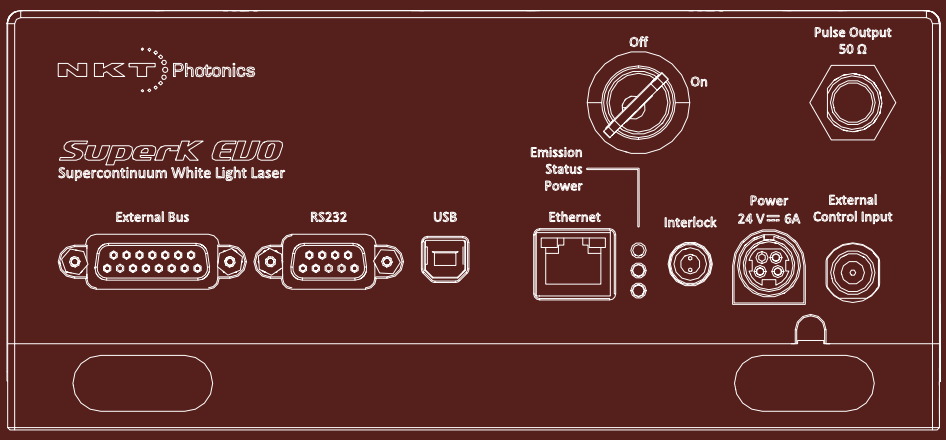
800-612-01

SuperK
EVO SERIES

Product Guide

Revision 1.4 10-2023



NKT Photonics

PRODUCT GUIDE

This guide includes information for the following NKT Photonics products:

SuperK EVO Passively Cooled

Supercontinuum White Light Laser in a Compact Form Factor

SuperK EVO HP Air Cooled

Supercontinuum White Light Laser with Regulated Cooling Fans

SuperK EVO HP Water Cooled

Supercontinuum White Light Laser with a Water Cooled Base

CAUTION: Do not open the laser module. The laser is equipped with warranty labels (see Figure 40) on the covers of the module. The warranty is void if the system is opened.

Manufactured by:

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

Author: W-10456

Guide Overview

This product guide is intended to provide functional, operational and installation information for all SuperK EVO laser system models. The guide is divided into three sections:

- **SuperK EVO Description** – introduces the laser's theory and functionality, its interfaces, and chassis variants.
- **Installing the Laser** – includes the details on how to install the laser chassis variants 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.

Safety

WARNING: Do not operate the laser before first reading and understanding all warnings, cautions and handling information stated within the documents:

SuperK EVO Safety, Handling and Regulatory Information

NOTE: The paper copy of this document is included with your laser; however, it can also be downloaded from:

https://www.nktphotonics.com/lasers-fibers/support/product-manuals/

WARNING: 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 EVO laser series including its general operational principles, management and interfaces.
- Chapter 2 "Chassis Types" — Describes the laser chassis models available within the SuperK EVO series.
- Chapter 3 "Mechanical Installation" — Includes information and procedures on how to correctly install the laser chassis. Procedures within this chapter focus on providing adequate temperature regulation.
- Chapter 4 "Connecting the Laser" — This chapter provides the information on how to physically connect the safety interlock, power, the optical collimator, and the optional interfaces.IF
- Chapter 5 "Communicating with the Laser" — Includes procedures on preparing a PC with the laser's management software and connecting it to the laser.
- Chapter 6 "Turning on the Laser" — Contains procedures on how to safely turn the laser emission on and off using the management software.
- Chapter 7 "CONTROL Interface" — Includes descriptions and procedures of CONTROL software menus and panels.
- Chapter 8 "Configuring External Control" — This chapter provides details on implementing a feedback circuit to modulate the laser's output power.
- AppendicesAppendicesAppendices — The guide includes multiple appendices including laser specifications, support contact details, 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 that may be caused when using the laser.

Revision Revision details are documented in the following table.

