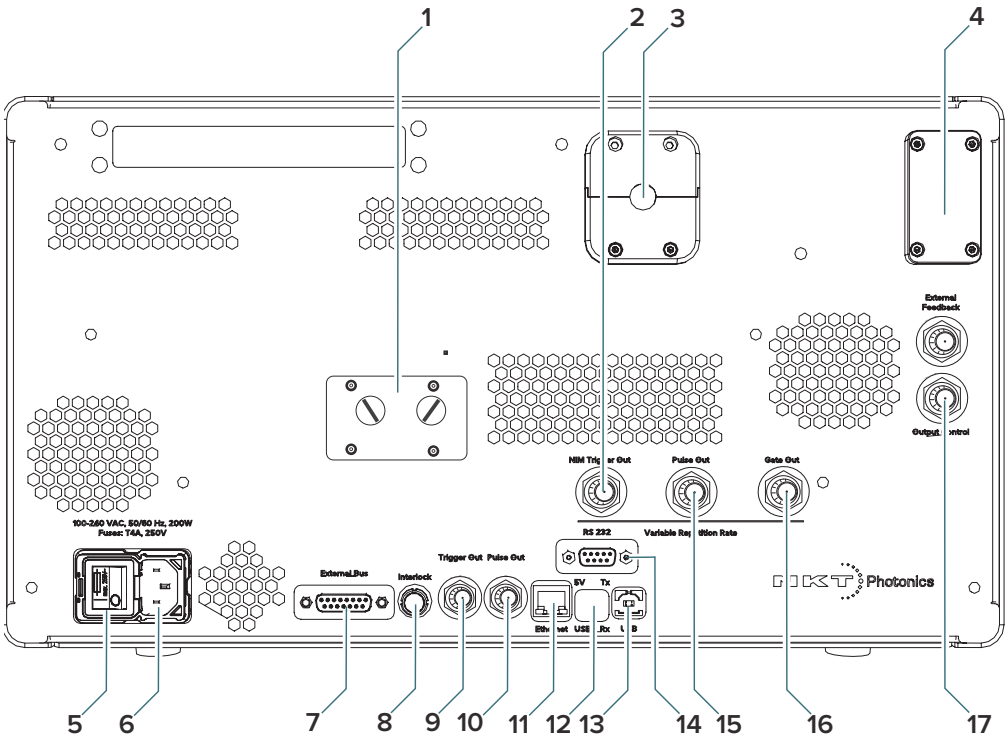
Emission button Press this button to enable or disable emission.

NOTE: For details on using the front panel controls, see “Front Panel Controls” on page 61.

Rear panel

The rear panel houses the electrical ports and status LEDs. The panel and its components are shown in Figure 5.

Figure 5 Rear panel features and connectors



1 Collimator holder - storage
2 NIM Trigger out (post-VRR) – BNC[i]
3 Collimator and Armored Cable Assembly
4 External Feedback – BNC
5 ON/OFF power switch
6 AC power connector – IEC13
7 External bus – DB-15
8 Interlock – LEMO plug door switch connector
9 Trigger out (pre-VRR) – BNC
10 Pulse out (pre-VRR) – BNC
11 Ethernet port – RJ-45
12 Status LEDs
13 USB port – type B
14 RS-232 serial port – DB-9
15 Pulse out (post-VRR) – BNC[i]
16 Gate out (post VRR) – BNC[i]
17 Booster ON/OFF – BNC

i. Only with VRR option

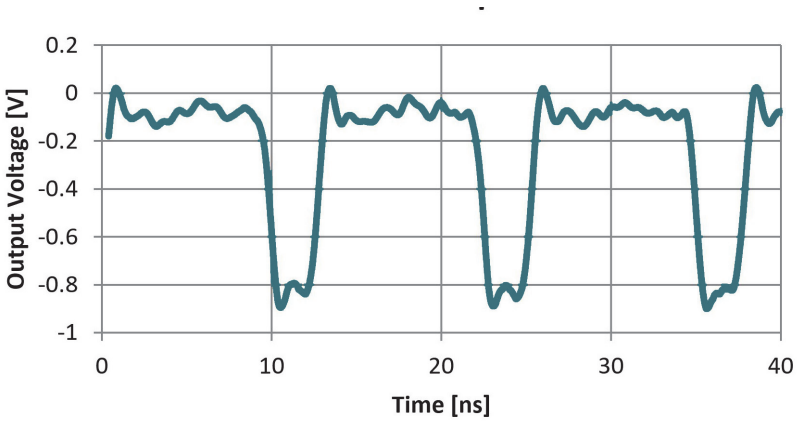
Input and output BNC ports

Pre-VRR ports These interfaces provide synchronization signals that represent the laser pulse output after the optional VRR module.

Trigger out
This signal represents the seed pulse of the laser prior to the optional VRR module (see Figure 5). You can use the signal to synchronize external devices to the seed frequency of the laser. The signal is NIM compliant (see standard

DOE/ER-0457) and ranges from 0 to approximately -1 V as shown in Figure 6, For further information, see “Connecting synchronization ports” on page 50.

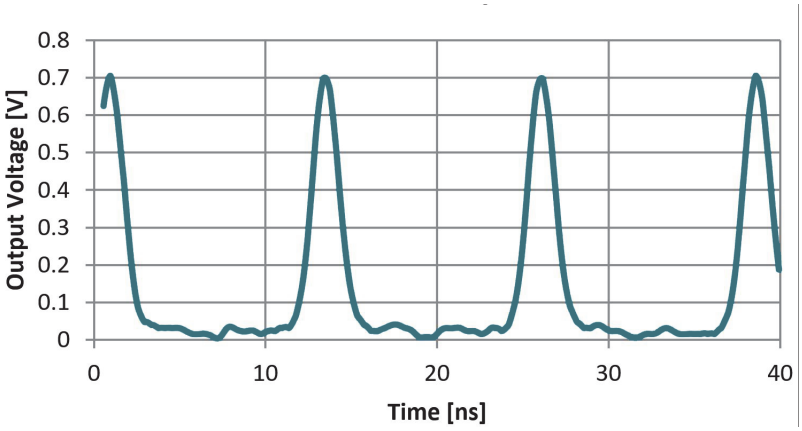
Figure 6 NIM pulse output



Pulse out

This signal represents the seed pulse of the laser prior to the optional VRR module (see Figure 7). You can use the signal to synchronize external devices to the seed frequency of the laser. The signal is an analog output that ranges from 0 to +0.7 V. For further information, see “Connecting synchronization ports” on page 50.

Figure 7 Pulse output



Post-VRR ports

These interfaces provide synchronization signals that represent the pulse output after the optional VRR module.

NIM Trigger out

The port outputs a NIM level signal similar to the pre-VRR “Trigger out” on page 28. However, this signal is synchronized with the laser pulse output following the VRR module. The signal is NIM compliant (see standard DOE/ER-0457) and ranges from 0 to approximately -1 V. A typical NIM Pulse signal is shown in Figure 6. For further information, see “Connecting synchronization ports” on page 50.

Pulse out
The port outputs a signal similar to the pre-VRR “Pulse out” on page 29. However, this signal represents the laser pulse output following the VRR module. The signal is intended for applications that require a positive bias synchronization signal for external devices. Its output level ranges from 0 to +1.2 V (approximately). For further information, see “Connecting synchronization ports” on page 50.

Gate out
This port outputs a digital signal from 0 to +1.2 V (approximately). A high logic signal indicates a pulse passed through the VRR, whereas a low level indicates pulses are suppressed. The output signal frequency is synchronized with the configured repetition rate of the laser after the VRR module. For further information, see “Connecting synchronization ports” on page 50.

NOTE: In any application, the fiber and cable lengths used may add to the delay between pulses measured on any of the pulse monitoring ports.

External Feedback

The purpose of the external feedback port is to establish an input connection for controlling and stabilizing the laser emission power. This BNC port can accommodate input voltages ranging from 0 to 4.1 V. Typically an external detector circuit measures the laser’s emission and outputs a voltage proportional to the emission power. The laser, in response, evaluates this voltage and makes continuous adjustments to the emission power in order to maintain a consistent voltage level at the port, effectively establishing a power lock.

NOTE: Feedback voltage variations above 100 Hz cannot be accurately detected by the sampling circuit. Refer to “External feedback” on page 55 for further information on how to employ a feedback circuit.

NOTE: Due to the fiber and cable lengths used, a delay is present between pulses measured on any of the pulse monitor ports.

Booster ON/OFF

This input works with a booster control feature that provides fast rise time ON/OFF control. A TTL or CMOS level square wave applied at the port, turns the booster ON when the signal is high and OFF when the signal is low.

Maximizing the laser warranty
The laser’s lifetime is influenced by the total usage of the main amplifier. When the application does not require the laser to be ON continuously, you can use this port to optimize the lifetime by minimizing the laser ON time.

WARNING: When this port is connected and the feature turns OFF the laser booster, the laser seed is still ON and low level Class 4 emission is still present at the laser aperture.

WARNING: The Booster ON/OFF port and feature must not be used as a safety interlock.

NOTE: For information on connecting the Booster ON/OFF port, see "Booster ON/OFF" on page 57.

Connecting a PC

The laser is managed and configured from a PC with NKT Photonics CONTROL application installed on it – see "Configuration and operation overview" on page 32. You can connect the PC to the laser using either a serial or Ethernet connection.

Typically a CONTROL PC is connected over a serial connection using the USB2 Type B port. However, a standard serial RS-232 COM cable may also be used to connect a CONTROL PC's serial port or USB (using a converter) port to the laser's standard DB-9 RS232 port.

NOTE: If both serial ports are connected, the USB2 port has priority.

For remote CONTROL PC operation, a standard 100M RJ-45 Ethernet port is also equipped on the front panel. The laser supports IPv4 networking and the port must be connected to a local subnetwork that is accessible to the subnetwork that the CONTROL PC is connected to.

USB port

This is a USB2 type B port and operates as a USB serial port. In most cases, you should install the serial USB drivers included with the CONTROL installer for your PC to communicate with the port.

Priority
When connected, the laser's USB port has priority for external communication over all other ports.

RS-232 serial port

If you connect your PC to the laser using the serial port, set the PC serial port to the settings listed in Table 3.

Table 3 RS-232 serial port settings

Setting	Value
Baud Rate	115.2 kbps
Data Bits	8
Parity	None
Flow Control	None
Transmitted Text	Append LF
Received Text	Mono-spaced

Ethernet port This port supports an IPv4 connection over 10/100 Mbps Ethernet. Refer to the Ethernet port setup procedure in the NKT Photonics CONTROL instruction manual.

NOTE: Always use shielded twisted pair (STP) cabling when connecting to the Ethernet port.

Configuration and operation overview

You can configure and operate the laser from a PC using either:

- NKT Photonics CONTROL application

  -or-

- a custom software application using the NKT Photonics SDK.

CONTROL application NKT Photonics CONTROL application is a graphical interface that can manage the laser from a PC.

Through CONTROL, you can manage the laser emission state and its power settings. Further parameters such as line settings and bandwidths of various attached accessories can also be configured. Additionally, CONTROL can upload firmware or download the laser's log file.

The chapter: "Using CONTROL to Turn ON the Laser" on page 71 provides the details and procedures on how to connect CONTROL to the laser and enable it. For a description of the interface refer to "CONTROL Interface" on page 81.

NOTE: Multiple lasers can be managed from the same PC using CONTROL. The application automatically detects connected NKT Photonics lasers and their accessories.

Advanced laser control You can also manage the laser by building your own custom platform and software integrating with the NKT Photonics SDK kit. Download the kit and it's documentation from:

https://www.nktphotonics.com/support/

Key switch and interlock safety To enhance safety, the laser is equipped with an interlock and a keyed switch. The two components work together to safely control laser emission. To permit laser emission, the interlock loop must be closed, the key switch must be in the *Armed* position and a software interlock reset must be sent.

The interlock connects to a door switch operated by an access door to the enclosure surrounding the laser emission path. If the door unexpectedly opens, the door switch (interlock) circuit opens and laser emission is immediately shut

down. “Connecting the safety interlock” on page 42 describes details on how to connect the interlock.

Interlock safety reset
If the enclosure door opens and closes, the laser is shut down by the interlock. When the door is closed again, laser emission can be enabled after resetting the interlock either on the front panel or by software – see “Interlock operation description” on page 42. Note that any open or short-circuit in the interlock loop will result in shutting down laser emission.

External bus

The External Bus port connects optional SuperK FIANIUM accessories. The port provides a bus control interface and 12V DC power to optional smart accessories. When multiple smart accessories are utilized with the laser, the bus supports daisy chain connectivity. Smart accessories connected to the External bus are recognized and managed by the CONTROL PC connected through the laser. Further, the bus extends the interlock safety circuit to the accessories. Because of this, the bus defeater must always be placed on the last open External Bus output, otherwise laser emission cannot be enabled as the circuit must be complete. For information on connecting the bus, see " Connecting the external bus".

NOTE: The External Bus only prevents the laser from operating when the Interlock circuit is connected as required by safety regulations.

Status LEDs

The rear panel houses four status LEDs as described in Table 4. The LEDs indicate the status of the laser's USB serial connection with a PC.

Figure 8 SuperK FIANIUM rear panel status LEDs

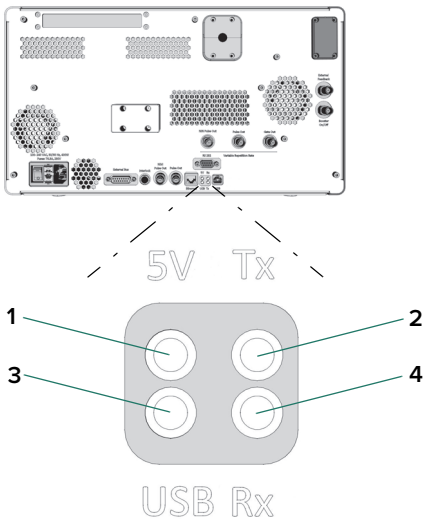


Table 4 Status LEDs

	LED	Condition	Description
1	5V	ON Green	Laser system DC voltage OK
		ON Red	Laser system DC voltage too low
		OFF	Laser system power OFF
2	Tx	Flashing Green	The SuperK FIANIUM is transmitting serial data to a connected PC.
		OFF	No received data detected
3	USB	ON Green	USB serial port is connected and the driver is installed and configured correctly.[i]
		ON Amber	USB serial port is in suspend mode; possibly due to the connected PC deactivating its port.[ii]
		OFF	No USB serial data connection detected.[i]
4	Rx	Flashing Amber	The SuperK FIANIUM is receiving serial data from a connected PC.
		OFF	No transmitted data detected

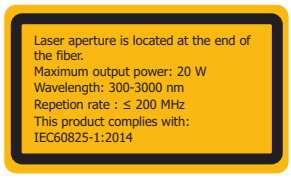
i. If system power is OFF, this LED is lit GREEN when the port connects to a USB source.
ii. The laser's RS-232 serial or Ethernet ports are available.

NOTE: DO NOT OPERATE the laser until you are familiar with the controls and have taken all precautions necessary as described in the *SuperK FIANIUM Safety, Handling and Regulatory Information* document.

Chassis labels

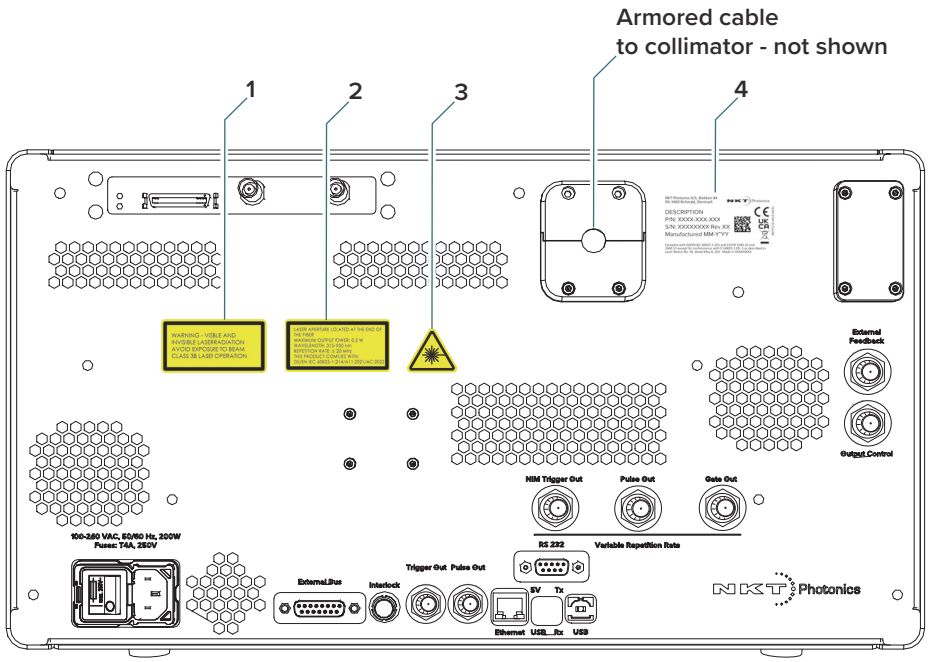
The SuperK FIANIUM chassis includes multiple labels that indicate hazards and regulatory or manufacturing information. The labels are located on the rear panel, the armored fiber cable, and the collimator as described in Table 5. Rear panel label locations are shown in Figure 9.

Table 5 Chassis labels

Label	Panel	Description	
Classification	Rear (1)	Safety information stating the laser emission hazards and the laser's class rating.	
Manufacturing[i]	Rear (4)	Manufacturing information including address, part and serial number, date manufactured and regulatory compliance.	
Laser Radiation Warning	Rear (3)	Safety information alert indicating this area of the laser is near a source of dangerous laser emission.	
Laser Aperture	Collimator	Safety information alert indicating the location of the aperture where laser radiation is emitted from the laser.	
Product[i] information	Rear (2)	Safety information notice indicating the location of the aperture where laser radiation is emitted from, safety compliance information, and key emission specifications.	

i. Exact label text may vary.

Figure 9 Rear panel labels



Section 2 Installing the laser

This section describes how to install the laser and includes the chapters:

2 Mechanical Installation

This chapter presents guidelines mechanically installing the laser with focus on achieving optimal regulation of the laser's temperature.

CAUTION: For reliable operation, the laser should not be exposed to corrosive agents or excessive moisture, heat or dust.

CAUTION: The SuperK FIANIUM laser is heavy. Its weight is approximately 18 to 19 kg, observe and follow all regional safety regulations and techniques when lifting and carrying the laser.

General installation

Install the laser on a level surface that is free from vibrations and ensure the ambient temperature in the vicinity of the laser is stable and free from any factors that could induce temperature fluctuations. Fluctuations in temperature and the presence of vibrations can adversely impact the laser's operation, potentially leading to abnormal performance.

Location and environment

The laser is intended FOR INDOOR USE ONLY and is rated for operation in POLLUTION DEGREE 2 environments.

Positioning

Position the laser to allow convenient access and removal of its AC power cord. It is essential to ensure unobstructed access to both the laser's AC inlet and the AC mains wall outlet to which the AC cord is connected so that it easily disconnected.

Air cooling

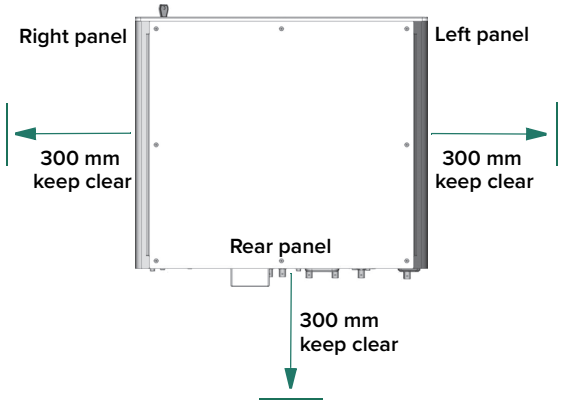
The laser is cooled using a forced air system, which operates by drawing air in through the air inlet vents located on the side panels and expelling it through the exhaust vents on the rear panel. The system incorporates five electrically controlled fans that dynamically adjust the airflow based on the laser's operating temperature. To ensure unobstructed air circulation, it is crucial to maintain a clearance gap in front of both the inlet and exhaust vents, allowing for the unrestricted flow of air.

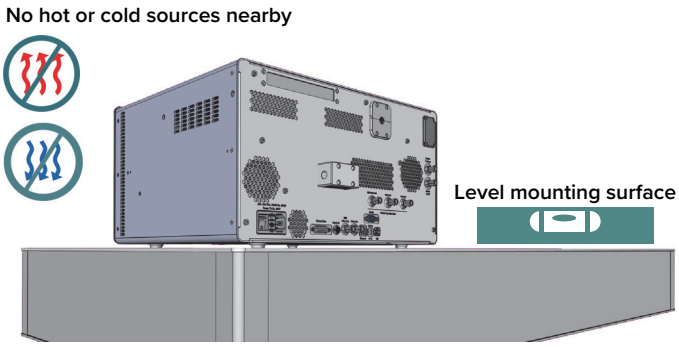
Installation is described in "Installing the laser chassis" on page 40

Installing the laser chassis

Always position the laser in a manner that avoids obstruction of the fan intake and exhaust vents. The laser unit is equipped with four mounting feet, allowing it to be securely placed on any suitable surface that is both level and stable enough to support the weight of the laser.

Figure 10 SuperK FIANIUM placement





Air flow considerations

Specific clearance requirements and recommended ambient operating temperatures are listed in Table 6.

Table 6 Air flow considerations

Requirement	
Side panel gap	A minimum of 300 mm must be clear of obstructions
Rear panel gap	A minimum of 300 mm must be clear of obstructions
Ambient operating temperature	18°C to 30°C (64°F to 86°F)

3 Connecting the Laser

Before operating the laser, follow the procedures in this chapter to ensure its correct and safe operation.