Date	Revision	**Comments**
October 2019	1.01	1st release
October 2019	1.02	Numerous technical corrections
November 2019	1.03	CONTROL interface updates and technical corrections
April 2020	1.04	Updated table 20
January 2021	1.10	Release 1.0 includes the following changes: • Updated support contact details in appendix B. • Appendix D - Reordered accessories and removed discontinued product Extend-UV.
March 2021	1.00	Revision rolled back to 1.0 due to internal system requirements.
November 2021	1.10	Minor errors corrected; updated language and figures throughout. Water cooled SuperK EVO – Hose and fitting connections are updated - see “Installing the water cooled chassis” on page 39.
March 2022	1.2	Updated the following: • Added section .“Termination necessary” on page 48
April 2022	1.3	Updated the following: • Updated the front cover to indicate all EVO series lasers are included. • Updated the front cover inside page to list lasers included as EVO and EVO HP laser forms. • Updated text and figures in section “Connecting the Safety Interlock” on page 41 and its subsections.
October 2023	1.4	Updated the style of the manual.

CONTENTS

TABLES

FIGURES

PROCEDURES

SECTION 1

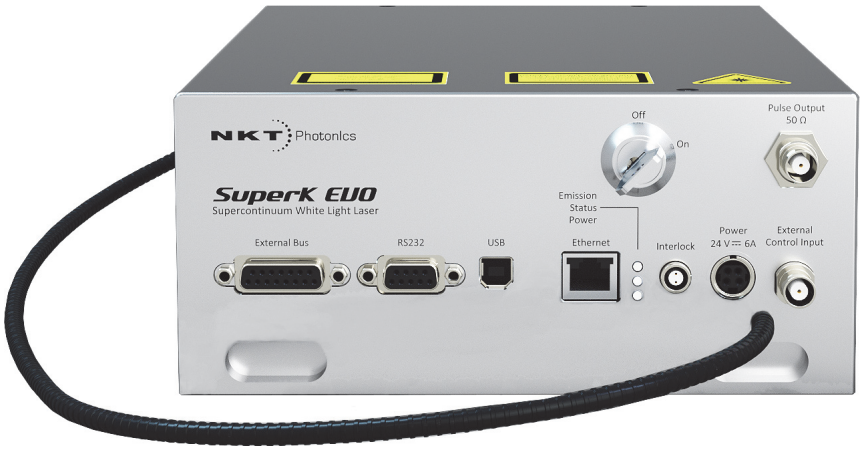
DESCRIPTION

This section provides a description of the laser and its chassis types.

1 Laser Description

SuperK EVO lasers are a series of compact white light lasers (WLL) with passive, water, or air cooled variants. The lasers are Class 4 laser sources that generate a pulsed supercontinuum beam. The emitted beam is spatially coherent and composed of light frequencies from 400 to 2400 nm with a pulse rate that is customizable. To synchronize external equipment, the lasers include a BNC port that outputs a NIM logic output signal at the laser pulse repetition rate.

Figure 1 SuperK EVO (passive) – general view



Terminology The SuperK EVO series includes the model variants as listed on page 3. This guide uses the term, “laser” to refer to all model variants. When information related to a specific variant is noted, the model name is specified. The guide may also refer to NKT Photonics as simply NKTP.

Accessories A series of accessories are available for use with the laser to modify the output beam. Accessories can be used for beam delivery and filtering to obtain a desired narrow band, wide band, or extended spectrum. An overview of the accessories is described in Appendix D.

CONTROL For general use, the laser and its accessories are controlled and configured using the NKTP CONTROL application on a PC. A CONTROL PC connects to the laser through either an RS232, serial USB, or Ethernet link. To control accessories from the same CONTROL PC, the laser is equipped with an external bus interface which can connect up to eight accessories in a daisy chain configuration. Connecting and controlling the laser with CONTROL is described in “Communicating with the Laser” on page 51.