For information on how to connect:

- The safety interlock – see “Connecting the safety interlock” on page 42
- Power – see “Connecting power” on page 44
- The optical output – see “Connecting the optical output” on page 45
- Accessories – see “Connecting accessories with the external bus” on page 47
- Synchronization ports – see “Connecting synchronization ports” on page 50
- External control ports - these ports are described chapter – “Connecting External Control” on page 55

Connecting the safety interlock

To ensure compliance with safety regulations and create a secure operating environment, it is essential to connect the laser's safety interlock to a switch that is activated by accessing the laser's enclosure door.

When the switch connected to the door is opened, it interrupts the interlock circuit, This interruption is detected by the laser, triggering the shutdown of laser emission. To prevent the laser from immediately powering on when the door is subsequently closed, the interlock needs to be reset either through the front panel or software control. The subsequent section provides an overview of the interlock's general operation, while Procedure 1 outlines the steps to connect a door switch to the interlock.

Interlock operation description

The interlock circuit can be understood as a complete looped circuit. When the laser controller's interlock monitor function detects an open or break in this circuit, it immediately initiates a shutdown of the laser.

The loop can be opened by various means, including the keyswitch relay, the door switch circuit, or the external bus loop. In Figure 11, when the keyswitch is turned to the Armed position, a logic circuit within the laser detects this change. When a reset command is issued from the front panel controls or CONTROL software to the laser, the controller sends a set signal to the logic circuit, activating the normally open keyswitch relay.

As long as the door switch is closed and the external bus circuit is looped (shorted) using a Bus defeater, the laser controller's interlock monitor recognizes the closed interlock circuit, allowing laser emission to be permitted.

Figure 11 Interlock connected to a door switch - laser armed

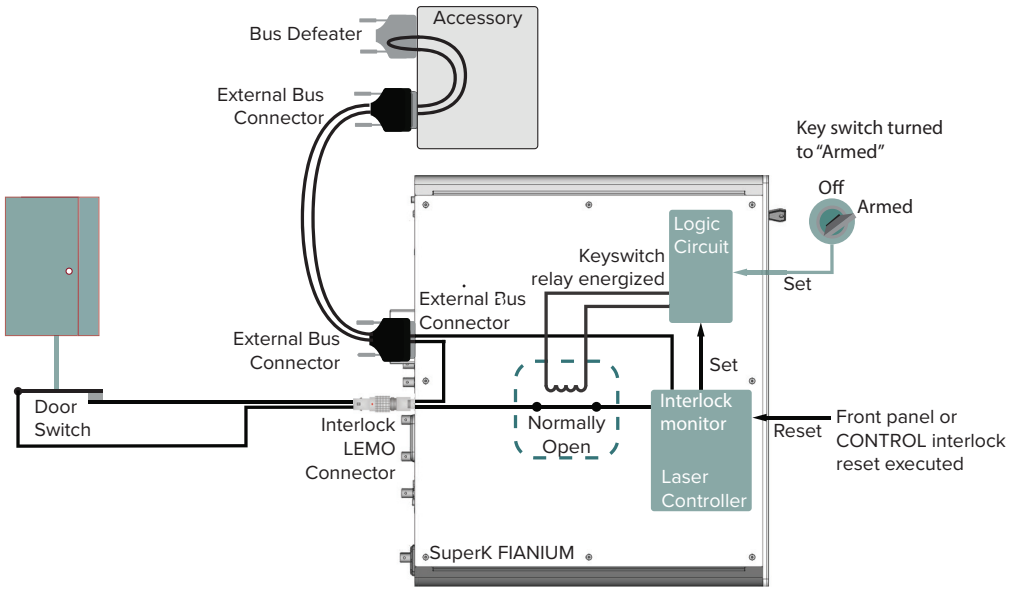
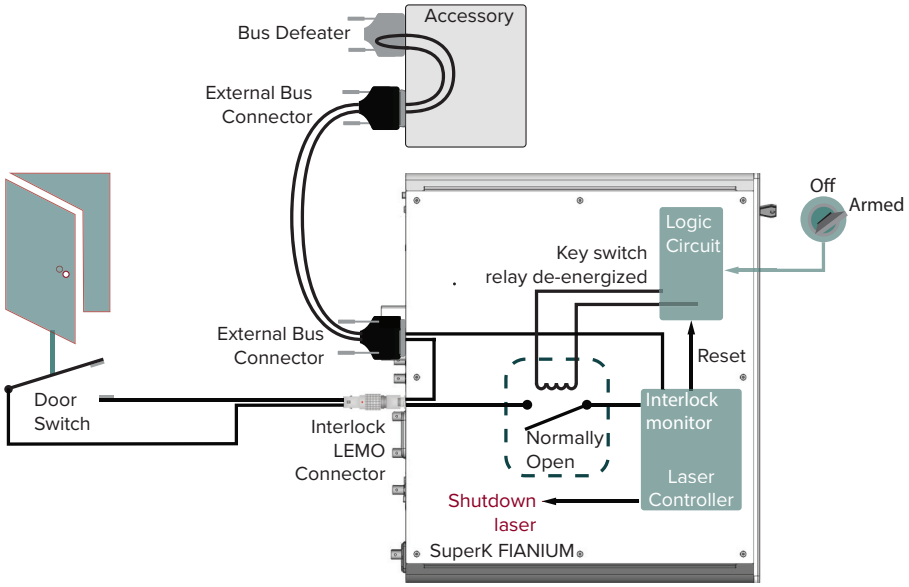


Figure 12 shows the door switch in the open position. This action causes the interlock loop to open, which is detected by the interlock monitor. As a result, the controller promptly sends a shutdown signal to the laser's pump, ceasing laser operation. Simultaneously, a reset signal is transmitted to the logic circuit.

This reset causes the logic circuit to de-energize the keyswitch, leading to the opening of the relay.

Once the door is closed again, it is necessary to reset the interlock using either the front panel controls or CONTROL software. This reset operation triggers the setting of the logic circuit (a D Flip-Flop), resulting in the re-energization of the coil and the subsequent closure of the keyswitch relay, as depicted in Figure 11.

Figure 12 Interlock connected to a door switch - Laser SHUTDOWN



CAUTION: Do not short-circuit the Interlock input. Short-circuiting the interlock circumvents safety regulations and NKT Photonics does not take liability for any injuries or damage caused by doing so.

CAUTION: The switch connected to the interlock must be of an approved type. Additionally, the switch must be installed in a manner that prevents the use of a tool to defeat or bypass its operation.

WARNING: If the interlock is bypassed, personnel may be exposed to hazardous laser radiation. To reduce the risk to personnel, the person or group responsible for operation of the equipment must undertake a risk assessment and provide personnel with appropriate personal protective equipment and safety training.

Safety door switch

Follow the steps in Procedure 1 to connect a door switch to the interlock safety circuit.

LEMO plug

The laser is supplied with a prewired 2-pin LEMO interlock plug, specifically for connecting the laser to a safety door switch circuit. In the event that you require a replacement plug, contact NKT Photonics support. You can find our contact. details on page 99 under the section “Support contact details” on page 103”.

Procedure 1 Connecting the door interlock circuit

	Action
1	Install a switch that complies with local regulations and opens when the door accessing the laser enclosure is opened.
2	Connect the switch to the prewired interlock plug using insulated wire. Ensure that the wire used meets the minimum requirement of 26 AWG gauge and keep the cable length within five meters. For cable lengths longer than five meters, it is recommended to use shielded cable. **NOTE:** Refer to Table 7 for specific interlock circuit specifications.
3	Perform a continuity test using a multimeter: *a.* Connect the multimeter leads to the terminals of the interlock plug. *b.* With the enclosure door closed, confirm that the meter shows the circuit as closed (indicating continuity). *c.* Open the enclosure door and verify that the meter shows the circuit as open (indicating a break in continuity).
4	Insert the LEMO plug into the Interlock connector of the laser, see item 8 - Figure 5.

Table 7 Interlock circuit specifications

Specification	Value
Open loop voltage	12 V maximum
Closed loop voltage	Typically 5 V to ground
Closed loop current	Typically 43 mA

Connecting power

Power is supplied to the laser by connecting it directly to the AC mains. Refer to the specifications in Appendix A for the specific electrical details.

To connect power, follow the instructions in Procedure 2.

Procedure 2 Connecting power

	Action
1	To ensure easy access and removal of the AC power cord, it is important to position the laser in a way that allows unobstructed access to the cord. Both the laser's AC inlet and the AC mains connector to which the AC cord is connected should be free from any obstructions.
2	Connect the AC cord supplied with the laser to the rear 3-pin IEC power input connector.
3	Connect the AC cord to a nearby AC mains supply.
4	Press the power toggle button to the ON position. (The switch is next to the rear IEC power input connector.)

CAUTION: Always connect the laser to an earthed (grounded) AC outlet to comply with regional safety regulations.

CAUTION: DO NOT connect the unit to an AC outlet (power supply) without an earth (ground) connection.

CAUTION: The AC outlet must be near to the laser and easily accessible. You can remove power from the unit by disconnecting the power cord from the outlet.

CAUTION: Ensure you use an approved cord set when supplying AC mains power. The cord set must be suitable for the laser's power ratings and be approved by your regional electrical safety regulations.

CAUTION: The cord's appliance coupler (the connector at the laser; not the wall plug) must be a configuration that mates with an EN 60320/IEC 320 appliance inlet.

Connecting the optical output

Back reflection

When building and connecting your optical system, you must be careful to avoid creating a path where Back Reflection (BR) can occur. BR occurs when a laser beam is reflected back into the laser cavity. This increases noise and may cause the laser beam to scatter causing damage or injury.

You must always reduce the risk of BR into the laser. For example, in a bulk-optic system, ensure all reflective optics are securely fixed, minimizing the risk of back-reflected light into the laser. Also, before turning on the laser the first time, check the optical path to confirm no BR is possible from the application light path.

WARNING: Back reflection (BR) is a hazard and may cause injury or damage.

Automatic BR cut-Off
For protection, the laser is equipped with an automatic back-reflection cut-off. For example, when you are aligning the optical path, the laser may automatically turn off. Before turning the laser on again, check the path for possible sources of back-reflection.

Installing the collimator

The collimator is constructed so that its steel sleeve inserts into a holder or a receptacle of a next stage optical device such as a SuperK accessory. To install the collimator, follow the instructions in Procedure 3.

Procedure 3 Installing the collimator

	Action
1	Remove the yellow protective cap from the end of the collimator sleeve.
2	Carefully align the collimator sleeve with the target receptacle as shown in Figure 13 and Figure 14.
3	Slide the collimator into the receptacle and then: – **for SuperK accessories:** *a.* Slide the collimator sleeve into the optical input receptacle of the device. *b.* Turn the collimator so that its alignment key aligns with the slot in the receptacle. *c.* Push the collimator in until it clicks in place (release button lock). *d.* Tighten the accessory lock screw to securely retain the collimator. **– for holders, power meters, etc.:** *a.* Slide the sleeve into the receptacle until it stops. *b.* Tighten any locking screws to securely retain the collimator as shown in B of Figure 14.

Figure 13 Collimator installed into a SuperK accessory receptacle

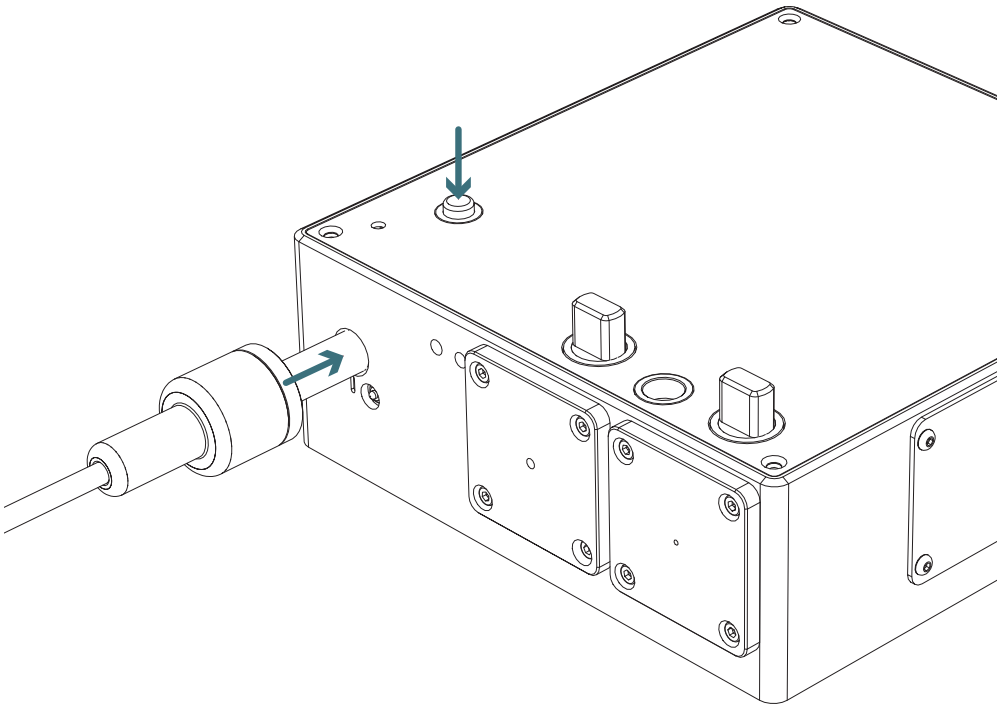
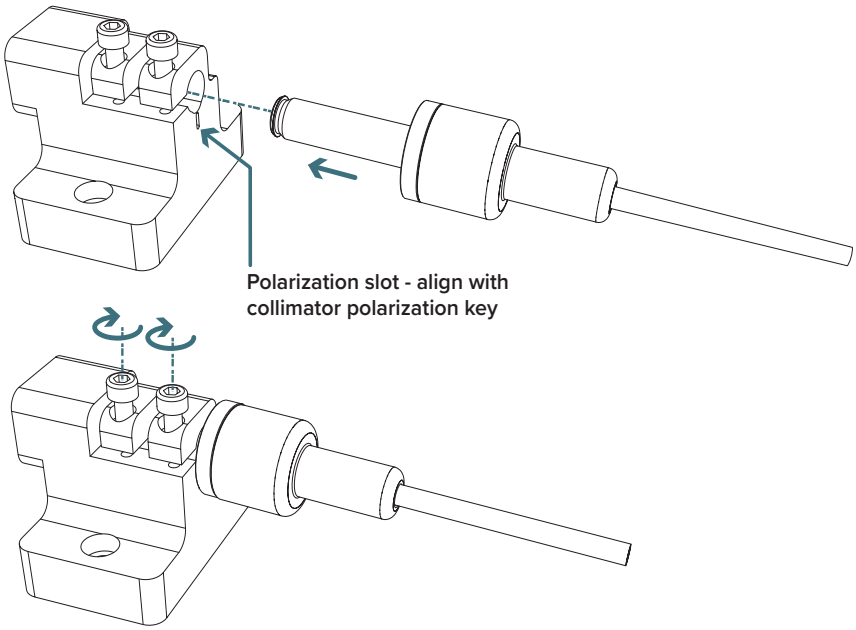


Figure 14 Inserting a collimator into a holder



WARNING: Care should be taken to mount the collimator so that the beam emitted is contained in an area where no personnel or flammable material is present.

Connecting accessories with the external bus

External bus

The External Bus port is a digital bus interface and 12 volt supply for some optional accessories. These accessories when used with the laser are connected to CONTROL through the external bus and the laser. The bus data signals are based on a subset of the RS-485 protocol. The bus is also made up of other signal lines, including a logic output pin representing laser emission and an extension of the laser's interlock circuit loop.

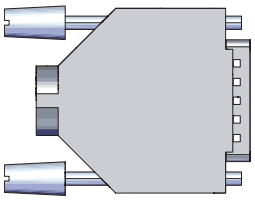
Connecting the external bus

If no accessories requiring an External Bus connection are used with the laser, place the supplied bus defeater onto the laser's External Bus port. If accessories requiring a bus connection are used, connect the accessories to the External Bus port in a daisy chain configuration using the supplied External Bus cable(s). The last accessory in the daisy chain must have the bus defeater placed onto its output bus.

Bus defeater

A bus defeater is a DB-15 connector with it's interlock circuit pins looped back. A bus defeater is included with the laser. If you need a replacement, contact NKT Photonics support – see "Support contact details" on page 103.

Figure 15 Bus defeater



External bus

Refer to Table 8 for the details on how the External bus is connected. A bus defeater is placed on the last open External Bus port to loop the circuit back. (Refer to Figure 16 and Figure 17 for connecting the port with and without accessories.)

Table 8 External Bus port – connecting accessories

Accessory #	External Bus port connection
No accessories	Bus Defeater
1 accessory	*a.* External Bus cable to accessory bus input *b.* Accessory bus output – Bus Defeater
2 tor more accessories	*a.* External Bus cable to accessory 1 input. *b.* Accessory 1 bus output – External Bus cable to accessory N bus input *c.* Accessory N bus output – Bus Defeater

NOTE: See Appendix C for a pinout description of the External Bus.

Figure 16 External bus connections - no accessories

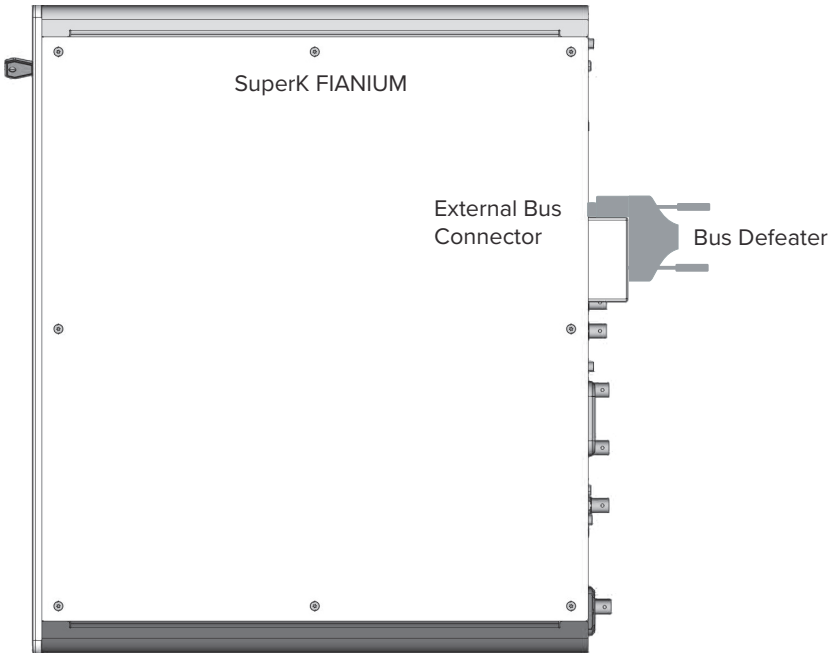
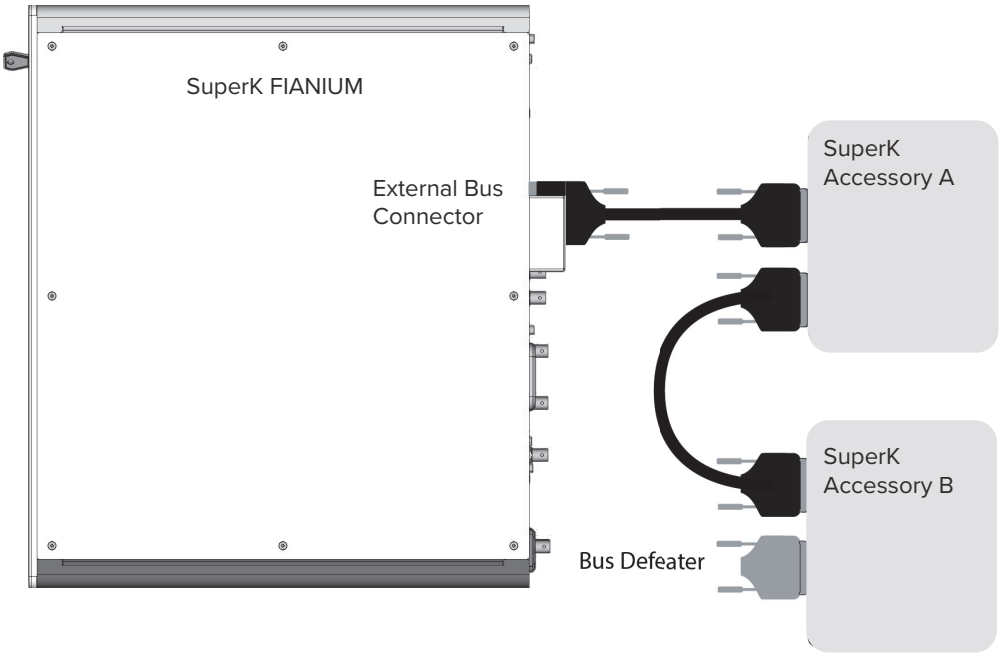


Figure 17 External bus connections - multiple accessories in a daisy chain



Connecting synchronization ports

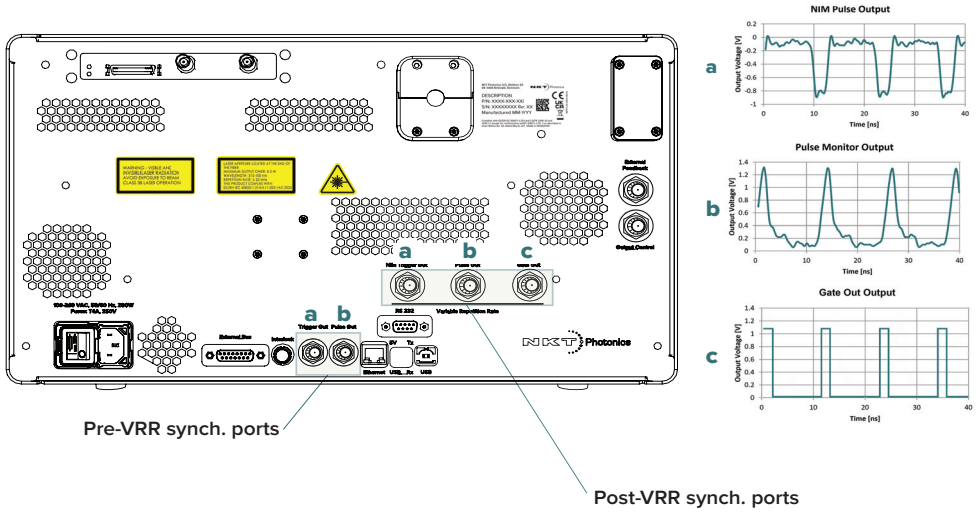
The SuperK FIANIUM can supply up to five different synchronization signals. The signals can synchronize external devices with the laser pulse at two stages within the laser. If the laser is fitted with a VRR (pulse picker) module, all five signals are available. Otherwise, only the pre-VRR ports are equipped. The rear panel houses the five synchronization ports depicted in Figure 18. The ports are mounted in pre and post-VRR groups on the rear panel.

Table 9 Pulse synchronization signals

Sync. Port	Pulse	Type	Level	See
Gate Out (optional)	Post-VRR[i]	Digital	0 to ~1.2V	Gate out on page 51
Pulse out	Pre-VRR (seed) Post-VRR (optional)	Analog	0 to ~1.2V	Pulse out on page 51
NIM Pulse	Pre-VRR (seed) Post-VRR (optional)	Analog	NIM	Pulse out on page 51

i. VRR - Variable Repetition Rate module or pulse picker

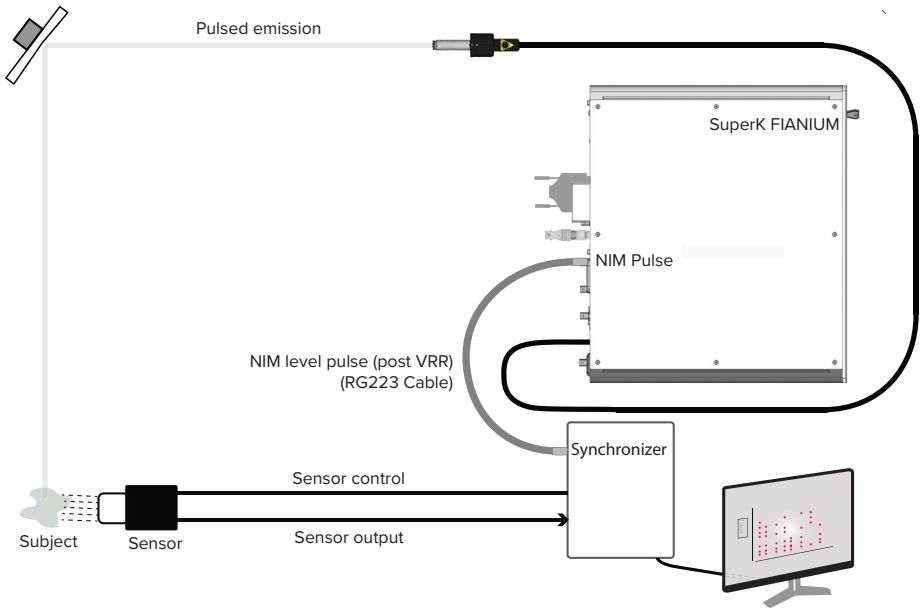
Figure 18 Synchronization ports with output signals



Example synchronization circuit

As an example, the pre or post-NIM pulse signal could be used to synchronize the emission with a subject under study. A general diagram of a synchronization circuit is shown in Figure 19.

Figure 19 Example NIM pulse circuit



Gate out

The Gate out port supplies a digital signal synchronized with pulses which have passed the VRR module (pulse picker). The port outputs a positive digital signal as shown in graph C of Figure 18.

The signal at the Gate Out port assumes a logic high state when a pulse is allowed to pass through the pulse picker, while it transitions to a logic low state when pulses are suppressed from the output of the pulse picker. The signal's rate corresponds to the repetition rate set in the CONTROL settings or configured on the device's front panel.

To ensure optimal waveform quality when connecting the port, it is recommended to adhere to the specifications outlined in Table 10.

Table 10 Gate out – port specification

Item	Description
Cable Type	Use RG223 type or similar double shielded cable ≤ 3M
Connector	BNC
Termination Impedance	50 Ω

Pulse out

The pre and post-VRR synchronization Pulse out ports convey the pulse signal before and after passing through the VRR module, respectively. These signals are represented by a positive analog voltage range of 0 to +1.2 V (approximately), as illustrated in graph B of Figure 18. The signal rate aligns with the repetition rate configured in the CONTROL settings or set on the front panel of the device.

When connecting these ports, it is advisable to adhere to the specifications provided in Table 11. Following these specifications will help achieve the optimal waveform quality for the signals.

Table 11 Pulse out – ports specification

Item	Description
Cable Type	Use RG223 type or similar double shielded cable ≤ 3M
Connector	BNC
Termination Impedance	50 Ω

NIM pulse

The pre and post-VRR NIM pulse ports provide NIM level electrical signals that accurately represent the pulsed output of the laser. The signal from each port complies with the standards set by DOE/ER-0457. These signals are synchronized with the laser pulse, both before and after the VRR module has adjusted the repetition rate.

When properly terminated, the voltage range of these signals is approximately 0 to -0.9 V. A typical waveform from either port can be observed in graph A of Figure 18, providing a visual representation of the signal characteristics.

Table 12 NIM pulse – ports specification

Item	Description
Cable Type	Use RG223 type or similar double shielded cable ≤ 3M
Connector	BNC
Termination Impedance	50 Ω

Termination necessary

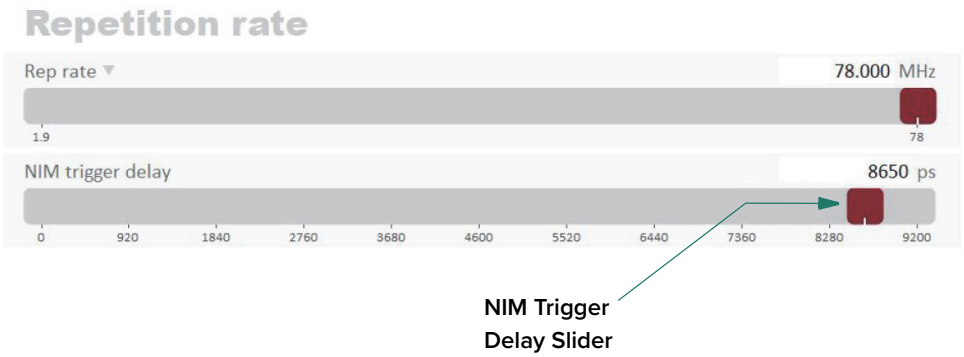
Both NIM outputs are current outputs and they therefore require to be correctly terminated to avoid signal degradation. As noted above in Table 12, the NIM outputs are specified to be terminated with 50 Ω.

Trigger delay

You can delay the NIM output pulses by up to 9200 picoseconds using the CONTROL interface. In the control panel of the laser's graphical interface, slide the NIM Trigger Delay slider to the desired setting (or use the text input field).

The slider, indicated in Figure 20, has been adjusted to a value of 8650 picoseconds. In this configuration, the NIM output pulses experience a delay of 8650 picoseconds following the occurrence of the laser pulse.

Figure 20 Pulse (NIM) trigger delay control



4 Connecting External Control

This chapter includes the configuration details for:

- "External feedback" – describes how to connect a feedback circuit to the laser to stabilize the output power level.
- "Booster ON/OFF"– describes how to connect an external logic signal to the laser to turn ON or OFF the laser's booster.

External feedback

To ensure a stable optical output power, you can utilize the external feedback feature of the laser system. This feature requires the setup of an external feedback circuit equipped with a power sensor, which is used to measure the laser's output power. The feedback circuit generates a modulating signal that represents the measured power and sends it to the "External Feedback – BNC" port of the laser system.

In the CONTROL settings, you can enable the "External Feedback" function along with specifying a desired setpoint power level and sample rate. When the laser system is operating in *External Feedback* mode, the output power level of the laser stabilizes around the setpoint value based on the feedback voltage received from the power sensor.

By incorporating external feedback, the laser system can compensate for slow output variations that may arise due to system limitations and changes in ambient temperature. This feature helps maintain a consistent and stable optical output power, ensuring reliable performance in varying operating conditions.

Feedback circuit

When an external feedback signal is fed to the laser, microprocessor control within the laser samples the voltage at the External Control port. Based on the measured sample, it then steps up or down the output emission of the laser to maintain the setpoint level. A typical feedback circuit employs a photodiode sensor that generates a current proportional to the laser radiance. With an Op-amp, the current is converted to a proportional voltage, and the signal is fed to the External Control port. The port is connected to an internal 470 kΩ pull-up resistor. Consequently if no signal is connected to the port, the output is set to the minimum level. The circuit output and cabling specifications are shown in Table 13.

When the laser receives an external feedback signal, the microprocessor control embedded within the laser system samples the voltage at the External Control port. Based on the measured sample, the control algorithm adjusts the laser's output emission either upwards or downwards to maintain the desired setpoint level.

To establish an effective feedback circuit, a typical approach involves utilizing a photodiode sensor that generates a current proportional to the laser's radiance. This current is then converted to a corresponding proportional voltage using an operational amplifier (Op-amp). The resulting voltage signal is subsequently connected to the External Control port of the laser system. It is important to note that the port is connected to an internal 470 kΩ pull-up resistor. Consequently, if no signal is connected to the port, the output is set to the minimum level.

Specifications for the circuit output and cabling are provided in Table 13.

Table 13 External Feedback port and cabling parameters

Parameter	
Port type	BNC
DC voltage range	0 – 4.1 VDC
Cable type	Use shielded coaxial cabling with BNC connectors ≤ 3 M e.g. RG223 or RG58 type

NOTE: For optimal performance, supply a feedback signal that varies in the upper scale of the input range. A feedback signal at the limits of the input range, results in unstable operation and is unsuitable.

For example, a signal at 4.1 volts effectively disables emission power as the system attempts to lower the power to the setpoint. For a signal at 0V, maximum emission power is enabled, therefore the feedback system should optimally avoid the range limits to minimize large fluctuations of the emission level. When the laser is in feedback mode, the internal feedback circuit varies the pump current in relation to the received external feedback voltage.

Booster ON/OFF

With this feature, you can apply a TTL or CMOS level logic signal at the Booster ON/OFF port to enable or disable laser emission. When the feature is enabled, a logic high applied at the port enables laser emission with a fast rise time. When a logic low is applied, emission is disabled. The feature controls the state of the main amplifier.

Figure 21 illustrates and example where a trigger signal is applied to the Booster ON/OFF port. As the trigger signal rises to a logic high, the output emission, shown by the output graph of the detector, rises correspondingly with a fast rise time. Without overshooting, the booster output can rise up to 100% output power level within 80 ms.

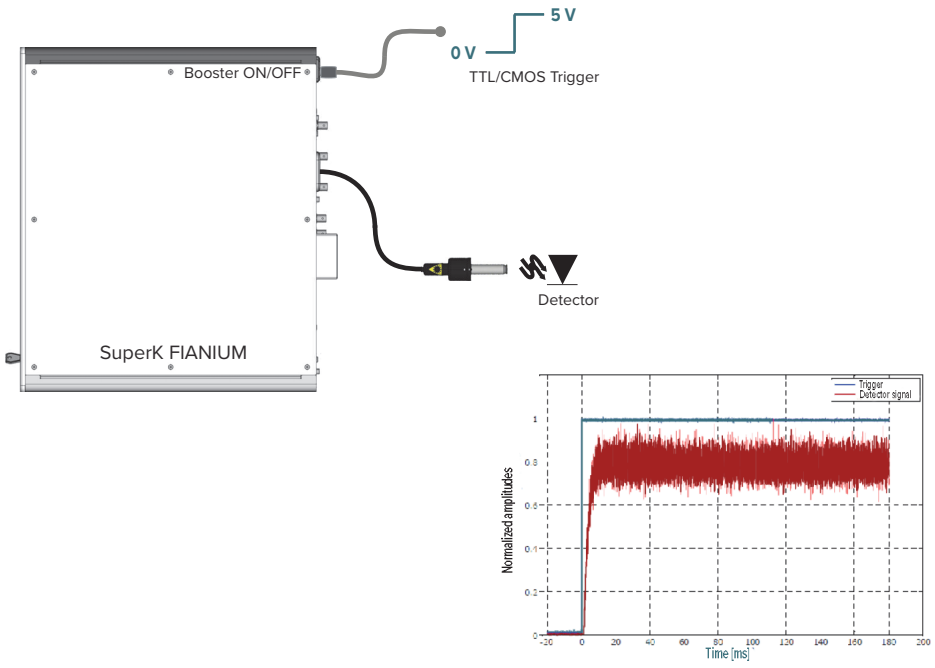
The port parameters and cabling specifications are shown in Table 14.

Table 14 Booster port and cabling parameters

Parameter	
Port type	BNC
DC voltage range	TTL or CMOS
Cable type	Use shielded coaxial cabling with BNC connectors ≤ 3 M e.g. RG223 or RG58 type

WARNING: Although the laser emission is disabled when the booster is OFF, residual laser emission is still present.

Figure 21 Output control trigger vs optical output rise



Section 3 Operating the laser

This section describes how to manage and operate the laser and includes the chapters:

5 Front Panel Controls

Overview

The front panel features an OLED display, control buttons, and an interlock keyswitch. You can use the display and buttons to:

- Enable and disable emission.
- Adjust the laser output power level from 0 to 100%.
- Switch system power ON or OFF.
- View system errors and notification messages.
- Select pages to display.

Figure 22 Front panel buttons and display

The keyswitch disables the safety interlock (disabling emission) when turned to *Off* and prevents unauthorized use of the laser when its key is removed from the lock. When set to the *Armed* position, laser emission is permitted.

Figure 23 Keyswitch control – set to *Armed*

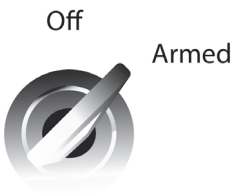


Table 15 provides and overview of the various functions of each button associated with each button and the keyswitch. For the details, click the link in the rightmost column.

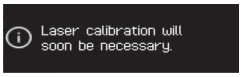
Table 15 Panel buttons and keyswitch

Button	Press the button to:	See
Power	Turn ON the laser system. The rear AC mains switch must be set to (I).	Powering ON and OFF the laser on page 66
Status	Scroll through the pages in the front panel display.	Viewing display pages on page 62
- and +	Set the emission output power in percentage.	Adjust the power on page 67
Emission	Enables and disables EMISSION.	Enable and disable emission on page 69
Keyswitch	**Turn the key to:**	**See**
	• OFF to disable the interlock, disabling and preventing emission. • ARMED to permit laser emission.	Arming the laser

Display

The display can show four page types. The pages are listed below in Table 16; and for detailed information click the link in the right column.

Table 16 Display pages

	Page type	Function	See
	Operation	Displays current operational settings.	Operation page on page 63
	Connected modules	Displays all connected modules and if configured, the IPv4 address.	Connected modules page on page 64
	Error	Errors appear when a fault is detected by the system.	Error page on page 65
	Notification	Displays a system notification, informational only.	Notification page on page 65

Viewing display pages

To view available pages, press the *Status* button on the front panel. The display will automatically show the next available page.

Error pages

Error pages are displayed by the system whenever a fault is detected. These pages consist of an error code accompanied by a descriptive message. It is crucial to take note of any error information presented. It's important to keep in mind that once an error page is shown and you press the Status button, the subsequent page will be displayed, and you won't be able to retrieve the previous error page again.

Notification pages

Notification pages are displayed by the system to convey informational messages. Similar to Error pages, when a notification is presented and the Status button is pressed, the subsequent page is displayed, and it is not possible to retrieve the previous notification page again.

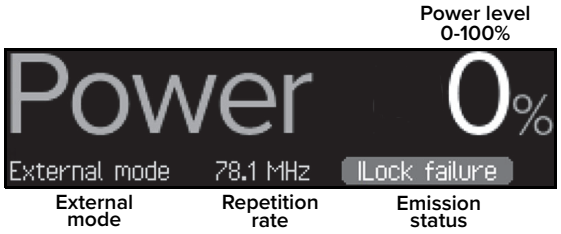
Dimming

For both the Operation and Connected module pages, the display will automatically dim after a brief period of inactivity, assuming no buttons are pressed. To restore the brightness of the display, simply press the status button.

Operation page

Figure 24 depicts an example of the *Operation page* following a successful power ON of the system. To access the *Connected modules* screen, press the *Status* button and refer to “Connected modules page” on page 64” for further information and details.

Figure 24 Operation page



The *Operation* page shows the following fields:

- **Power** – Indicates the configured level of output emission power for the laser. RANGE: 0 to 100%
- **External mode** – *External mode* is displayed when the laser is configured to use an external input signal to stabilize the output pulse. External mode is configured using CONTROL. The field is blank when internal mode is configured (normal operation). See “External Feedback mode” on page 94.
- **Repetition rate** – Displays the output pulse rate measured in either MHz or kHz. If the laser includes the VRR pulse picker option, you can adjust the pulse rate using CONTROL. See “Setting the pulse repetition rate (pulse picker)” on page 95.
- **Emission status** – This field displays the current emission status of the laser. Table 17 lists all possible messages the field can display.

Table 17 Emission status

Emission status field	Message	Meaning
[Emission ON]	Emission ON	Emission is ON – Hazardous class 4 laser emission is present
Armed	Armed	Laser is Armed i.e. the laser emission can be enabled.[i]
ILock failure	ILock failure	Interlock OFF due to interlock circuit failure
Interlock off	Interlock off	Interlock OFF with no specific reason
ILock power	ILock power	Interlock OFF due to interlock power failure
Disabled	Disabled	Interlock OFF
Int. module	Int. module	Interlock OFF due to an internal module failure
Ext. module	Ext. module	Interlock OFF due to an external module failure

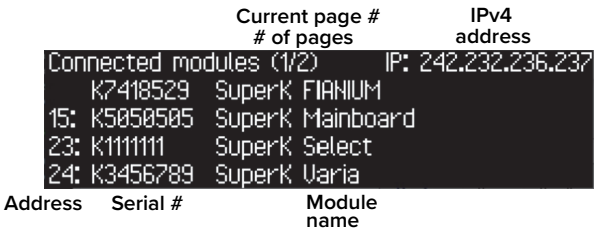
Emission status field	Message	Meaning
Door open	Door open	Interlock OFF due to: an open door switch (access door open). a short to ground or an open in the door switch circuit.
Key off	Key off	Interlock OFF due to the keyswitch in the OFF position
Updating	Updating	Firmware update in progress
Calibrating	Calibrating	System calibration in progress

i. Keyswitch - Armed, Interlock and door switch circuits - closed

Connected modules page

The Connected modules page, as shown in Figure 25, provides an overview of the connected modules along with the system's configured IP address. Depending on the total number of modules present in the system, there may be more than one page required to display all the connected modules.

Figure 25 Connected modules page



The *Connected modules* page includes the following fields:

Current page # / # of pages – the current page # displayed and total pages for additional modules. A maximum of four modules is displayed per page. Press the Status button to scroll through all the *Connected module* pages.

IPv4 address – Displays the configured IPv4 address. If an IP address has not be entered (using CONTROL) the field will display *Unconfigured*.

Address – The address assigned to the module by the system software.

Serial # – The factory serial number of the system or module

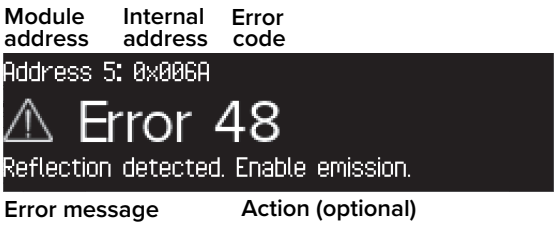
Name – The module name

Error page

If a fault occurs, the system display shows a page with an error message. The error message includes:

- Module address – System module address
- Internal address – Address for NKT Photonics use only
- Error code – Code number assigned to the error for a module
- Error message – A description of the error
- Action – An action to undertake may be displayed along with the error.

Figure 26 Error page



Error identification

All errors are listed in Table 31 on page 127 of Appendix F. An error is identified by its module address and the error code as follows:

Error = *Module Address* + *Error Code*

Clearing the error message

Pressing the *Status* button shows the next available system page.

CAUTION: Clearing the error message does not resolve the fault.

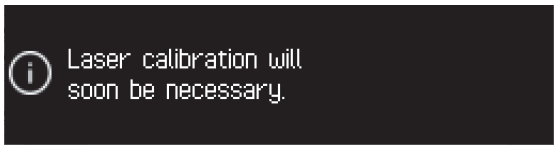
NOTE: Before pressing the Status button make a note of the error. The error can also be subsequently retrieved over the system communication port.

Notification page

The system may display a notification. This is for informational purposes only and does not warrant immediate action. Figure 27 shows a Laser calibration notification.

To calibrate the laser, emission should be enabled from the disabled state. See “Enable and disable emission” on page 69.

Figure 27 Notifications page – Laser calibration



NOTE: If the Laser calibration notification is sent while emission is enabled, an error may be generated if calibration is not executed.

Clearing the notification page

Pressing the *Status* button shows the next available system page.

NOTE: Before pressing the Status button make a note of the message. The notification page cannot be retrieved again.

Operating the laser from the front panel

WARNING: Before turning ON the laser, ensure to implement all CLASS 4 laser safety recommendations applicable for your region. Ensure all personnel are notified of the laser’s operating area and that the beam path is safely contained. For further information refer to the NKT Photonics document:

SuperK FIANIUM Safety, Handling and Regulatory Information

Front panel operations

To operate the laser from the front panel controls, follow the link in Table 18 for the desired procedure:

Table 18 Front panel operations

Procedure	See
Turn the laser ON	Turning ON the laser
Set the output power level	Adjust the power
Set the emission status to *Armed*	Arming the laser
Enable and disable emission	Enable and disable emission
Turn the laser OFF	Turning OFF the laser

Powering ON and OFF the laser

Procedure 4 Turning ON the laser

If the laser is OFF, do the following,

1. Ensure AC mains power is connected and the rear AC mains switch is set to the (I) position.

2. To connect power to all internal modules of the laser, press and hold the *Power* button for approximately 1 to 2 seconds before releasing it.