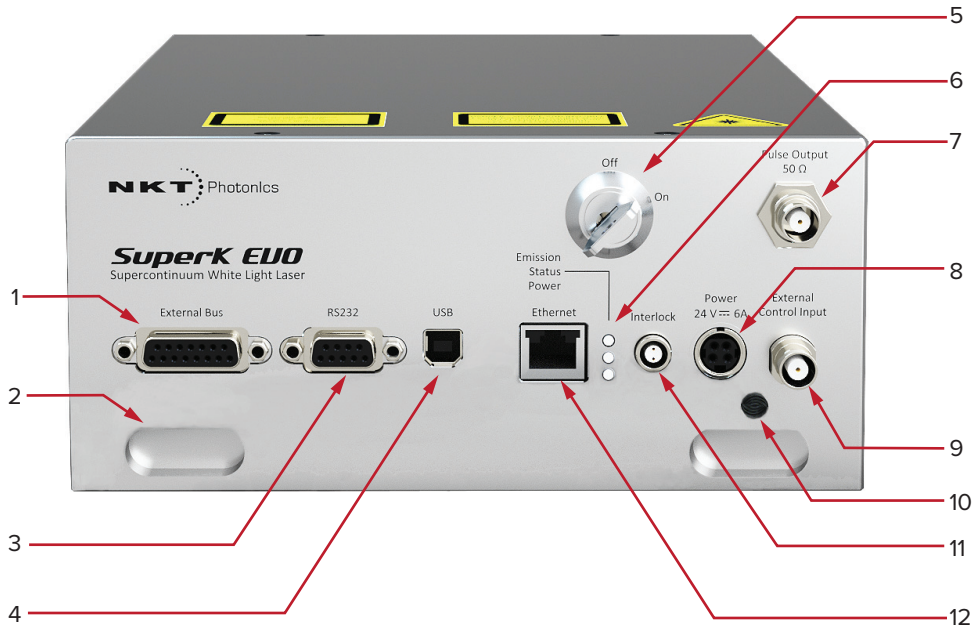
Temperature regulation

The laser series includes three chassis variants characterized by their temperature regulation system. The laser's chassis is either passively cooled, forced-air cooled, or water cooled. Installation requirements differ due to the heat dissipation method employed and this is described in "Mechanical Installation" on page 35.

Front panel interfaces

The front panel houses all of the laser interfaces as shown in Figure 2.

Figure 2 SuperK EVO front panel



1 External bus - 15 pin D-sub female
2 Mounting clamp slot (passive variant only)
3 RS-232 serial port – 9 pin D-sub female
4 Type B USB serial port
5 Key switch
6 Status LEDs
7 Pulse output – 50 ohm BNC
8 DC power input
9 External Control Input
10 Optical output fiber (not shown)
11 Interlock - 2 pin Lemo connector
12 Ethernet - RJ-45

External bus

This port connects optional optical accessories to the laser. The port supports communications, power and the interlock signal. See also "Laser accessory management" on page 26.

Mounting clamp slot

Passively cooled variants can be firmly mounted and held against a heat sink with clamps holding the laser in these slots. For all variant mounting information refer to "Mechanical Installation" on page 35.

RS-232 Serial port

As an option, you can use a standard serial cable to connect this port to a CONTROL PC equipped with a 9 pin serial port.

Key switch The key switch provides keyed ON/OFF authorization of laser emission as follows:

- In the ON position, laser emission can be enabled[1]
- In the OFF position, laser emission cannot be enabled.
- Removing the key and storing it securely prevents unauthorized emission.

The switch also resets any interlock breaks once the interlock circuit has been restored. Also see – “Key switch and interlock safety” on page 25.

Status LEDs See “Status LEDs” on page 27.

Pulse Output Connect external equipment to the port to synchronize it with the laser pulse. See “Synchronizing external equipment” on page 26

DC power input An AC mains power adapter is included with the laser. Connect it to this port – see “Connecting Power” on page 43.

External control input Connect an external feedback signal to this port to stabilized the laser’s emission power level. See “Laser emission stabilization using feedback” on page 25

Optical output fiber See “Optical output” on page 23.

Interlock Connect the laser enclosure door switch to this 2 pin LEMO connector. When the circuit is open, laser emission is disabled. For more information see “Connecting the Safety Interlock” on page 41.

Ethernet 100 M RJ-45 Ethernet port – see “Remote operation” on page 24.