3. A boot screen (Figure 28) with the NKT Photonics logo is displayed until the system is ready for operation.

4. If the laser boots correctly, the laser's operation page appears (see "Operation page" on page 63) and the laser is ready for operation.

5. If the laser encounters an error on boot up, an "Error page" appears. Report the error to NKT Photonics – "Support contact details" on page 103.

Figure 28 Boot screen

Procedure 5 Turning OFF the laser

To turn off the laser when it is ON (front panel is lit), do the following:

1. Press and hold momentarily the *Power* button until the front panel LEDs are extinguished.

2. The laser modules power down and the laser returns to the standby state. In standby state only the laser's internal power supply is ON i.e. the rear AC mains switch is set to (I).

Adjust the power

To set the output power in percent, press the:

- **−** button to reduce the power level.
- **+** button to increase the power level.

Range: You can adjust the power from 0 to 100%, however some systems may limit this.

WARNING: Even when the power is set to 0%, Class 4 emission may still be present.

NOTE: When turning ON the laser using the power button, the previously configured power level is set.

Usage
When using the laser in a new application, set the power level to 0% (Figure 30) before enabling emission. Once emission is enabled, slowly increase power by pressing the + button, making sure the beam is safely contained.

Figure 29 Power adjusted to 0% before enabling emission

WARNING: Only adjust the power to a higher level when you are certain the beam path is safe and all personnel in the operating area are aware of the danger. The laser is a CLASS 4 laser and emits hazardous emission.

Figure 30 Power adjusted to 100% with emission enabled

Arming the laser

The laser is ready and emission can be enabled when *Armed* is displayed in the emission status field (see "Operation page" on page 63). To arm the laser, do the following:

Procedure 6 Arming the laser

1. Close the access door to the laser's operating enclosure. The interlock door switch circuit must be in place and the circuit must be closed - see Procedure 1 on page 44.

2. Ensure an external bus defeater is placed on the last external bus port in the accessory chain. See "Connecting the external bus" on page 47.

3. Turn the keyswitch from the *Off* to the *Armed* position.

4. If *Armed* is displayed in the emission *status* field (Figure 31), emission can be enabled, END procedure.

5. If another message is displayed, refer to Table 17 and make any corrections necessary. The laser only achieves the *Armed* emission status if all of the following is true:

   - The keyswitch is set to the Armed position.
   - The interlock circuit to the door switch is closed.

- The external bus interlock circuit is closed and no other internal issues are present.

Figure 31 Laser is *Armed*

Enable and disable emission

Procedure 7 Enabling emission using the front panel

1. Press the front panel *Emission* button once. The emission status field changes from *Armed* to *Emission ON*.

Calibration
The laser auto-calibrates when emission is enabled from the disabled state.

Figure 32 Emission enabled

WARNING: Only enable emission when you are certain the beam path is safe and all personnel in the operating area are aware of the danger. The laser is a CLASS 4 laser and emits hazardous emission.

2. Press the Emission button again. The laser returns to the Armed state.

6 Using CONTROL to Turn ON the Laser

You can operate a SuperK FIANIUM laser using NKT Photonics CONTROL software installed on a PC. This chapter focuses on:

- How to obtain and install the CONTROL software.
- Connecting a PC to the laser using a USB or Ethernet connection.
- Enabling and disabling emission using CONTROL.

CONTROL software

You can download the most recent CONTROL software from the following link:

https://www.nktphotonics.com/lasers-fibers/support/software-drivers/

CONTROL software is capable of managing, configuring and monitoring NKT Photonics products including this laser and associated accessories. Both 32 and 64 bit versions are available and are installed on a PC running Microsoft Windows 7, 8, or 10.

Installing the software

After downloading the CONTROL installer software on to your PC, double click it and follow the built-in wizard. Further details on installing the software is available in Appendix E.

Connecting the laser to a CONTROL PC

You can connect a PC with CONTROL software using a USB serial connection. USB connectivity provides a simple connection option within the maximum USB cable length of 3m. Connecting over USB is described in Procedure 9.

After the PC is connected, use the search feature in CONTROL to find the laser or its connected accessories.

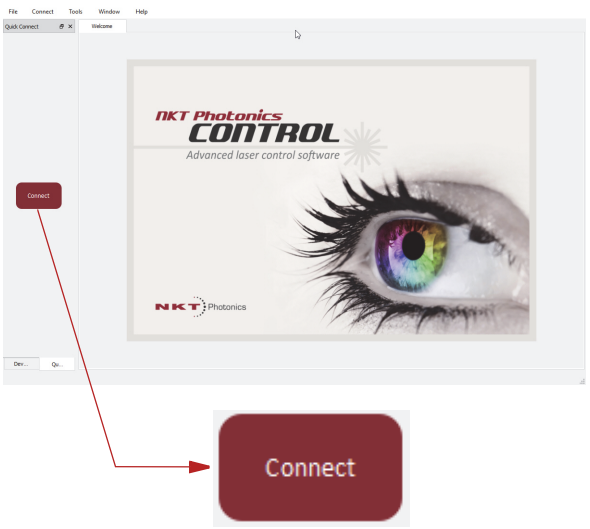
Ethernet
For Ethernet connections, the laser is configured for DHCP IP address assignment from the factory. For static address assignment, first connect using USB to set the IP assignment mode to static so you can configure the address. Connecting over Ethernet is described in Procedure 9.

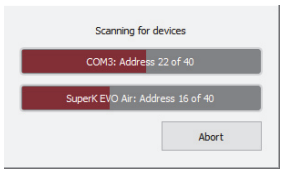
NOTE: You can also connect the CONTROL PC to the RS-232 serial connection.

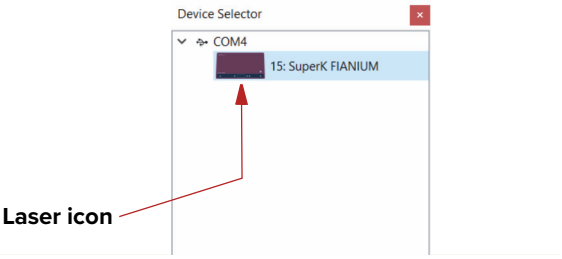
Procedure 8 Connecting a PC to the laser over USB

	Action
1	Connect power to the laser – see Connecting power on page 44.

	Action
2	Connect the PC to the USB port on the rear of the laser using the included USB AB cable.
3	Launch the CONTROL software by either: clicking on Windows – Start – Programs – NKT Photonics –CONTROL – or – double clicking the CONTROL shortcut on the desktop
4	The CONTROL window opens. Click on the *Connect* button in the left region of the *Quick Connect* panel.
5	CONTROL automatically scans for any connected lasers and accessories available on both COM and configured Ethernet ports.
6	When connected, you can manage the laser, by clicking on the SuperK FIANIUM laser icon in the *Device Selector* panel.







Ethernet connection

To establish an Ethernet connection between the laser and a PC, ensure that both devices are connected to a suitable IP network using either the same or separate IPv4 subnets. If they are on separate subnets, it is essential that their IP addresses are reachable to each other.

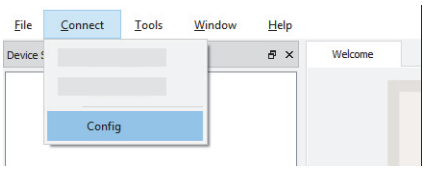
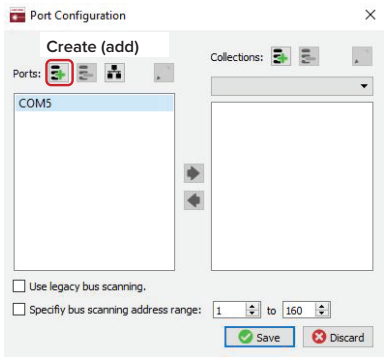
DHCP

By default, the laser's port is set to DHCP (Dynamic Host Configuration Protocol) when it leaves the factory. Simply connect the Ethernet port to a DHCP-enabled subnetwork and using the front panel, note the IP address assigned – see “Connected modules page” on page 64. Then with the IP address noted, proceed to step “4” of Procedure 9 below.

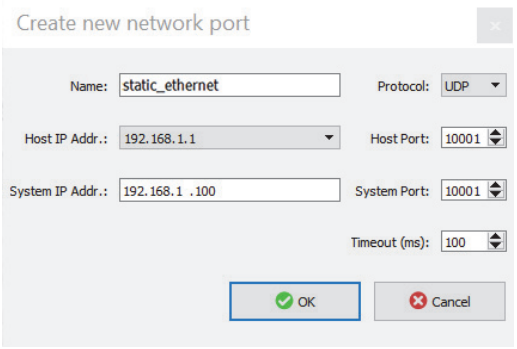
Static

To configure a static IPv4 address for the laser, follow all the steps in Procedure 9 on page 73.

Procedure 9 Connecting a PC to the laser using Ethernet

	Action
1	Connect to the laser from your CONTROL PC using a USB cable as described in Procedure 8.
2“4”	Using a CAT5 or better Ethernet cable, connect the laser’s Ethernet port to a local subnet or directly to the CONTROL PC’s Ethernet port.
3	Using CONTROL (over USB) - configure the laser’s IPv4 address and port - see Ethernet on page 86. **NOTE**: Ensure that the RJ-45 Ethernet port of the laser is connected to your network using a CAT5 or better cable.
4	From the Connect menu list select *Config* to open the *Port Configuration* window. 
5	In the *Port Configuration* window, click on the *Create new port* button. 

	Action
6	The *Create new network port* window appears. Configure the port parameters as described below:



Name – Enter a name for the Ethernet connection (e.g. Lab-Laser-2).

Host IP Addr. – Select a Host IP address (PC) from the drop down list of the computer's available network adapters.

System IP Addr. – Enter the laser IPv4 address configured in step 2.

Protocol – Select either UDP or TCP. UDP is the default and recommended.

Host Port – Enter a TCP or UDP port the PC will use for communications with the laser. The default value is 10001.

System Port – Enter a TCP or UDP port the laser will use for communication with the CONTROL PC. The default port address is 10001 and set in step 2.

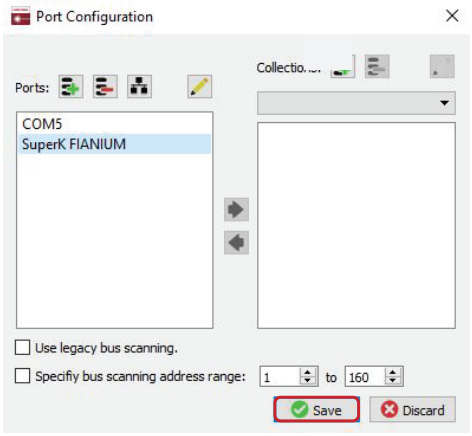
NOTE: To connect multiple lasers over IP with the same NKT Photonics CONTROL PC, configure each laser with a unique local system port.

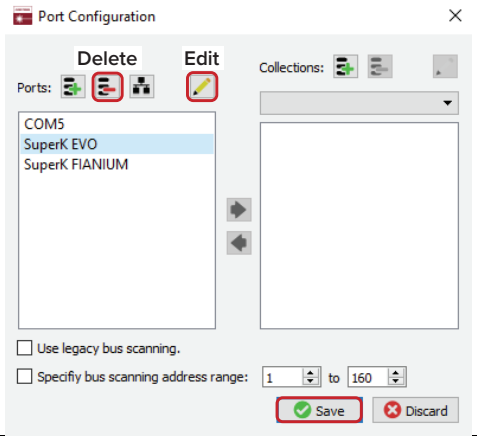
Timeout (ms) – Enter a timeout value in milliseconds. When CONTROL sends a request to the laser, it waits for a reply from the laser until the timeout value expires. Default value is 100 milliseconds.

Click *OK* to accept the configuration of the new *Ethernet connection* port.

NOTE: The parameters set here can be viewed from the Ethernet settings for either DHCP or Static - see Ethernet on page 86. For DHCP ensure the Ethernet port is connected to a DHCP enabled network.

7	Click the *Save* button to save the configuration of the new *Ethernet connection*.

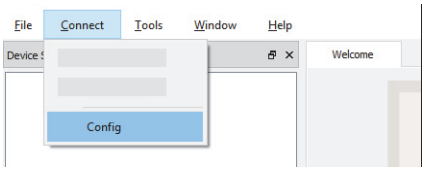
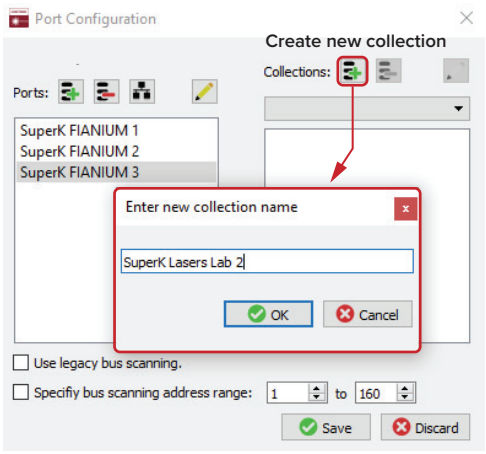


	Action	
8	To delete or modify a configured port: *a.* Highlight the port and: • click the *Delete* button. - or - • click the *Edit* button and make any changes required. *b.* Click *Save* when finished.	
10	Click the CONTROL *Connect* drop down menu item and click on the newly created *Ethernet connection* name.	
11	CONTROL connects to the laser. **NOTE:** If CONTROL cannot reach the laser over Ethernet, verify that the CONTROL PC has connectivity with the laser by executing a PING test.	

Grouping connections

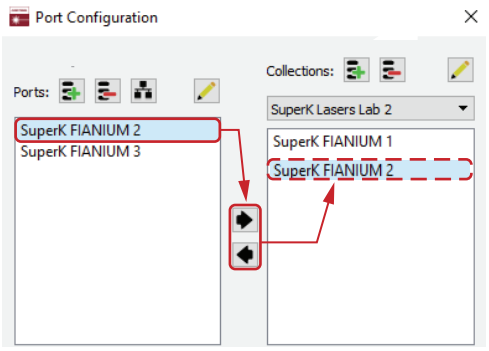
You can group configured lasers into a collection and then connect to all lasers in the group from the *Connect* drop down list. Use the *Port Configuration* dialog box to create the group and then click the *Connect* menu item to select the group from the drop down list. To create a collection group, follow the steps in Procedure 10.

Procedure 10 Grouping connections in a collection

	Action	
1	From the *Connect* drop down menu list, select *Config* to open the *Port Configuration* window.	
2	Create Ethernet connections for the lasers to be added to the collection – see Procedure 9.	
3	In the *Port Configuration* window, click on the *Create new collection* button. In the *Enter new collection name* dialog box, enter the name of the new collection and click OK.	

Action

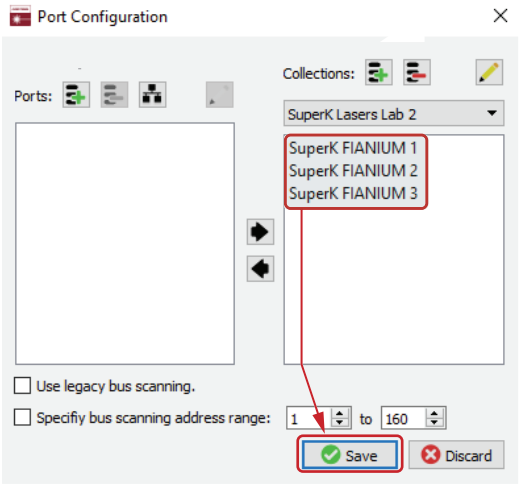
4 To add a connection to the collection, highlight the connection and click the right arrow button.



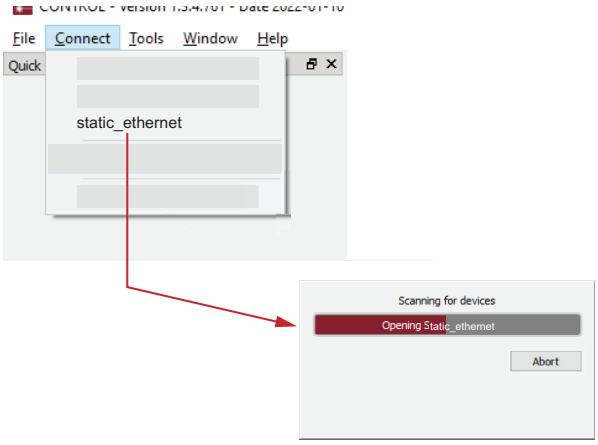
NOTE: Before adding a new connection, ensure the collection group created is selected in the drop down menu near the top of the right panel.

To remove a connection from the collection, highlight the connection and click the left arrow button.

5 When you have added all connections to the collection, click *Save*.



6 Open the Connect drop down menu and click on the collection. CONTROL scans only the ports included in the collection.



NOTE: Collection groups are separated from connections by a thin grey line in the drop down menu.

Controlling the laser emission

Safety Before you enable laser emission, ensure that you are completely familiar and follow all safety information and recommendations stated within this document and the document:

SuperK FIANIUM Safety, Handling and Regulatory Information

WARNING: You must follow all safety regulations required by the location where the laser is operated.

Preparation The laser emission is ready to be enabled when the following steps are completed.

1. The laser is securely installed and connected according to the procedures in "Mechanical Installation" on page 39 and "Connecting the Laser" on page 41. This means the laser should be installed in the recommended environment with power applied and at the very minimum, a door switch interlock circuit and CONTROL PC connected.

2. The laser is communicating with the CONTROL application according to Procedure 8 or Procedure 9.

NOTE: You can also use the front panel interface to operate the laser, see "Front Panel Controls" on page 61.

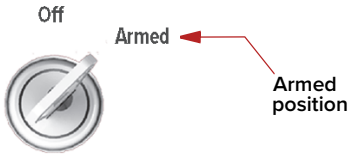
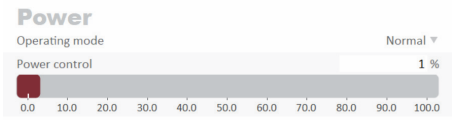
WARNING: Enabling the laser emits hazardous laser 4 radiation. Ensure to observe and implement all safety regulations, warnings and cautions in this guide and the *SuperK FIANIUM Safety, Handling and Regulatory Information* document before continuing.

CAUTION: Do not enable the laser if it has been exposed to temperature and humidity beyond the operating specifications. The SuperK FIANIUM is designed to be operated in a non-condensing environment from +18 to +30°C (or 35°C). Before enabling the laser, allow it at least 30 minutes to reach room temperature. Enabling a laser that is too cold or hot may lead to the system being damaged.

Turning ON the laser

First check you have prepared the laser according to “Preparation” on page 77 and then follow the steps in Procedure 11 to enable laser emission using CONTROL.

Procedure 11 Enabling emission with CONTROL

	Action	
1	On the front panel of the laser, turn the key switch on the laser’s front panel to the *Armed* position. When the key is in the *Armed* position, laser emission can be enabled from CONTROL software. The connected interlock circuit must also be closed i.e. door closed for emission to be enabled.	
2	In the CONTROL application, adjust the laser power and ensure the operating mode is set to *Normal*. If a pulse picker is included, set the repetition rate to the desired setting.	
3	Click the interlock *RESET* button once to clear the interlock alarm. If the indicator does not turn GREEN, check for shorts to ground or opens in the interlock and door switch circuit.	
4	Enable laser emission by clicking on the *Emission ON/OFF* button. The Emission button light turns from green (OFF) to RED (ON).	

Errors

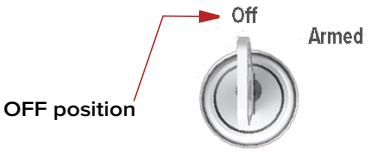
If the laser does not turn ON or is unexpectedly disabled, a fault may have occurred. Faults occur when the laser controller detects one or more operation conditions not within the normally expected range. When a fault occurs the system raises an error and the laser is disabled.

For a list of errors and their appropriate responses see Appendix F.

Turning OFF the laser emission

Follow the steps in Procedure 12 to turn OFF the laser emission.

Procedure 12 Disabling emission with CONTROL

	Action	
1	Disable laser emission by clicking on the *Emission ON/OFF* button. The *Emission* button light turns from RED (ON) to green (OFF).	 ON OFF
2	Turn the key switch to the *Off* position to disable the laser. **Note**: If you plan to leave the laser unattended, it is recommended to remove and store the key in a secure location.	

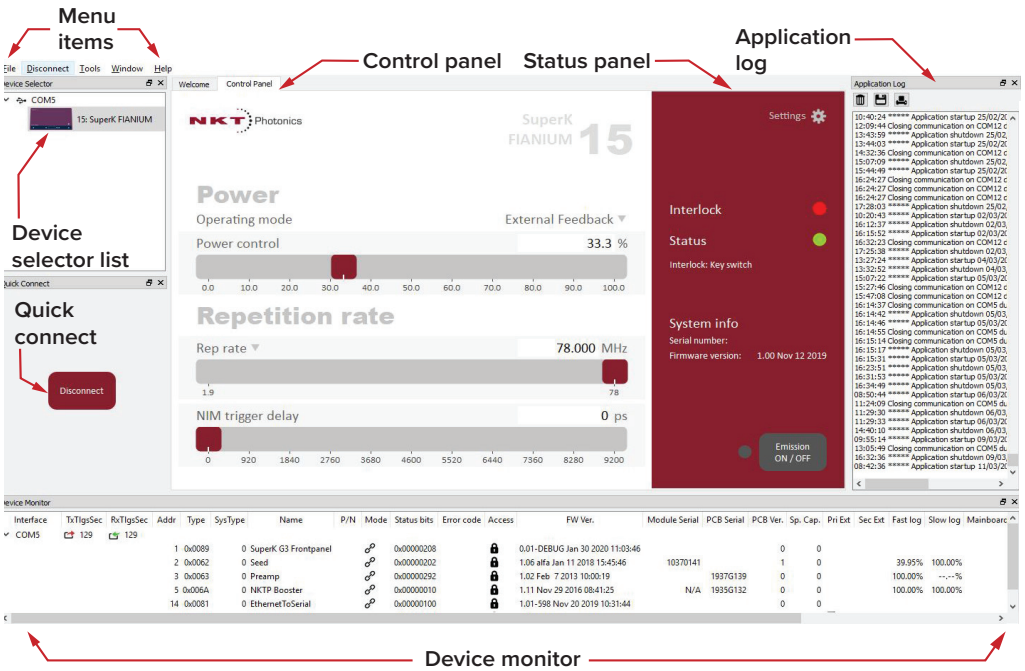
7 CONTROL Interface

CONTROL overview

The CONTROL user interface comprises several panels and a selection of menu drop down items in the upper left corner. Utilizing the drop down menu, you can add or remove panels. Additionally, panels can be repositioned within the main window or separated into individual windows. Figure 33 shows the panels and menu items; their functions are briefly described in the table below.