Optical output

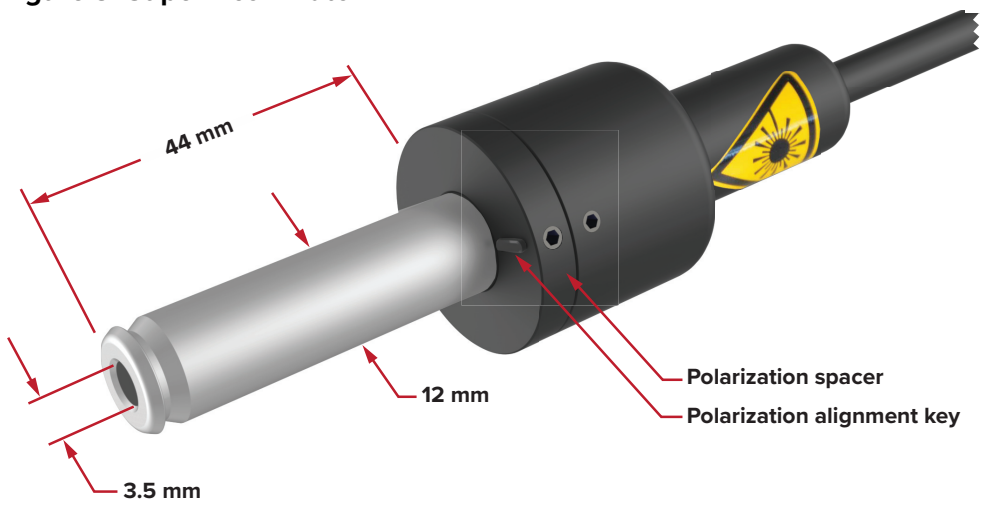
The optical output of the lasers is a 1.5 meter armored fiber connected to an output collimator.

Collimator The optical output of the laser is a collimator at the end of an armored fiber cable as shown in Figure 3. A collimated beam exits the collimator from a steel sleeve connector designed for insertion into a receptacle of a target optical device such as for example, a SuperK accessory, holder, or an optical power meter. Once

1. Interlock circuit must be closed

inserted, the substantial construction of the collimator maintains the output beam alignment.

Figure 3 SuperK collimator



Configuration and operation overview

You can operate the laser using either NKTP's CONTROL application from a connected PC or with your own custom application using NKTP's Software Development Kit (SDK). The CONTROL application is connected to the laser using one of the laser's front panel Ethernet or serial interfaces shown in Figure 2. To ensure safety, a key switch and door interlock circuit help to prevent accidental exposure to emission.

NOTE: The laser output is rated as Class 4, to enable emission, the laser requires the key switch in the ON position and (door switch) interlock circuit closed.

CONTROL application

Connect a PC with the CONTROL application to the laser's USB2 Type B serial port. However, by using a standard RS-232 serial cable you can also connect the serial port of a CONTROL PC to the laser's standard DB-9 RS232 port. Either way, once connected, use CONTROL to operate and monitor the laser and configure its power settings. Other parameters such as line settings and bandwidths of various attached accessories are also configurable with the application.

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

Remote operation

When operating a CONTROL PC from a remote location or for multiple laser management, connect to the standard 100M RJ-45 *Ethernet* port on the front panel. The laser supports IPv4 networking and the port must be connected to a local subnetwork that is accessible to the CONTROL PC's network connection. The laser's *Ethernet* port is first assigned an IP address using CONTROL on a PC connected through a serial interface connection. Once the laser IP address is assigned, the address is added to a list of connections in the CONTROL application itself.

Multiple lasers
Multiple devices can be managed from the same PC with CONTROL. The application detects connected NKTP lasers and their accessories.

NOTE: The Chapter "Communicating with the Laser" on page 51 provides the details and procedures on how to connect CONTROL to the laser.

Custom laser control

If required, you can control the laser from a custom platform connected to either the USB, serial, or Ethernet port. To build your own custom control application, NKTP provides a software development kit (SDK) which can be downloaded from:

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

Laser emission stabilization using feedback

You can control the output power of the emission using external feedback connected to the *External Control Input* BNC connector. The connector accepts an input voltage ranging from 0 to 4.1 volts. Using an external detector monitoring emission power, a circuit can provide a feedback voltage level. The laser monitors the level at its *External Control Input* port and adjusts the output power accordingly to maintain and stabilize emission at the setpoint power level. (Also known as power lock.)

NOTE: Feedback voltage variations above 100 Hz cannot be accurately detected by the sampling circuit. Refer to "Power stabilization using external feedback" on page 77 for further information on how to employ a feedback circuit.

External laser emission control

You can also use the *External Control Input* port for external ON/OFF emission control. A TTL or CMOS logic level applied at the port, turns the laser's booster ON when the signal is high and OFF when the signal is low. See feature "External enable" on page 78.

Maximizing the laser lifetime
The laser's lifetime is influenced by usage of the main amplifier. When an application does not require that the laser is ON continuously, you can optimize the laser's lifetime by minimizing the laser ON time.

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

WARNING: Do not use the Output Control feature as a safety interlock.

NOTE: The feature is by request only, contact NKT Photonics.

Key switch and interlock safety

To enhance safety, the laser is equipped with an interlock interface and a keyed switch. The two components work together to safely control laser emission. To

permit laser emission, the interlock circuit must be closed (door closed position) and the laser key switch must be in the ON position.

Connect the interlock LEMO pins to a switch which is activated by an access door to the laser operating enclosure. If the door unexpectedly opens, the switch opens and laser emission is immediately shut down. “Connecting the Safety Interlock” on page 41 describes the 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. Despite the door being closed again, you cannot enable the laser again until the key lock is first cycled to OFF and back to ON. This resets the interlock and you can enable emission.

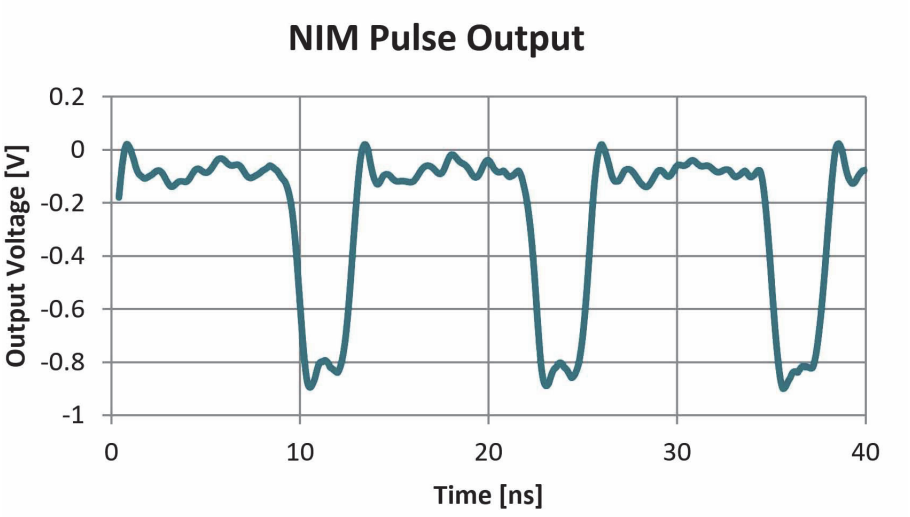
Synchronizing external equipment

The signal from the *Pulse Output* BNC port can synchronize external devices to the output pulse train of the laser. The port outputs a signal that is synchronized to the pulsed oscillator inside the SuperK EVO. The signal is NIM compliant (see standard DOE/ER-0457) and ranges from 0 to approximately -1 V.

An example of the pulse output pattern is shown in Figure 4. Data is sampled using an oscilloscope with a 500 MHz bandwidth. (Use a 100 MHz bandwidth oscilloscope as a minimum to view the pulse.)

Refer to “Connecting the External Bus and pulse interfaces” on page 46 for more information regarding the *Pulse Output* port.

Figure 4 *Pulse Output* port signal as measured by an oscilloscope



NOTE: The actual output voltages from the *Pulsed Output* port are negative.

Laser accessory management

The *External Bus* port connects optional SuperK EVO 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 to the laser. For safety, the bus also extends the interlock safety circuit through each connected accessory. Always place the included bus defeater on the External Bus output of the last device in the chain to close the interlock loop circuit. Emission cannot be enabled unless the interlock circuit is in the closed state. See also “Connecting the External Bus” on page 46.