Panel	Function	See
Device Selector	Selectable list of connected devices (lasers and accessories) sorted by the PC port they are connected to.	Connecting the laser to a CONTROL PC on page 71.
Quick Connect	Provides a button when clicked, scans all available PC ports for connected devices.	Connecting to the laser on page 83
Status Panel	This panel displays the selected device status, emission control and a CONTROL settings drop down menu.	Status Panel on page 84
Menu Items	Five drop down menus with multiple functions.	CONTROL menu on page 90
Control Panel	Includes slider controls for output control and trigger delay plus an operating mode drop down menu.	Setting emission power on page 94
Application Log	This panel displays a debugging log that can be saved to a file.	Application Log panel on page 96
Device Monitor	To help debugging communication issues, this panel displays multiple port and device module parameters.	Device Monitor on page 96

Figure 33 CONTROL navigation



Relocating panels

You can freely drag the various panels of CONTROL within the main interface or into separate floating panels. Procedure 13 describes how to rearrange panel positions.

Procedure 13 Relocating panels

	Action
1	Left click and hold the top title bar of the panel.
2	While holding the left mouse button down, drag the panel to another location in the main window.
3	In the new location. when the background turns blue, release the mouse button – see Figure 34.
4	Alternatively, drag the panel out from the main window and release the mouse button. A separate window for the panel is created. (see Figure 35)

Figure 34 Dragging panels to a new location in the main window

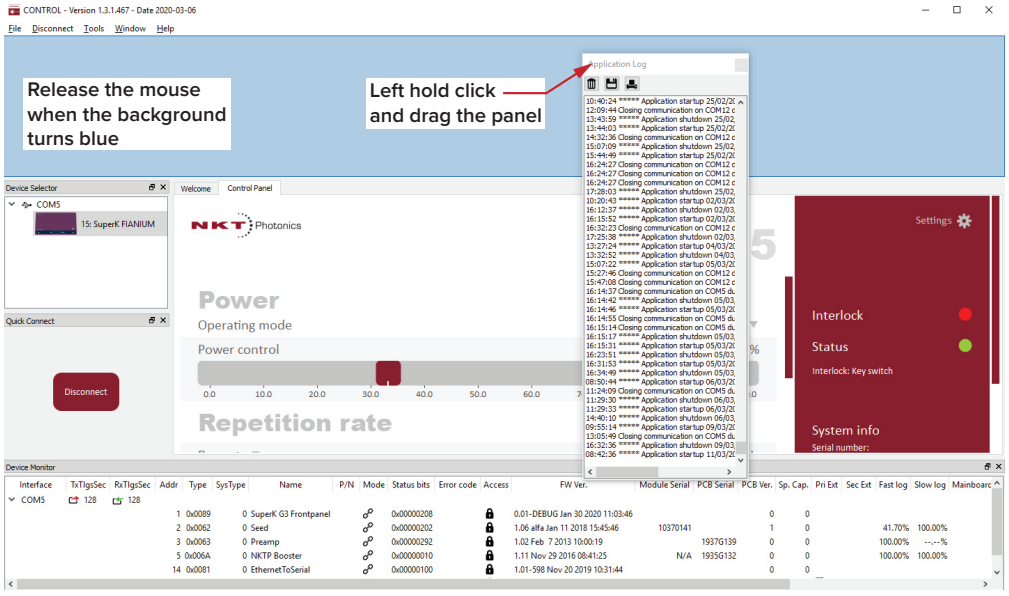
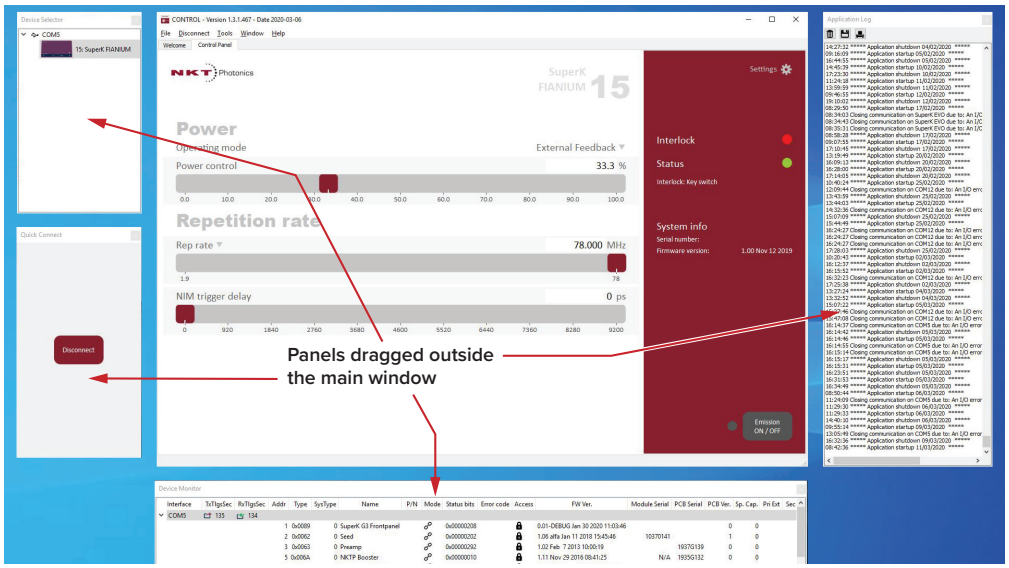


Figure 35 Dragging panels outside the main window

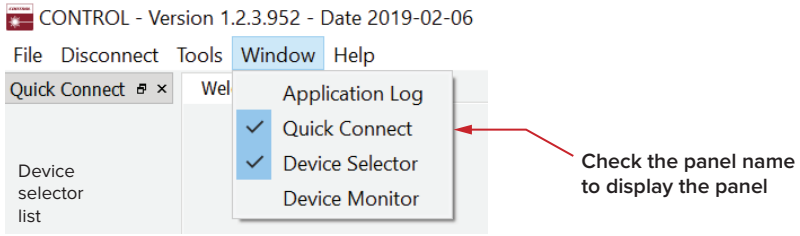


Toggling the panels visible

By checking or unchecking the items in the "Window" menu, you can easily control the visibility of panels in the CONTROL interface, allowing you to customize the display according to your preferences.

Click *Menu* > *Window* and check or uncheck the panels listed in the drop down menu. Checking (clicking it) the panel name makes it visible and unchecking it removes it from view.

Figure 36 Toggling panel visibility



NOTE: In addition to managing panel visibility through the "Window" menu, you can also close individual panels by clicking on the "X" symbol located in the upper right corner of each panel. Clicking the "X" will close the respective panel, removing it from view within the CONTROL interface.

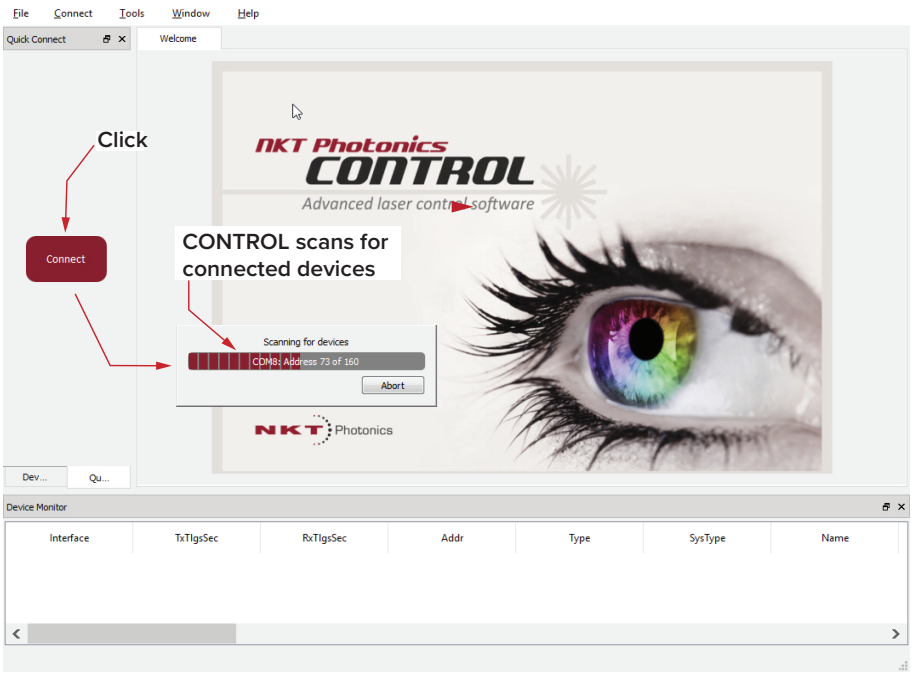
Connecting to the laser

When CONTROL is launched, a “Welcome” panel is displayed as depicted in Figure 37. Click the *Connect* button and CONTROL scans all available ports for NKT Photonics devices that it can connect to. Once CONTROL finishes the scan, a list of the devices is presented.

See either “Connecting a PC to the laser over USB” on page 71

or B.

Figure 37 Quick connect

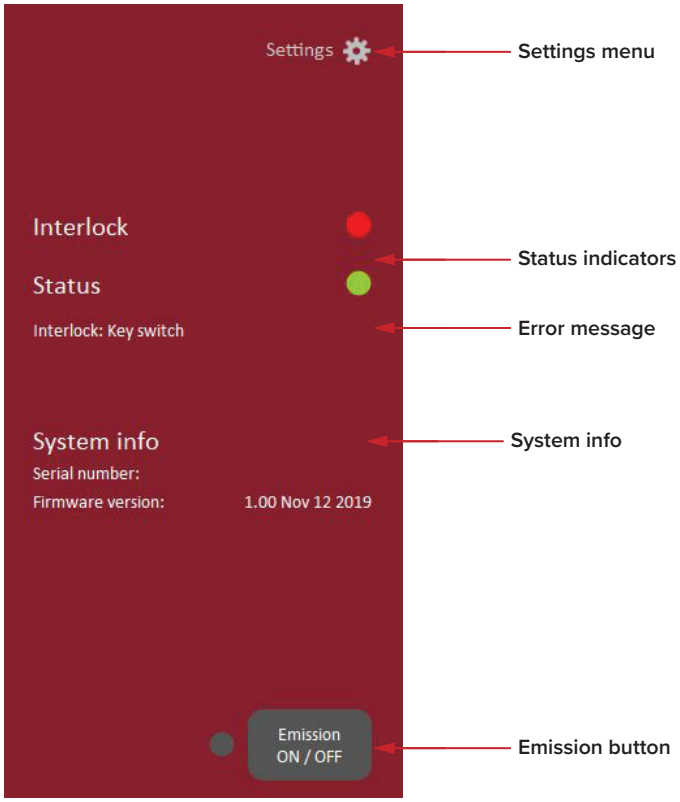


NOTE: Devices must already be connected to the CONTROL PC for quick connect to find them. A connected device means the laser's USB connector is connected and a Windows COM port is assigned to it. For Ethernet connected lasers, the Ethernet parameters must already be configured or assigned by DHCP.

Status Panel

The Status Panel displays status indicators, error messages, emission control function and CONTROL settings are selectable from a drop down menu.

Figure 38 Status Panel



Status Indicators

The panel displays the following indicators:

Interlock
Indicates the status of the Interlock circuit and whether emission can be enabled. The indicator is either:

- ON RED – the interlock circuit is open or shorted to ground – emission not allowed.
- ON GREEN – the interlock circuit is closed and reset – emission allowed.

To clear an ON RED interlock indicator, the interlock and door switch circuit must be closed and reset. Any shorts to ground must be removed.

Status
Indicates the operational status of the laser. The indicator has the following states:

- ON GREEN – The laser emission can be turned on.
- ON RED – There is a fault, laser emission is shutdown and cannot be turned ON. A fault message is displayed when this indicator turns ON RED:

Fault Message	Action
Interlock opened while emission on	*a.* Cycle the key switch to *Off* and then *Armed* *b.* Close the external interlock circuit
Watchdog timeout	Reconnect NKT Photonics CONTROL and reset the interlock by cycling the key switch.

NOTE: See also "Connecting the safety interlock" on page 42.

System Info The *System Info* section shows the following:

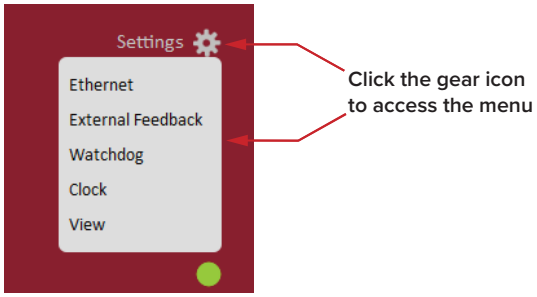
- Laser Serial Number
- Laser Firmware Revision

Emission button The emission button turns the laser emission ON or OFF – See "Using CONTROL to Turn ON the Laser" on page 71. The button indicator turns ON RED when laser emission is generated. Otherwise, it is OFF Grey.

Control settings

The CONTROL settings are accessible by clicking the gear icon in the upper right corner of the Status panel. Clicking the gear icon displays a menu of setting items as shown in Figure 39:

Figure 39 CONTROL settings



Setting Item	Function	See
Ethernet	Opens the network configuration panel	Ethernet on page 86

Setting Item	Function	See
External Feedback	Sets the sample rate for the external feedback feature.	External Feedback on page 88
Watchdog	Enables or disables a watchdog between CONTROL and the laser..	Watchdog on page 88
Clock	Sets the time and date that CONTROL uses for time stamping log messages.	Clock on page 89
View	Enables and disables items displayed in the Status panel.	View on page 89

Ethernet

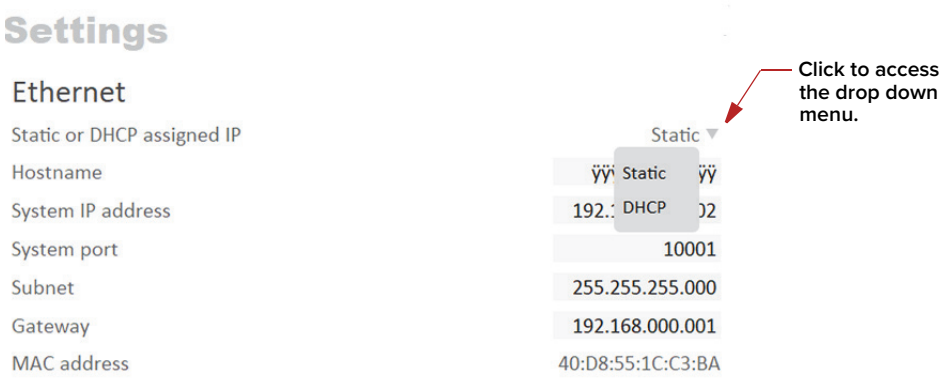
This setting page configures the network settings of the laser when you intend to connect to the laser using an Ethernet connection. To set up an IP connection using this page – see Procedure 9 on page 73.

Static or DHCP

You can set the network connection to use either static or DHCP assigned network settings. The laser is set to use DHCP IP address assignment by default from the factory. To change to static, click on the down arrow as shown in Figure 40 and select *Static*.

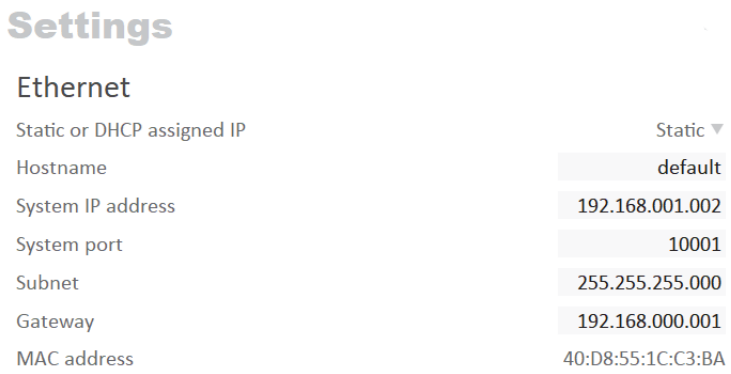
When using DHCP, ensure the subnetwork that the laser is connected to supports DHCP address assignment service. DHCP settings assigned to the laser are displayed on this page once DHCP lease negotiation is completed. Use the settings on this page when setting up the CONTROL PC connection over Ethernet.

Figure 40 Network address assignment – DHCP/Static



Static network settings

Figure 41 Ethernet (network) static settings



Hostname
If your system supports name resolution, you can use this field to set a hostname for the laser.

System IP address
Enter the IP address assigned to the laser. The IP address set must be reachable from the subnet that the CONTROL PC is connected to.

System port
The *System port* sets the port address the laser uses for reception of TCP or UDP packets. The *System Port* address set in the network connection of CONTROL must match this address – default: 10001.

Host IP address
To help prevent unauthorized access, the laser can be configured to only accept packets from a single IP address assigned to the CONTROL PC.

Configure the *Host IP address* with the IP address of your CONTROL PC. When set, the laser only accepts packets with a source address that matches the *Host IP address* and ignores all others. When set to 000.000.000.000 (default setting), the laser accepts packets from any source IP address.

Host port
The *Host port* sets the port address the laser uses for transmission of TCP or UDP packets. The *Host Port* address set in the network connection of CONTROL must match this address – default: 0.

NOTE: If the *Host port* is set to 0, the laser uses the same port address for transmission as for reception i.e. the *System port* setting. The ports addresses set in the laser and in CONTROL must match.

MAC Address
The unique *MAC address (Ethernet hardware address)* of the FIANIUM is read-only and cannot be set.

External Feedback

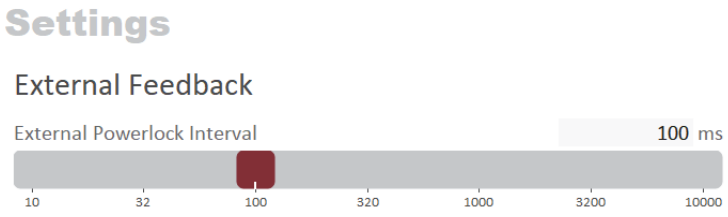
If external feedback is utilized, you can set the sampling rate of the feedback detector in the laser using this setting. The sampling rate is set using the *External Powerlock Interval* slider or text input field. The setting range is from 10 to 10000 ms which gives a sampling rate from 0.1 to 100 Hz. To turn on External Feedback, see “External Feedback mode” on page 94.

For information regarding feedback circuits and connections to the External Feedback port, see “External feedback” on page 55.

Setting the sampling interval

The sampling rate (*External Powerlock Interval*) set should be sufficient to measure the feedback variations. However if the sampling rate is set too high (i.e. a short interval period) in relation to the rate of feedback changes, unwanted oscillations in the laser output power may occur. To avoid this, increase the interval time to stabilize the output power but ensure it is still fast enough to sample the feedback variations.

Figure 42 External feedback - sample rate setting

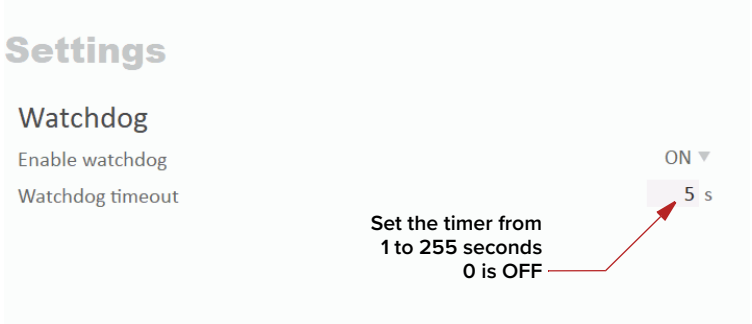


Watchdog

As an added safety feature, a watchdog function monitors the communication link between CONTROL and the laser. If communication with CONTROL is lost, the laser automatically disables emission. The function can be enabled or disabled and has an adjustable timeout. When communication is lost, the watchdog timer counts down from the timeout setting value (1 to 255 seconds). Upon expiry, the watchdog disables emission by internally opening the interlock circuit.

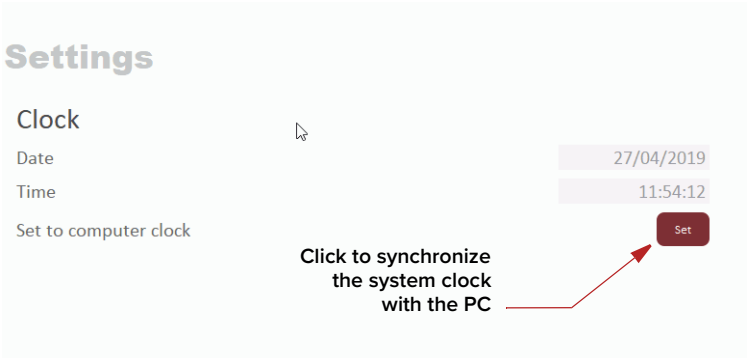
NOTE: Setting the timeout to 0 seconds disables the watchdog function.

Figure 43 Watchdog



Clock You can view and set the laser's time and date using this setting. Click the *Set* button to synchronize the laser clock with the PC time and date. Logs collected by the laser are time stamped with the date and time set here.