NOTE: The External Bus will only prevent the laser from operating when the Interlock circuit is connected as required by safety regulations either local or mandated.

Status LEDs

The front panel houses three status LEDs shown in Figure 5.

Figure 5 SuperK EVO status LEDs

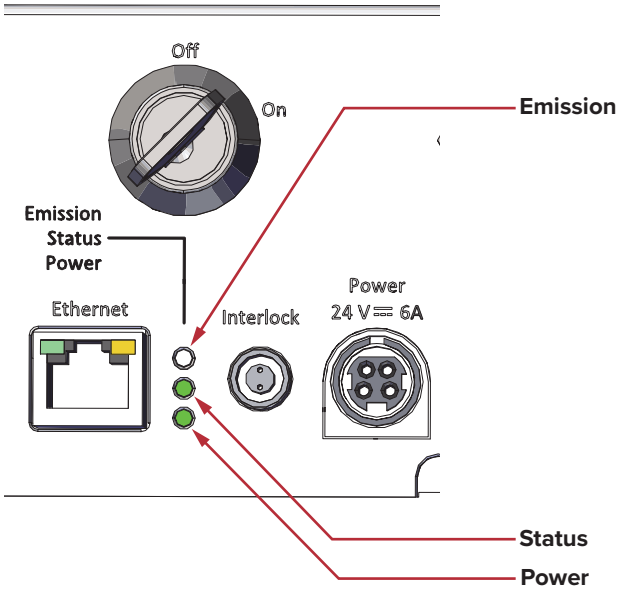


Table 1 Status LEDs

LED	Condition	Description
Emission	ON White	The laser is ON and emitting Class 4 laser emisison from the collimator.
	OFF	The laser is OFF.
Status	ON Red	The laser shutdown due to an error. An error code will be displayed in the status panel of CONTROL – see Troubleshooting and Errors page 103.
	OFF	No errors are detected.
Power	ON Green	24 VDC is supplied.
	OFF	No power is connected.

Chassis labels

The SuperK EVO chassis includes multiple labels that indicate hazards, regulatory and manufacturing information. The labels are located on the panels, and collimator described in Table 2 with the panel locations shown in Figure 6.

Table 2 Chassis labels

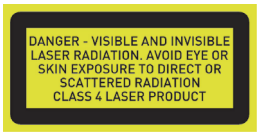
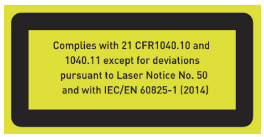
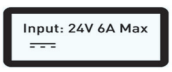
Label	Panel	Description	
Classification	Top	Safety information stating the laser emission hazards and the laser's class rating.	
Manufacturing	Left	Manufacturing information including address, part and serial number, date manufactured and regulatory compliance.	
Laser Radiation Warning	Front	Safety information 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.	
Certification	Top	Regulatory label indicating the regulatory items the laser is compliant with.	
Production Information	Top	Safety label showing the emission specifications the laser is capable of.	
DC Input	Front	Safety label stating the DC voltage and current ratings of the laser.	
WEEE Compliance	Rear	Environmental label Indicating the laser can be disposed of following European Community Directive 2012/19/EU regulations.	

Figure 6 SuperK EVO chassis panels

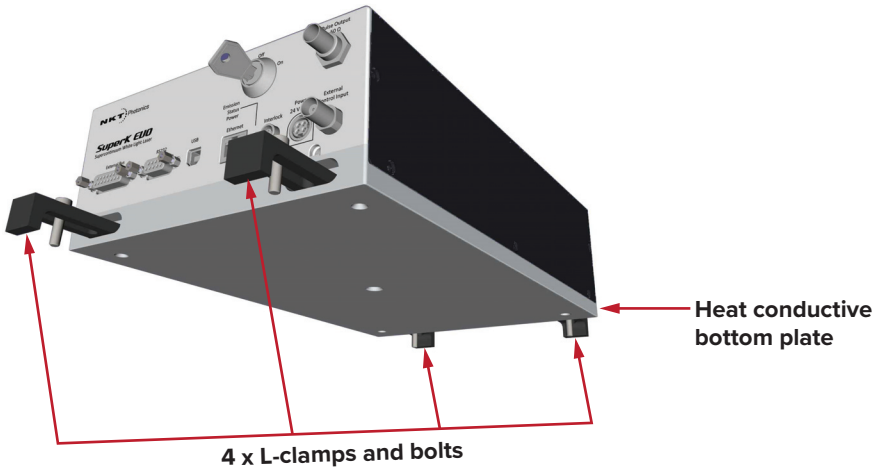
2 Chassis Types

The SuperK EVO Laser series consists of three separate chassis variants, defined by their cooling method. This chapter describes the characteristics of the cooling method of each variant.