Figure 44 Clock settings

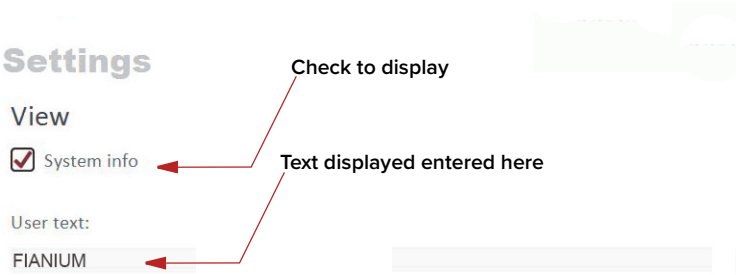


View The View settings control the display items in the status panel and the front LCD panel:

System info – check the box next to "System info" to toggle on displaying the system information.

User text – enter a text string, of up to 240 characters. The text is shown next to the device icon in the *Device selection* panel.

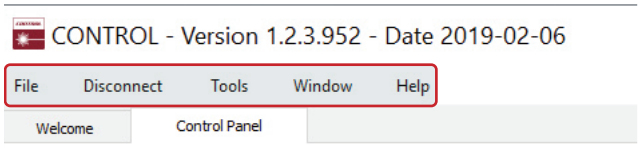
Figure 45 View



CONTROL menu

There are five menu items at the top left of the main CONTROL window. as highlighted in Figure 46. Clicking on each item, reveals a drop down menu.

Figure 46 Menu items



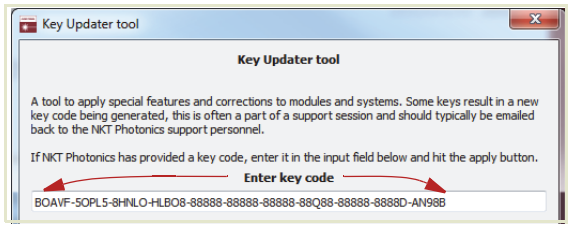
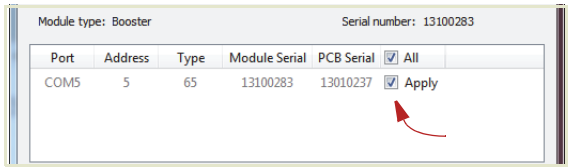
Menu Item	Function	See
File	Click *File>Exit* to exit the CONTROL program	N/A
Disconnect	Click *Disconnect>Close All to* disconnect the currently connected device from CONTROL.	N/A
Tools	Select from one of three special tools to use with your laser. Tools available are:	
	• Key Updater Tool	Key Updater tool on page 90
	• Log Downloader	Log Downloader on page 91
	• Extensions Overview	Extensions overview on page 93
Window	Sets whether certain panels are visible or not.	Toggling the panels visible on page 83
Help	Displays the current version of CONTROL and provides access to the included CONTROL user help.	N/A

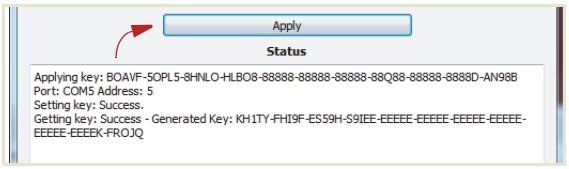
Key Updater tool

You can use the *Key Updater* tool to apply special features and corrections to modules and systems of the laser.

To use the *Key Updater* tool follow Procedure 14.

Procedure 14 Using the Key Updater tool

	Action	
1	Enter a key code in the field “Enter key code”. **NOTE**: Key codes are generated by NKT Photonics.	
2	In the list of modules, check the box on the right of each applicable module.	

	Action	
3	Click “Apply”	

NOTE: Certain keys generate a new locally generated key code. Locally generated keys are usually required during a support session and should be emailed to NKT Photonics support personnel.

Log Downloader

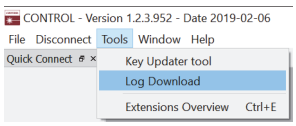
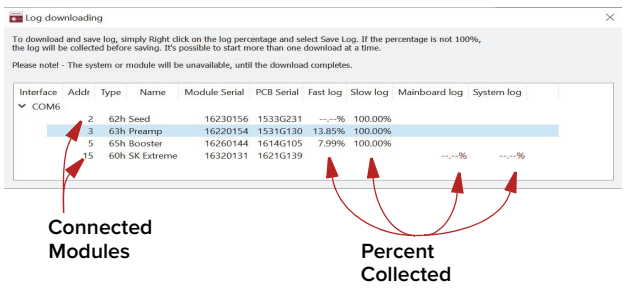
If your laser requires support from NKT Photonics, our support engineers may request you send them log files collected by the laser. You can use the *Log Downloader* tool to save log files from the laser to your CONTROL PC.

NKT Photonics CONTROL automatically downloads log files from modules of any connected devices. The log files are stored in a local database of the CONTROL PC. However, certain NKT Photonics modules, including the SuperK FIANIUM mainboard, do not support automatic download of log files. For these modules, you can use the *Log Downloader* tool to put the device into dedicated log download mode by enabling a collect log function.

NOTE: When the collect log function is enabled, it temporarily disables automatic log collection from all other devices. The CONTROL interface turns gray, and communication with the laser and log collection with all other modules is disabled.

To download log files use the *Log Downloader* as described in Procedure 15.

Procedure 15 Using the Log Downloader

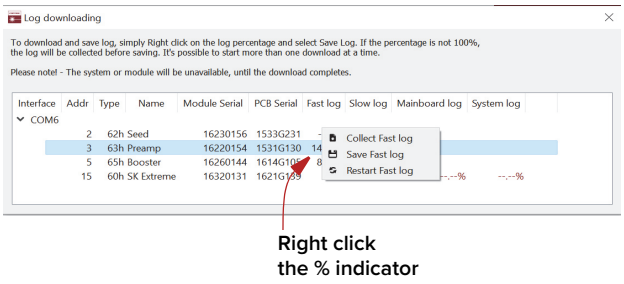
	Action	
1	Click the *Tools* menu and click on *Log Download* to start the Log Downloader tool.	
2	The tool displays all connected modules with log capability. To decrease the download time of the module log files, CONTROL continuously collects module log data and stores this log data in a local database on the PC. Logs are collected from each module and each has a percentage indicator that shows the percentage (%) collected of the module’s total log data.	

Using the Log Downloader

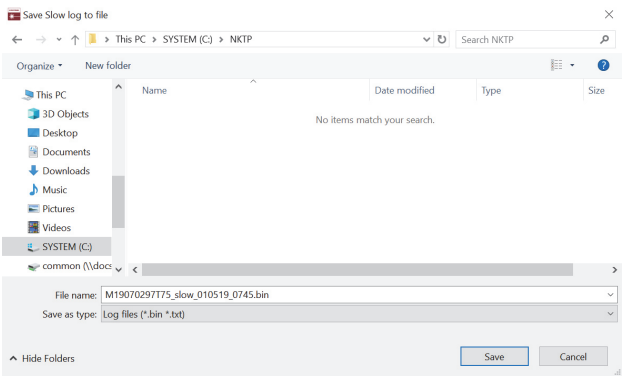
3 To download and save a log file to the CONTROL PC, right click the percentage indicator and select either:

Save log – Immediately saves the file onto the CONTROL PC, see step 4. If the percentage shows less than 100%, the log is first collected as described below.

Collect log – Starts a dedicated log collection mode that disables all other CONTROL activity, see step 5.

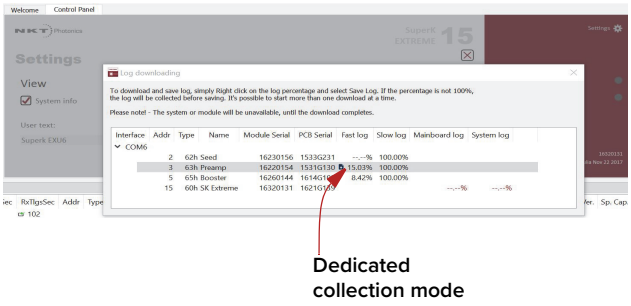


4 If you select *Save* log, a dialog box prompts for a filename and folder to store the log in.

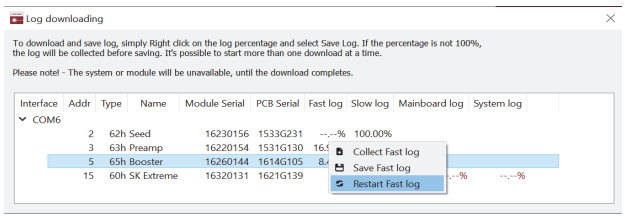


5 If you select *Collect* log, the log is retrieved and saved in dedicated mode. The CONTROL panel turns grey and all other functions are disabled.

When log collection is finished, all other CONTROL functions are accessible again.



6 Select *Restart* to clear out all collected log data and restart log data collection.



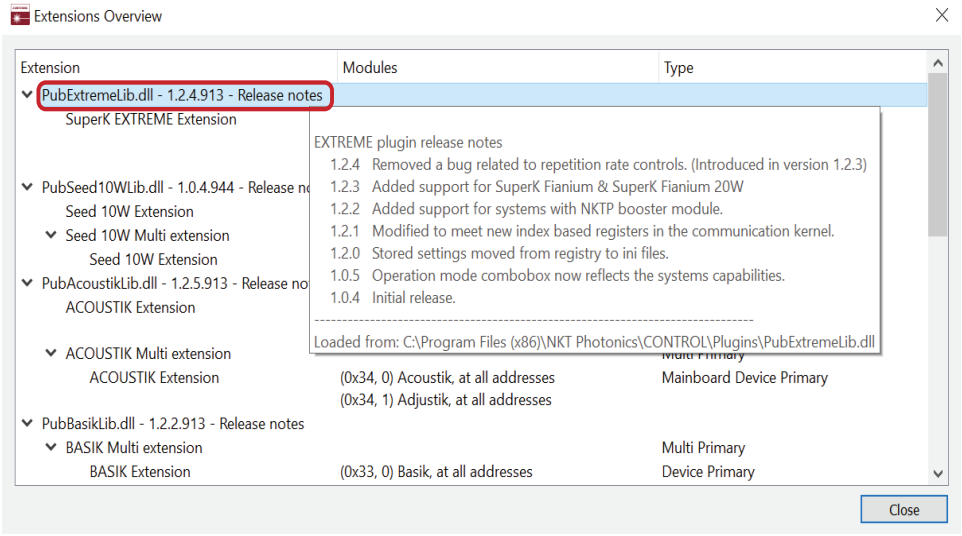
Extensions overview

You can use this tool to view the installed extensions (plugins) that are included with CONTROL. The extensions are found in the following folder:

C:\Program Files (x86)\NKT Photonics\NKTP CONTROL\Plugins

To view the extensions, click the *Tools* menu and then click on *Extensions Overview*. The *Extensions Overview* window is launched as shown in Figure 47.

Figure 47 Extensions Overview



NOTE: To show a short description of the release notes as seen in Figure 47, hover the mouse pointer over the “Release notes” text.

The PubExtremeLib.dll details highlighted in Figure 47 shows the version of the .dll file (1.1.2.303), the included extensions (SuperK FIANIUM Extension) and which module types they support.

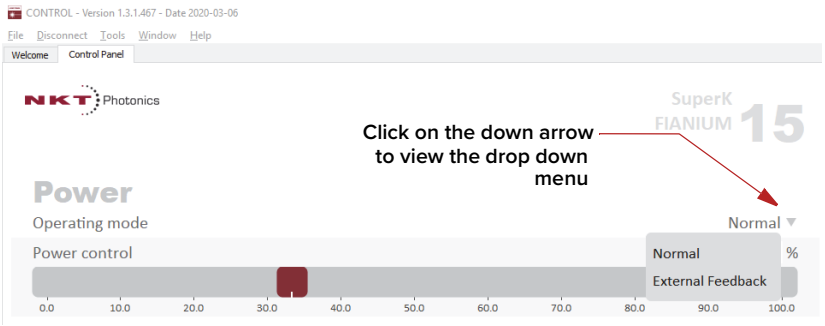
NOTE: Multiple extensions for a wide range of NKT Photonics laser types are typically installed when using the default installation of CONTROL.

Setting emission power

Setting the operating mode

In the *Control Panel*, you can configure the laser to operate in two modes by clicking on the Operating mode drop down menu shown in Figure 48. Each mode determines how the output emission power is set.

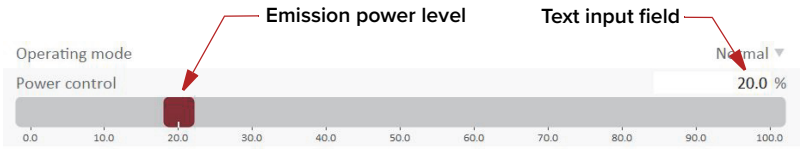
Figure 48 Operating mode



Normal mode

In *Normal* operating mode, adjusting the slider either right or left sets the laser emission power level from 0 to 100%. You can also directly input the power level set using the text input field on the right. This field is also updated from the slider and vice-versa.

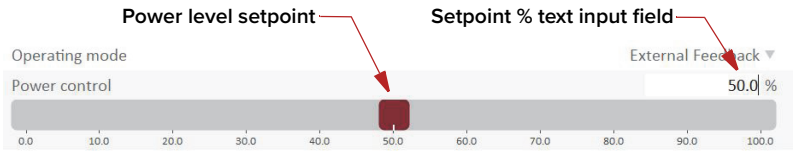
Figure 49 Power control slider – normal mode



External Feedback mode

In External Feedback mode, output power is stabilized based on feedback voltage applied at the “External Feedback” port and the setpoint level which is set using the *Power control* slider or text input field. Note that any connected feedback signal must be supplied from an external feedback circuit not included with the laser – see “External feedback” on page 55.

Figure 50 Power control slider – External Feedback



Detection sampling rate

The detection sampling rate of the external feedback signal is settable – see “External Feedback” on page 88 for more information.

NOTE: The configured setpoint level must align with the expected range of voltages received from the feedback circuit – see “Feedback circuit” on page 55.

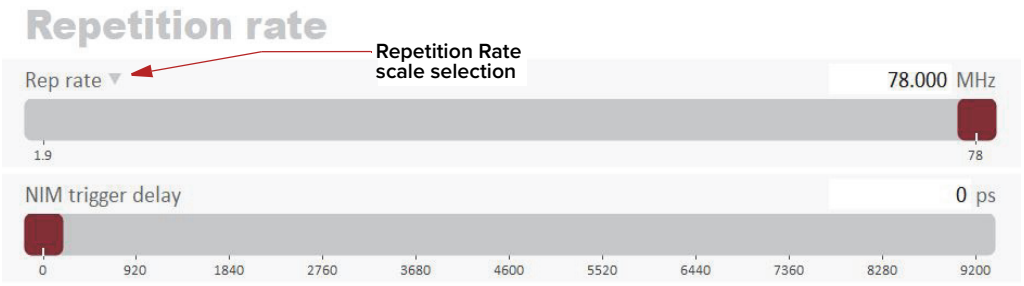
NO emission from the laser

When no emission is detected after enabling emission, check if the operating mode is set to *External Feedback*. When no feedback voltage is connected in this mode, emission power is set to the minimum level.

Setting the pulse repetition rate (pulse picker)

When the Variable Repetition Rate (VRR) feature is included with the laser, the repetition rate and post-VRR NIM trigger delay is adjustable using the control panel sliders shown in Figure 51.

Figure 51 Repetition rate and NIM trigger delay controls

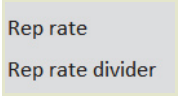


Repetition rate

The slider sets the output pulse frequency using the VRR feature – see “Setting the pulse repetition rate (pulse picker)” on page 95. Adjust the slider to the desired output pulse frequency.

You can set the repetition rate scale to show units in MHz or by the division factor. Click the arrow as shown in Figure 51 to select the scale unit type from the drop down menu (Figure 52). Select *Rep rate* for MHz or *Rep rate divider* to show the scale as the division factor.

Figure 52 Repetition rate scale selection



NOTE: When the scale is set to MHz (*Rep rate*), the slider only snaps to the values permitted by the pulse picker.

NIM trigger delay

You can delay the trigger pulse, from the post-VRR “NIM Trigger out” port, from 0 to 9200 picoseconds. Use the *NIM trigger delay* slider to adjust the delay of the output trigger as required.

NOTE: To delay the trigger signal more than 9200 picoseconds, a longer cable can be used as an additional offset from the *NIM Trigger out* port to the application.

Application Log panel

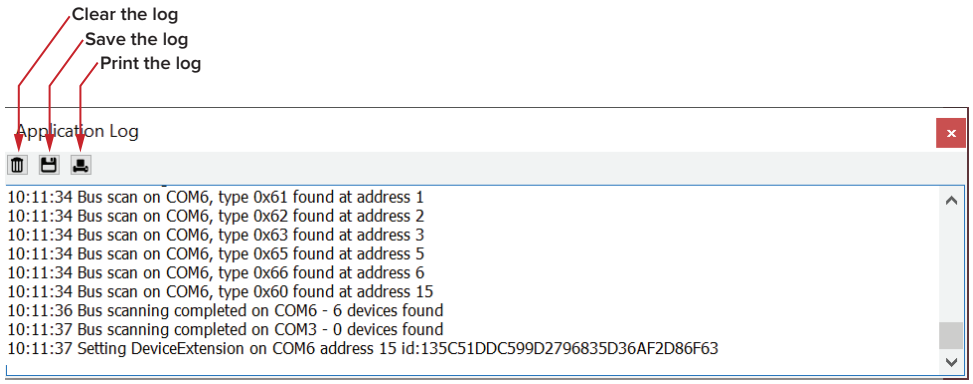
The *Application Log* panel displays and logs communication messages between the CONTROL PC and the laser. You can use the log to debug connection issues between CONTROL and NKT Photonics devices.

The panel displays and timestamps the following types of log messages:

- Port Scans
- Discovered Devices
- Closed Communication Ports

The panel includes three buttons in the upper left corner. You can use the buttons to clear, save or print the log. Click on the “X” in the upper right corner of the Application Log window to close the *Application Log*.

Figure 53 Application Log window



Device Monitor

The Device Monitor serves as a monitoring interface that offers real-time visibility of the transmit and receive parameters monitored on the laser's communication ports and any associated device modules.

This dynamic display provides up-to-date values of the parameters, enabling users to effectively troubleshoot potential issues with their connected devices. The parameters are described in Table 19.

Table 19 Device Monitor parameters

Parameter	Description
Interface	The PC port interface the device(s) is connected to. Click the “greater than” symbol to the left of the port to display the connected device(s) parameters.
TxTlgsSec	The number of telegrams per second being transmitted to the connected device.
RxTlgsSec	The number of telegrams received per second from the connected device.

Parameter	Description
Addr	The address of the connected module.
Type	The type of the connected module; read from the module.
SysType	The system type, default 0 – can be used to describe system variants and is read from the module.
Name	The name of the connected device module.
P/N	The device module part number.
Mode	The mode or status of the connected module: *connected*, *disconnected*, or *disabled*.
Status bits	The actual status bits read from the connected module.
Error code	The actual error code read from the connected module.
Access	Protected/Locked status of the module.
FW Ver.	The device module's firmware release date.
Module Serial	The serial number of the device module.
PCB Serial	The device module's printed circuit board serial number.
PCB Ver,	The version of the device module's printed circuit board.
Sp. Cap/	The module speed capability in bits per second as read from the module – values: 0=(default) 115200, 1=230400, 2=460800, 3=921600
Pri Ext	Primary extension/GUI loaded for this module. Hover over the icon to list more details – Note that there can only be 1 primary.
Fast Log	0%-100% collected. Note only if the module has a fast log and only internal modules have fast and slow logs.
Slow Log	0%-100% collected. Note only if the module has a slow log.
Mainboard Log	0%-100% collected. Note only if the module has a main log. Only main boards have main and system logs.
System Log	0%-100% collected. Note only if the module has a system log. Only main boards have main and system logs.
Timeout	Time in milliseconds since the last telegram was received from the device module.
Nack	Total number of negative acknowledgments received from the device module.
CRC	Total number of received telegrams with CRC failures.
COM	Total number of communication errors with framing or protocol errors. Hover over the icon to list more details.
Busy	Total number of busy responses from the module. Busy responses occur when a module receives a message but cannot process it due to its current work load.

Appendices

The appendices include:

A Specifications

Table 20 Interfaces

PC and micro processor interfaces	RS-232 serial COM - 9 Pin D-Sub Female Connector USB 2.0 - Type B Female Connector
External Pulse Control	External Feedback: BNC 0 to 4.1 V analog input – power stabilization Booster ON/OFF: BNC 0 to 5V TTL/CMOS input – on/off control
Pulse Synchronization	NIM Pulse: BNC – NIM synchronization pulse (Seed and post-VRR) Pulse Monitor – 0 to 0.9 V synchronization pulse (Seed and post-VRR) Gate Output: BNC +5 V saw or square wave input – pulse picking (post-VRR only)
External Bus	RS-485 Bus - 15pin D-Sub Female Connector
Door Interlock	2 pin Connector - LEMO Part Number FGG.0B.302

Table 21 Mechanical dimensions

Size (H x W x D)	443 x 252.3 x 376.8 mm (17.44 x 9.93 x 14.83 in)
Weight	18 kg / 19 kg with VRR option (39.7 lb / 41.8 lb)
Operating Temperature	18°C to 30°C (64°F to 86°F)
Operating Humidity (non-condensing)	20 to 80%
Storage Temperature	-10°C to 55°C (14°F to 140°F)
Maximum Operating Altitude	2000 m
Output Cable Length	1.5 m (59 in)

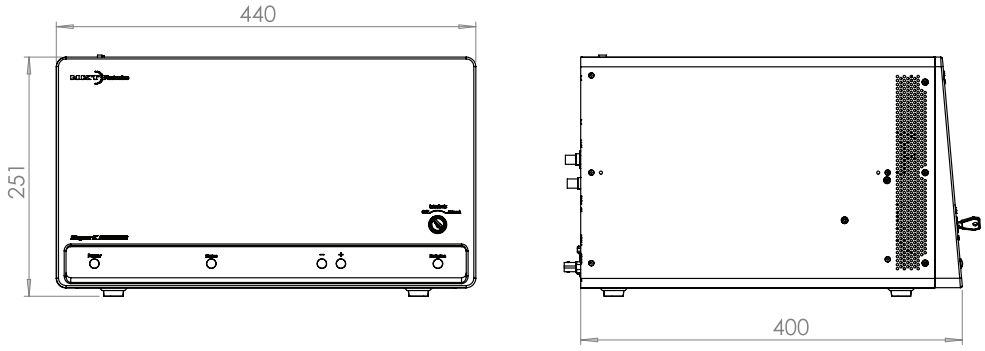
Table 22 Electrical

AC Power	Input 100-240 VAC 50-60 Hz
Maximum Power Consumption	200 W
Fuse	T6.3A, 250V 5 × 20 mm cartridge fuse

CE

CE Mark – Declaration of Conformance for EMI, Safety (EEC) and ROHS

Figure 54 Mechanical dimensions



B Service and Support Information

Servicing the laser

SuperK FIANIUM series lasers have no user serviceable components. In case of malfunction, contact NKT Photonics using the support channels in section “Support contact details”.

Factory safety tests

End of line safety tests according to EN61010-1 Annex F are performed on all Laser chassis.

Opening the laser chassis

Do not open the laser chassis. There are no user serviceable components inside the SuperK FIANIUM chassis. Should your laser malfunction, and it cannot be serviced on site by factory personel, it must be shipped to NKT Photonics headquarters in Denmark.

Return shipping

Damage may occur to the laser during shipping. To minimize the chance of shipping damage, package the laser in its original NKT Photonics shipping material – see “Shipping the laser” on page 104.

WARRANTY VOID IF REMOVED label

The unit is sealed with a label “WARRANTY VOID IF REMOVED”. It is strictly prohibited to remove the chassis cover and doing so invalidates the warranty.

Figure 55 WARRANTY VOID LABEL

Support contact details

If you need help or have questions regarding your SuperK FIANIUM laser or its accessories, contact NKT Photonics through our support website below:

Support website

1. Go to:

   https://www.https://www.nktphotonics.com/support/

2. Scroll down and click or press:

3. Select the type of help required, fill in the form, and click or press *Submit*.

NOTE: To ship the laser see “Shipping the laser” on page 104.

Shipping the laser

To ship the laser, prepare and pack the laser according Procedure 16 and ship it to the address below.

Shipping address

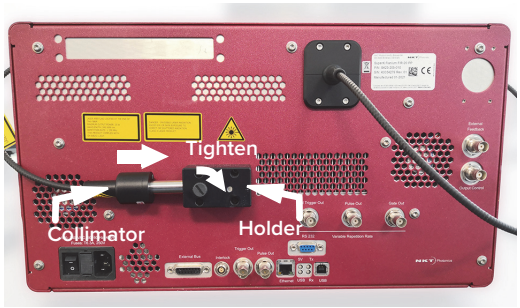
NKT Photonics A/S
Blokken 84
DK-3460 Birkerød
Denmark

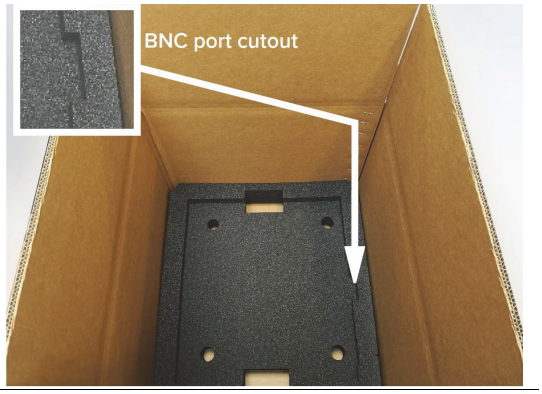
Packing the laser for return

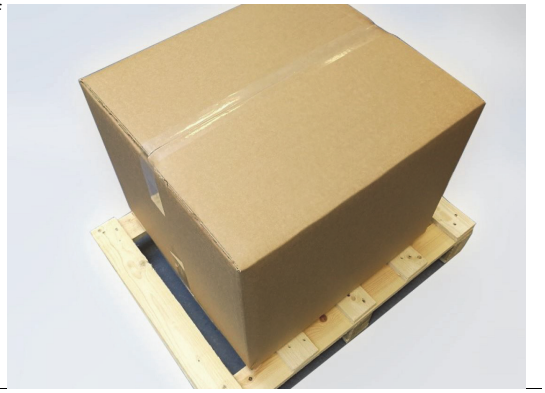
When shipping the laser, always use the original packaging that you received the laser in. If you no longer have the original packaging with foam inserts, you can request new packaging from us at a cost.

WARNING: Do not lift the laser alone. The laser is heavy and weighs close to 20 kg; two people are required to lift the laser when placing it into its packaging.

Procedure 16 Packing the laser

	Action
1	Cool the laser by turning it off and disconnecting it at least one hour before you pack it.
2	Place the output collimator in its holder on the rear panel of the laser. Ensure to secure it in place by tightening the lock screws. 
3	Tape the loose output fiber to the top panel of the laser.
4	Place the laser in an ESD bag. Slip the bag carefully over the laser from one side as shown. 

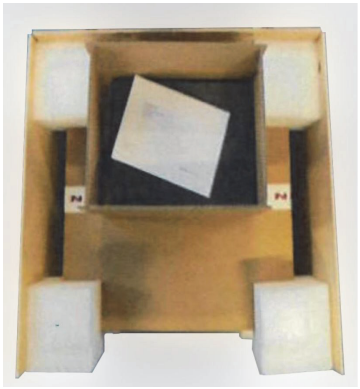
	Action	
5	Seal the bag to prevent moisture from entering. **OPTIONAL**: if you have a vacuum sealing machine, seal it as shown.	
6	Place the carton on a half pallet with the top flaps open. **WOODEN CRATE**: Should your original packing consist of a carton within a wooden crate, skip the following steps and continue packing using Procedure 17.	
7	Place the bottom layer of foam into the carton orientated as shown.	
8	Place the laser wrapped in the ESD bag onto the bottom foam layer in the carton. **NOTE**: Align the rear panel of the laser with the foam cutout highlighted in step 4.	

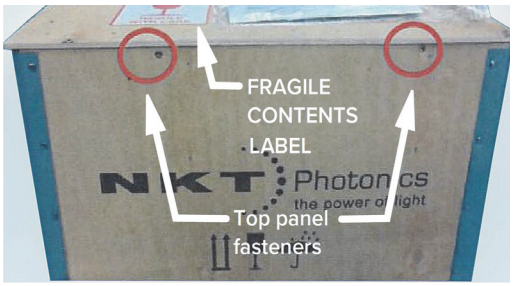
	Action	
9	Place the top layer of foam onto the laser as shown.	
10	You may be specifically requested to return certain accessories with the laser. Insert the requested accessories into a plastic bag; then place the bag in the foam cutout as shown. Never return accessories to NKT Photonics unless they are requested. **NOTE**: If you are shipping the laser to operate elsewhere be sure to pack all accessories with the laser.	
11	Using packing tape, seal the top flaps of the carton.	
12	Strap the carton securely to the pallet.	

	Action
13	Before shipping, ensure there are FRAGILE CONTENTS labels placed on the carton.

Procedure 17 Legacy wooden crate packaging

	Action
1	Place the original white protective “techno” foam onto the side panels of the laser **CAUTION**: Ensure the output fiber is not pinched between the laser and the foam.
2	Carefully place the laser in the original shipping carton as shown. **NOTE**: Check again to make sure the output fiber is clear of the foam and carton sides.
3	Place the laser’s shipping carton and accessory boxes into the crate with support foam inserts at each corner as shown. Accessory boxes - optional Only pack and return accessories requested by NKT Photonics personnel. Never return accessories to NKT Photonics unless they are requested. **NOTE**: If you are shipping the laser to operate elsewhere, be sure to pack all accessories with the laser.



	Action	
4	Ensure to seal any accessory boxes with tape. **NOTE**: Check to make sure the laser's carton and accessory boxes are held firmly in place to prevent them from shifting during transport.	
5	*a.* Fasten the lid on the crate by tightening the screws along the outside edge of the crate. *b.* Before shipping, ensure there is a FRAGILE CONTENTS label placed on top of the crate.	

C External Bus Pinout

Table 23 External bus pinout

Pin	Name	Description
1	NC	Not connected
2	RS485-	Negative (inverted) RS485 data signal
3	Interlock loop+	Positive connection of the safety interlock loop. Connect pin 3 to pin 4 *Interlock loop-* to enable laser emission.
4	Interlock loop-	Negative connection of the safety interlock loop. Connect pin 4 to pin 3 *Interlock loop+* to enable laser emission.
5	GND	0 volt / ground
6	GND	0 volt / ground
7	+12 V	+ 12 volt supply voltage for external accessories
8	+12 V	+ 12 volt supply voltage for external accessories
9	Emission	Logic output – set **high** (5V) when laser **emission** is **enabled**. To indicate laser emission using an external LED, connect the anode of an LED to this pin. Connect the LED's cathode to GND (pin no. 5,6, 13 or 14). **Note:** The pin features a 240 Ω internal series resistor to support connecting an LED.
10	RS485+	Positive (non-inverted) RS485 data signal
11	Not in use	For future use. Do not connect this pin.
12	Interlock	This pin outputs a logic **high** (5V) when the interlock circuit is closed and has been reset. This signal indicates the interlock is enabled and can be optionally used to control safety related precautions on the External bus.
13	GND	0 volt / ground
14	GND	0 volt / ground
15	+12 V	+ 12 volt supply voltage for external accessories.

D Accessories

This appendix provides a brief overview of the accessories available for your laser. Table 24 lists the accessories and their functions and provides a link to descriptions of the SuperK FIANIUM advanced accessories.

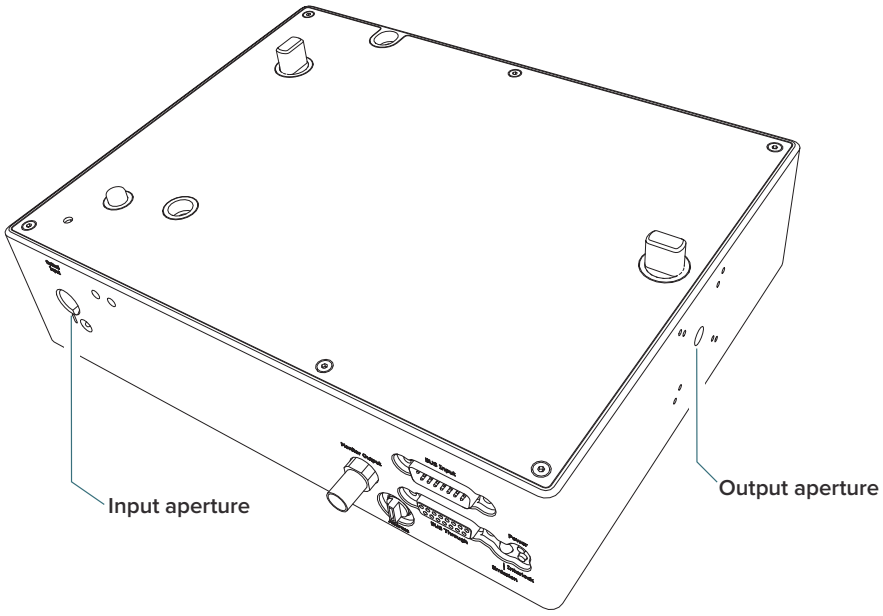
Table 24 SuperK FIANIUM accessories

Advanced accessories	Function	Part number	
VARIA	Variable bandpass filter	A301-100-000	“SuperK VARIA” on page 112.
Select	Multi-wavelength AOTF	A203-XXX-000 or A203-XXX-010	“SuperK Select” on page 113.
LLTF	Narrow laser line filter	A371-500-000 or A371-200-000	“SuperK LLTF” on page 115.
Split	Broadband filter	A102-200-000 or A102-500-000	“SuperK Split” on page 116.
Connect	Delivery fiber	A401-000-000 or A401-200-000 or A401-500-000	“SuperK Connect and Fiber Deliver System” on page 117.
Other accessories			
Connect Holder	Optical table mount for Connect accessory.	000-000-003	
Collimator Holder	Receptacle for laser or accessory collimator.	M0002-4041-00	
External Filter Holder	Beam path 1” filter mount for any filter accessory.	A000-000-004	
TL30 mm Adapter	Accessory adapter for Thorlabs 30 mm cage system.	A000-000-005	
USB Adapter Kit	USB to RS485 adapter, used to connect accessories to a PC.	A911-100-103	
Key	Spare key for the laser’s key switch.	A911-100-009	
External Bus Defeater	Spare bus defeater for the External Bus ports.	A911-100-007	
Door Interlock Connector	Spare Lemo connector assembly for the door interlock circuit.	A911-100-005	
Bus Cable	Used to connect the laser to any accessories.	A911-100-006	
USB Cable	Spare Type A to B USB cable.	A911-100-004	
BNC Cable	Used to connect External Control Input or Pulse Output.	A911-100-008	

SuperK VARIA

VARIA accessories act as bandpass filters when connected to the collimator of a SuperK FIANIUM laser. A portion of the beam from the SuperK FIANIUM is diverted to the VARIA's bandpass filter which removes the light wavelengths that fall outside a variable wavelength range. The filtered beam is then emitted from the main optical output of the VARIA. A CONTROL PC connected to the SuperK FIANIUM controls the VARIA through the laser's front panel External Bus connector connected to the VARIA's bus input connector. CONTROL is used to configure the variable range of the VARIA's bandpass filter. The beam portion not diverted to the bandpass filter is output from the auxiliary optical output of the VARIA. A diagram of the accessory connected to the laser is shown in Figure 56.

Figure 56 VARIA



VARIA specifications

The bandpass filter specifications of the VARIA are shown in Table 25.

Table 25 VARIA specifications

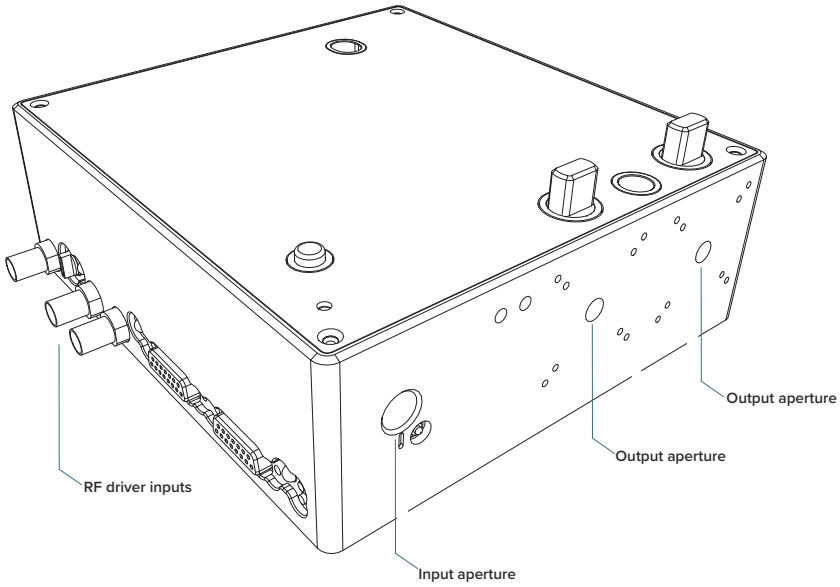
Specification	Function
Bandpass filter range (wavelength)	400 to 800 nm
Minimum linewidth	10 nm
Transmission efficiency	Approximately 80%
Filter suppression	Approximately 50 dB

NOTE: For further details, refer to the *SuperK VARIA Product Guide*.

SuperK Select

SuperK Select accessories can be fitted to extract multiple specific light wavelengths from the broadband spectrum output of the SuperK FIANIUM laser. The Select accessory uses Acousto-optic Tunable Filter (AOTF) technology using tellurium dioxide crystal(s) that diffracts the desired beam wavelength. The specific wavelength diffracted by each crystal is tuned by applying an RF signal to it. A single Select crystal filter can output up to eight tunable wavelengths configurable through CONTROL. A Select accessory is fitted with either one or two AOTF crystal filters to deliver a maximum of 16 specific wavelengths tuned and extracted from the laser's broadband output. A Select connected to a SuperK FIANIUM is shown in Figure 57.

Figure 57 Select



Output delivery

The beam delivery from the Select output is either a free space collimated beam or fiber coupled using SuperK Fiber Delivery (FD) with a SuperK Connect (fiber coupling connector). The AOTF crystal output naturally includes power from numerous sidebands, see Figure 58 on page 114. Free space delivery implements a small aperture to suppress the bulk of the side lobe power beyond the first order. However, when using a fiber delivery system with the SuperK Connect, a small aperture is not required; the delivery system aperture provides the suppression.

Output beam specifications

The AOTF type(s) is specified when ordering a SuperK Select. The type of AOTF determines the possible wavelength range and bandwidth that can be diffracted from the crystal. Table 26 lists the available AOTFs that can be fitted to a SuperK Select.

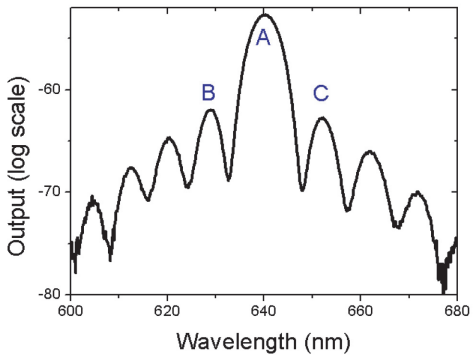
Table 26 Select AOTF types[1]

AOTF Type	Wavelength Range (nm)[i]
UV-VIS	400-650
VIS (1x)	430-700
VIS (4x)	450-700
VIS-nIR	500-900
nIR1	640-1100
nIR2	800-1400
IR	1100-2000

i. Subject to change, refer to the current product datasheet for the latest specifications.

As noted earlier, the tuned beam which is defracted from a Select crystal filter also includes a number of n'th order side lobes. A typical example is shown in the output spectrum graph of Figure 58. In this case, the tuned wavelength is set to 640 nm and the energy of the 1st order side lobe is approximately 10 dB less than the central wavelength.

Figure 58 Select AOTF example output - 640 nm central wavelength



NOTE: For further details, refer to the *SuperK Select Product Guide*.

1. Ranges subject to change, refer to the latest NKT Photonics datasheet.

SuperK LLTF

A Laser Line Tunable Filter (LLTF) Contrast accessory provides a tunable and extremely narrow bandpass filter with out-of-band (OOB) suppression in the order of 60 dB. The filter is continuously tuned over the entire spectrum of the supercontinuum laser, converting the wide band beam to a finely tuned ps laser. The LLTF Contrast uses a non-dispersive filter that maintains the intrinsic single-mode beam quality of the laser.

There are four LLTF Contrast models, each with a specific tuning range as shown in table Table 27. Depending on the tuning range required, the LLTF accessory supports filters that cover both visible and NIR tuning ranges. Note that a separate PC-based GUI application is required to provide filter tuning control using USB 2.0 connectivity. The LLTF Contrast connected to a SuperK FIANIUM is illustrated in Figure 59.

Output Delivery

The beam delivery from the LLTF Contrast is fiber coupled using a Fiber Deliver (FD) such as a SuperK Connect (fiber coupling connector).

Figure 59 SuperK LLTF Contrast

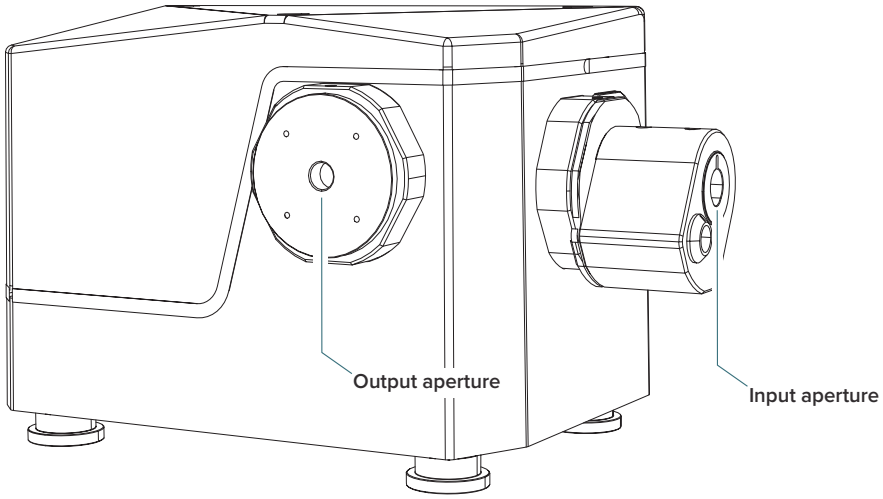


Table 27 LLTF Contrast model specifications

LLTF model	Wavelength range	Spectral bandwidth	Maximum power
LLTF Contrast VIS	400-1000 nm	1.0-2.0 nm	8 W
LLTF Contrast SWIR	1000-2300 nm	2.0-5.0 nm	8 W

SuperK Split

Use a SuperK SPLIT to divide the SuperK FIANIUM emission into two separate spectral outputs. A SPLIT is a passive filter and it is available in two standard models where the spectral outputs are configured as either:

- VIS/IR – Visible and Infrared

  – or –

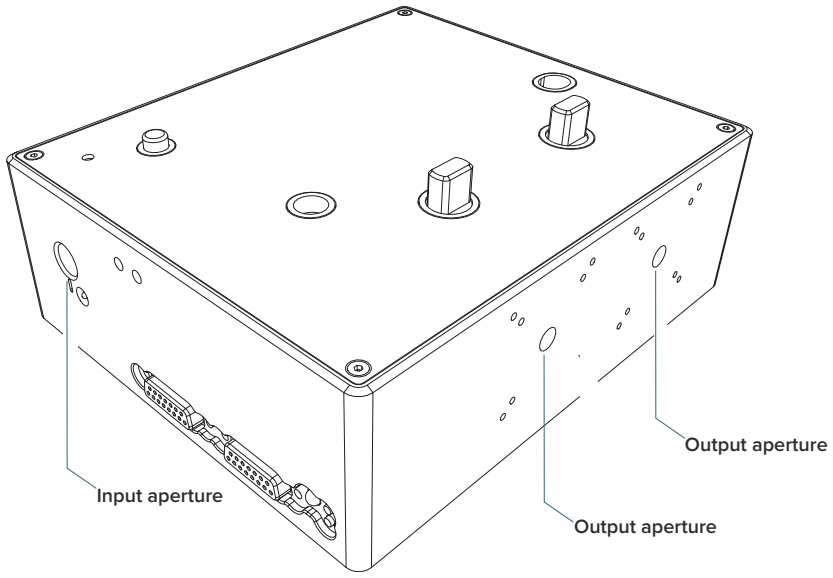
- nIR/IR – Near Infrared and Infrared

NOTE: A SPLIT can be ordered with custom wavelength splits, see Table 28 for the details regarding the wavelengths.