Passively cooled SuperK EVO

The passively cooled SuperK EVO includes a bottom mounting plate machined from an aluminum block. The plate acts as a passive heat sink to conduct excessive heat away from the laser. By using a passive thermal conduction design, the laser's dimensions can be minimized into a compact form factor as shown in Figure 7. The plate includes four slots machined from its front and rear sides; use these slots with clamps to mount the laser firmly onto a heat conductive surface. Alternatively, there are four M6 threaded holes machined in the bottom of the plate to fasten the laser to a mounting surface.

Figure 7 Passively cooled SuperK EVO - heat conductive plate

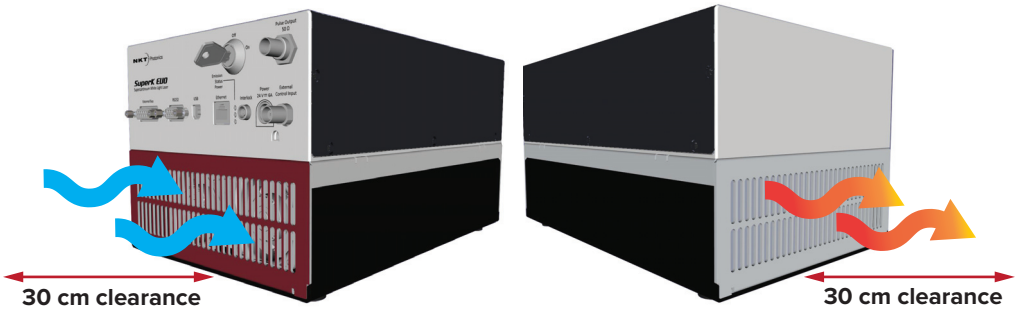


Air cooled SuperK EVO

The air cooled chassis of the SuperK EVO laser uses a fan plenum shelf with dual fans to thermally regulate the laser operation. Cool air drawn from the front panel grill is forced across the laser components regulating the system temperature. Hot air is then blown out through the exhaust grill at the rear of

the laser. Fan speed is adjusted automatically to maintain an optimum operating temperature.

Figure 8 Air Cooled SuperK EVO - air flow



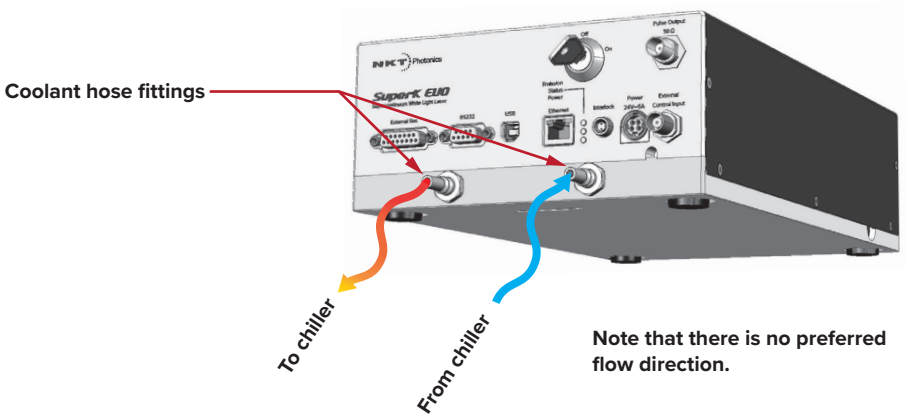
Air flow considerations

To avoid obstruction of the airflow, place the air-cooled SuperK EVO laser with at least 30 cm clearance at the front and rear panel vents.