The separate outputs are both collimated and free-space and can be fitted with additional filters, polarizers, attenuators and for beam deliver, the CONNECT accessory.

A diagram of the SPLIT connected to the laser is shown in Figure 60.

Figure 60 SuperK Split



SuperK Split specifications

The specifications of the Split are shown in Table 28.

Table 28 SPLIT wavelength ranges

Model	Wavelength Ranges
VIR/IR	400-800 and 915-2400 nanometers
nIR/IR	600-1120 and 1180-2400 nanometers

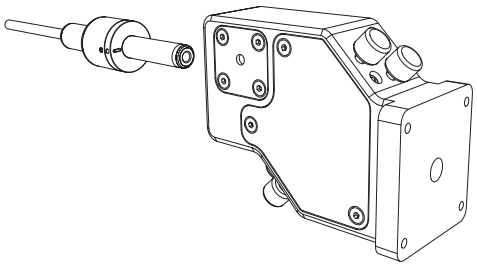
NOTE: For further details, refer to the *SuperK Split Product Guide*.

SuperK Connect and Fiber Deliver System

A CONNECT is a single mode fiber coupling device which can terminate to a collimator and an FC /PC or FC/APC connector. As a fiber delivery system, CONNECT can be used with the laser or its accessories. It combines high coupling efficiency with power handling up to 500 mW over a spectrum from 400 to 2000 nm. You can disconnect and reconnect it to a photonic system without needing to realign the coupling. There are multiple CONNECT models built to match the emission characteristics of the application, contact NKT Photonics for more information on the available models.

A general view of the Connect accessory showing the location of the collimator input is shown in Figure 61.

Figure 61 SuperK Fiber Delivery System using a CONNECT



E Control Software

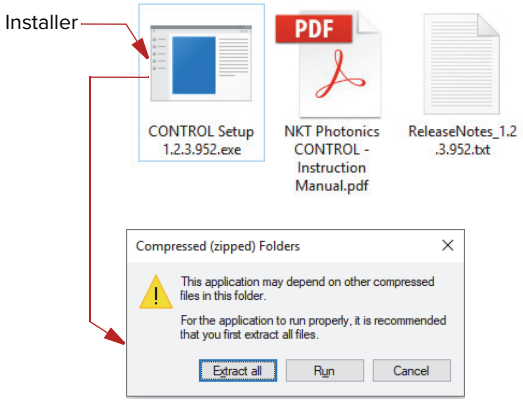
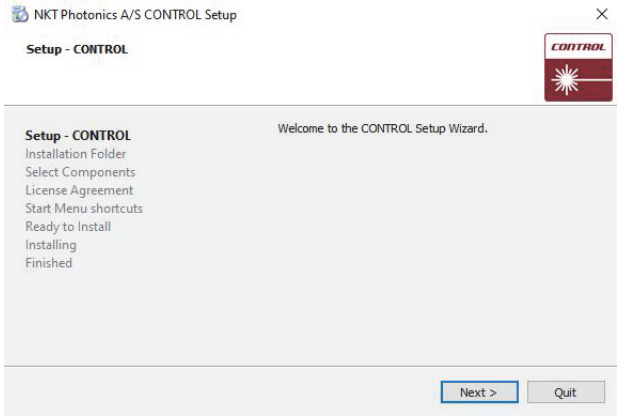
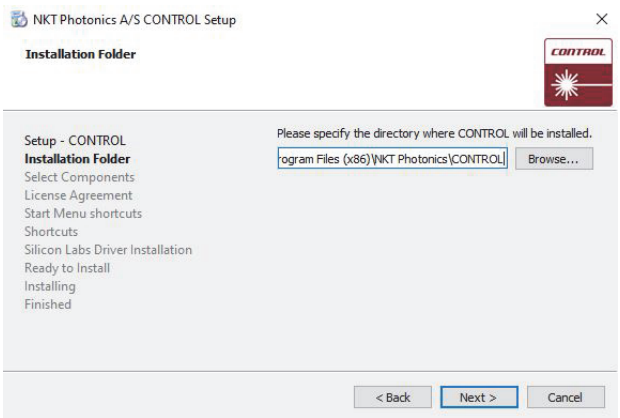
Installing CONTROL

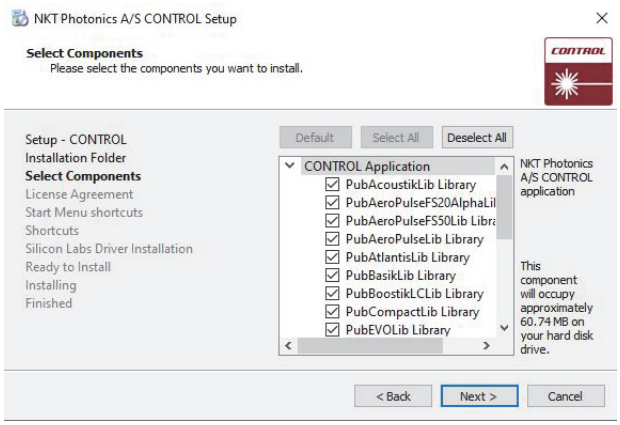
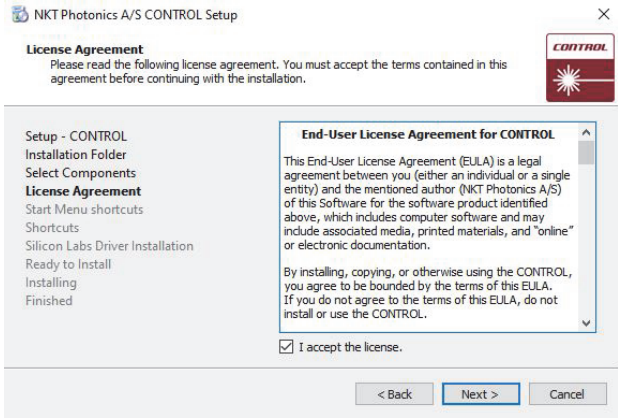
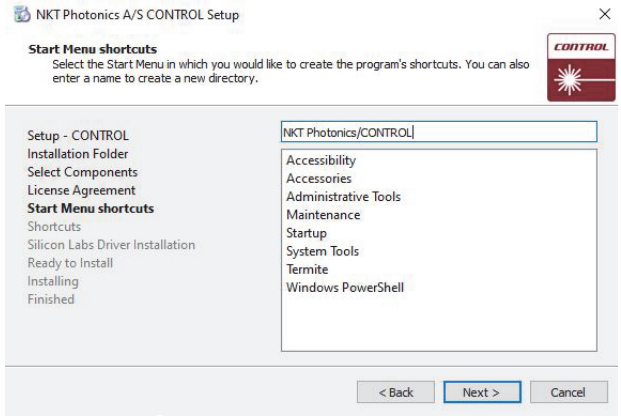
Download the software from:

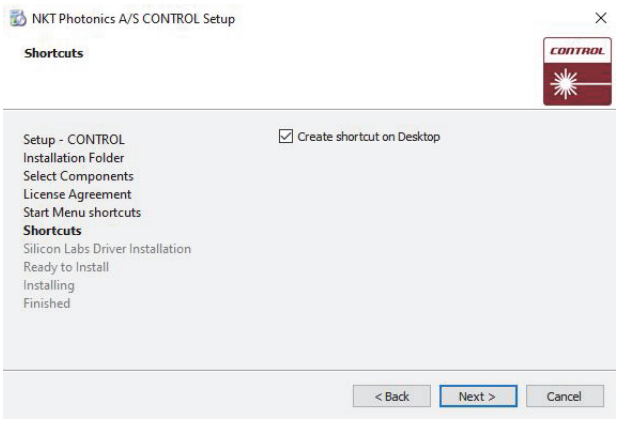
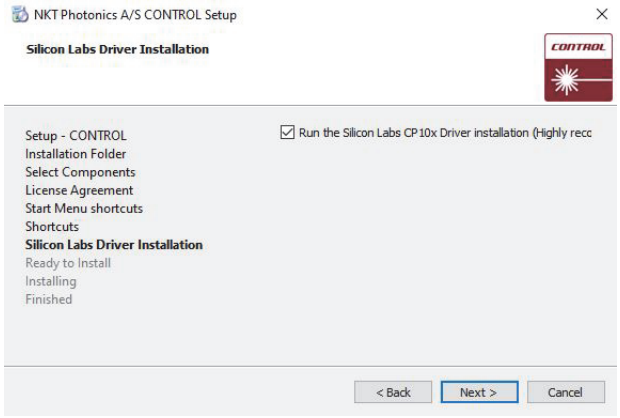
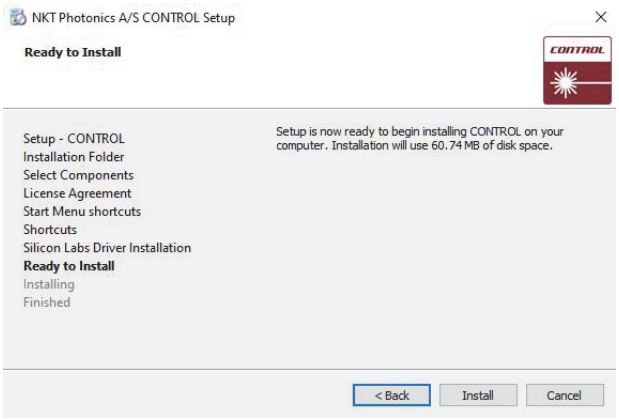
https://www.nktphotonics.com/lasers-fibers/support/software-drivers/

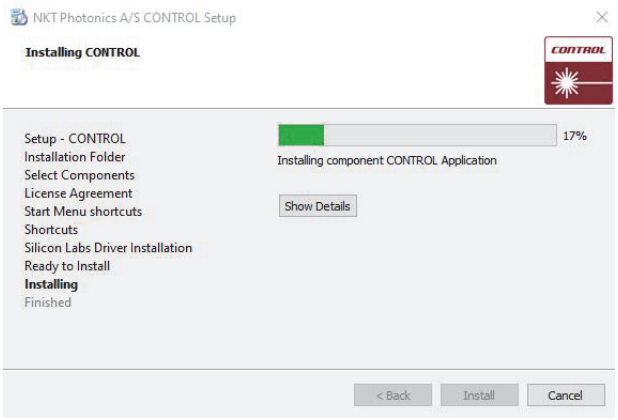
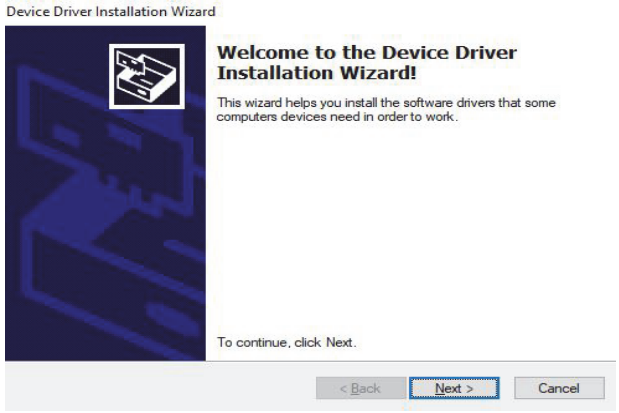
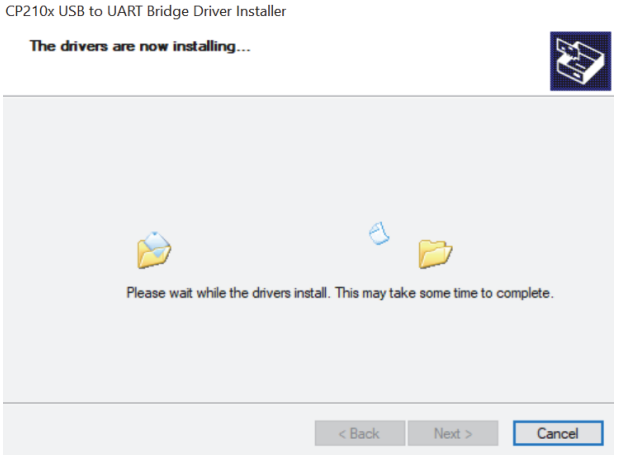
Follow the steps in Procedure 18.

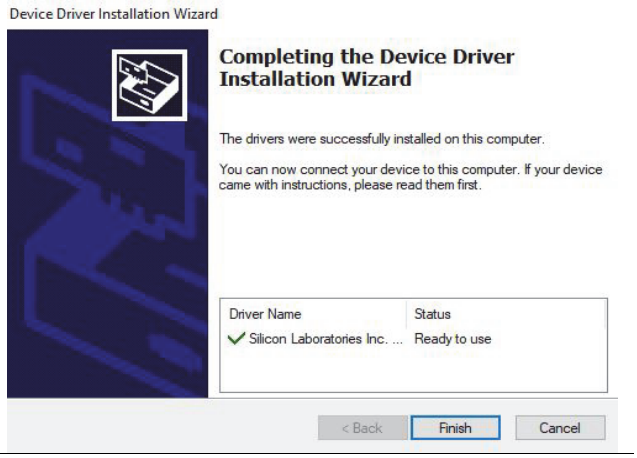
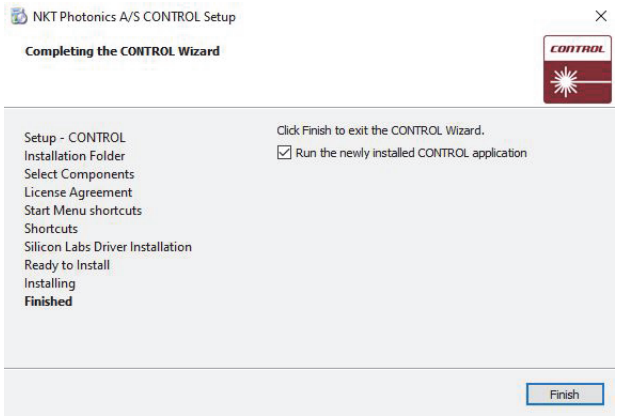
Procedure 18 Installing CONTROL

	Action	
1	On the PC, launch the installer package and then double click the installer icon.	
2	The installation wizard appears. Click Next to continue.	
3	Accept to use the default installation directory or select another directory by clicking the *Browse* button. Click *Next* to continue.	

	Action	
4	Uncheck the components you do not require. By default, all components are installed. Click *Next* to continue.	
5	Read the End-User License Agreement, and check “I accept the license.” box. Not checking the box ends the installation wizard. Click *Next* to continue.	
6	The wizard creates a start menu folder with program short-cuts. Use the default name or enter a new name for the folder. Click *Next* to continue.	

	Action	
7	Check the box to create a desktop shortcut to access Control. Click *Next* to continue	
8	Check the 'Run the Silicon Labs CP10x driver installation' box and click *Next*. **Note**: If you do not have the driver installed USB connectivity will fail.	
9	Click *Install* to install NKT Photonics CONTROL software on your PC. Click *Cancel* if you want to abort the installation..	

	Action	
10	The wizard displays a progress meter for the installation. **Note:** a normal install should only take a few seconds.	
11	Click *Next* to install the UART drivers for the PC USB port.	
12	The drivers are installed. **Note**: Depending on your computer this occurs so fast you may not see this.	

	Action	
13	The Silicon Labs drivers is installed successfully. Click *Finish* to end the driver installation.	
14	CONTROL is now installed. Check the Run box to launch CONTROL when the *Finish* button is clicked. Click *Finish* to end the installation wizard.	

F Troubleshooting and Errors

Troubleshooting

Table 29 Laser troubleshooting

Symptom	Possible cause(s)	Action
Laser Disabled	Interlock signals shorted to ground.	1. Disconnect the power to the laser. Locate and remove the interlock circuit short to ground. 2. Turn ON the SuperK FIANIUM system and reset the interlock with the key switch.
No Communication with CONTROL	1. No Power 2. COM port setting incorrect 3. Defective USB Cable	1. Check the AC Mains and the AC power cable. 2. Check that the PC has assigned a COM port to the laser. 3. Check the USB cable condition or swap it with a known working cable.
No Emission	1. Key Switch is *Off* 2. Interlock Circuit is open 3. The laser experiences a failure due to an alarm condition. 4. External Feedback mode is configured with no input signal.	1. Turn the Key to the *Armed* position 2. Correct the circuit open and reset the key switch. The circuit open could be one of the following: • External Bus Defeater loose or not connected • External Bus Accessory cable loose or defective • Door switch defective or an open in its connecting cable to the LEMO plug. • LEMO plug loose or defective 3. Check the laser alarms and refer to Table 30, “Errors codes - CONTROL,” on page 126. 4. Change the laser’s operation mode to Normal, see “Normal mode” on page 94..

Error codes - CONTROL

Table 30 lists the alarms and their appropriate responses.

Table 30 Errors codes - CONTROL

Error code	Recovery action
2	Check if the interlock has been activated, otherwise turn the key switch to the on position to enable the laser.
5	Check the communication links between the PC and CONTROL software. Enable the laser by clicking the Emission button OFF/ON. **If the problem persists** – disable watchdog mode.
7, 12	Ensure the ambient temperature in the environment surrounding the laser is within the specified range. See Appendix A. Also ensure the cooling requirements such as air or water flow are met depending on the chassis. See "Mechanical Installation" on page 39..
17-23	Laser calibrating - informational only; to clear the error, enable emission.
48	*1.* Move the beam delivery collimator head against a power meter. *2.* Set to 0% power. (Slider set all the way to the left.) *3.* Enable the laser by clicking the Emission button on. *4.* Slowly increase power to 100%. **If the alarm clears:** Before returning the laser to normal operation, check the installation for back reflections to the laser (e.g. from a lens mounted in front of the collimator) – see "Back reflection" on page 45.. **If the alarm persists:** – or – **If the laser emission is disabled**: Contact NKT Photonics. See Appendix B.
3, 49, 50, 55	*1.* Set to 0% power. (Slider set all the way to the left.) *2.* Enable the laser by clicking the Emission button ON. *3.* Slowly increase power to 100%. **If the problem is not resolved** contact NKT Photonics. See Appendix B.
Other codes:	Contact NKT Photonics. See Appendix B.

Possible fault causes

External reflection

An optical reflection from an external component may affect the laser system. For example, a mirror or shutter inserted into the beam path could cause a reflection sent back into the system causing an alarm to appear.

High power

The system may raise an alarm if it detects internal reflections. An internal reflection can be generated when the output power level is too high.

Errors - front display panel

Table 31 Error codes - front panel

Module address	Error number	Error message
2	2	Interlock open
2	3	Contact NKT Photonics support
2	4	Contact NKT Photonics support
2	7	Temperature out of range
2	8	Contact NKT Photonics support
2	12	Contact NKT Photonics support
2	17	Laser needs to calibrate. Enable emission.
2	18	Laser needs to calibrate. Enable emission.
2	19	Laser needs to calibrate. Enable emission.
2	20	Laser needs to calibrate. Enable emission.
2	21	Laser needs to calibrate. Enable emission.
2	22	Laser needs to calibrate. Enable emission.
2	23	Laser needs to calibrate. Enable emission.
2	25	Laser needs to calibrate. Enable emission.
2	26	Enable emission. If error persists, contact NKT Photonics.
2	27	Enable emission. If error persists, contact NKT Photonics.
2	28	Contact NKT Photonics support
3	2	Interlock open
3	3	Contact NKT Photonics support
3	4	Contact NKT Photonics support
3	5	Temperature out of range
3	7	Temperature out of range
3	8	Contact NKT Photonics support
3	12	Enable emission. If error persists, contact NKT Photonics.
3	32	Enable emission. If error persists, contact NKT Photonics.
4	40	Enable emission. If error persists, contact NKT Photonics.
5	2	Interlock open
5	3	Contact NKT Photonics support
5	7	Temperature out of range
5	8	Contact NKT Photonics support
5	11	Enable emission. If error persists, contact NKT Photonics.
5	12	Enable emission. If error persists, contact NKT Photonics.
5	48	Reflection detected. Enable emission.
5	49	Enable emission. If error persists, contact NKT Photonics.
5	50	Enable emission. If error persists, contact NKT Photonics.
5	51	Enable emission. If error persists, contact NKT Photonics.
5	52	Enable emission. If error persists, contact NKT Photonics.
5	53	Enable emission. If error persists, contact NKT Photonics.
5	55	Enable emission. If error persists, contact NKT Photonics.
5	56	Enable emission. If error persists, contact NKT Photonics.
5	57	Enable emission. If error persists, contact NKT Photonics.
5	60	Enable emission. If error persists, contact NKT Photonics.
5	61	Enable emission. If error persists, contact NKT Photonics.

Module address	Error number	Error message
5	62	Enable emission. If error persists, contact NKT Photonics.
5	63	Enable emission. If error persists, contact NKT Photonics.
5	64	Enable emission. If error persists, contact NKT Photonics.
5	65	Enable emission. If error persists, contact NKT Photonics.
5	66	Enable emission. If error persists, contact NKT Photonics.
5	67	Enable emission. If error persists, contact NKT Photonics.
5	68	Contact NKT Photonics support
5	69	Contact NKT Photonics support
15	2	Interlock open
15	3	Contact NKT Photonics support
15	4	Contact NKT Photonics support
15	5	Watchdog timeout
15	6	Emission LED failure. Contact NKT Photonics support.
15	7	Temperature out of range
15	128	Contact NKT Photonics Support

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