Water cooled SuperK EVO

The water cooled variant is equipped with two 1/8 inch hose fittings connected to internal channels where chilled coolant flows to regulate the temperature of the laser. Coolant is chilled and pumped through the laser in any direction using a suitable external chiller equipped with both flow and temperature setpoint control. To prevent scaling and corrosion issues, coolant consisting of water mixed with ethylene glycol and algaecide is recommended for use with the system. Tap water and deionized water should be avoided.

Figure 9 Water cooled SuperK EVO - water flow



CAUTION: Use coolant with anti-corrosive properties suitable for use with aluminum tubing only.

SECTION 2

INSTALLING THE LASER

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

3 Mechanical Installation

SuperK EVO lasers generate a substantial amount of heat, therefore consideration of heat dissipation is essential when installing the laser. To dissipate the heat, SuperK EVOs are available in three different chassis variants characterized by their temperature regulation system. This chapter provides information on how to mechanically install the three versions of the laser with focus on ensuring optimal regulation of the laser's temperature.

CAUTION: For reliable operation, do not expose the laser to corrosive agents, excessive moisture, heat or dust.

General installation requirements

Ensure to install SuperK EVO lasers on a level surface that is free from vibrations. The ambient temperature surrounding the laser should be stable and free from anything that could cause temperature fluctuations. Temperature changes and vibrations may affect the laser's operation and result in abnormal operation. When connecting the optical output, any bends in the armored fiber cable must exceed or equal the minimum bend radius of 15 cm.

Installing the passively cooled chassis

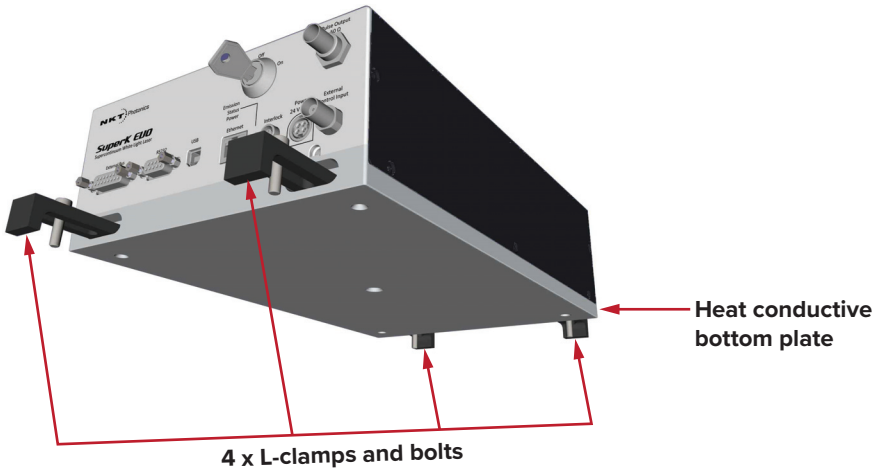
The passive cooling chassis is equipped with a thick aluminum bottom plate. The plate acts as a heat sink, cooling and conducting heat away from the laser. To effectively conduct the heat away from the laser, mount the laser on a flat and thermally conductive surface such as an aluminum table. Ensure the laser's plate lies flat against the table surface without any gaps.

Table 3 lists the specifications for a passively cooled installation.

Table 3 Passively cooled SuperK EVO installation specifications

Item	Characteristic
Mounting surface Size	200 mm x 300 mm minimum for maximum contact with the laser's bottom plate.
Mounting surface material	Aluminum - or any material with thermal conductivity that is equal to or better than aluminum.
Clamps	Example: Thorlabs CL5 L-shape clamp with 1/4-20 or M6 bolts (or similar)

Figure 10 Installing the passively cooled SuperK EVO



Mounting considerations

Mounting surface

When mounting a passively cooled SuperK EVO, place the laser with its bottom plate secured to a flat metallic surface. Ensure that the mounting surface makes contact with the entire bottom plate of the laser.

Ambient conditions

Check that the ambient conditions meet the specifications listed in Appendix A. Further, ensure there are no devices or other heat sources nearby that could cause temperature fluctuations in the laser.

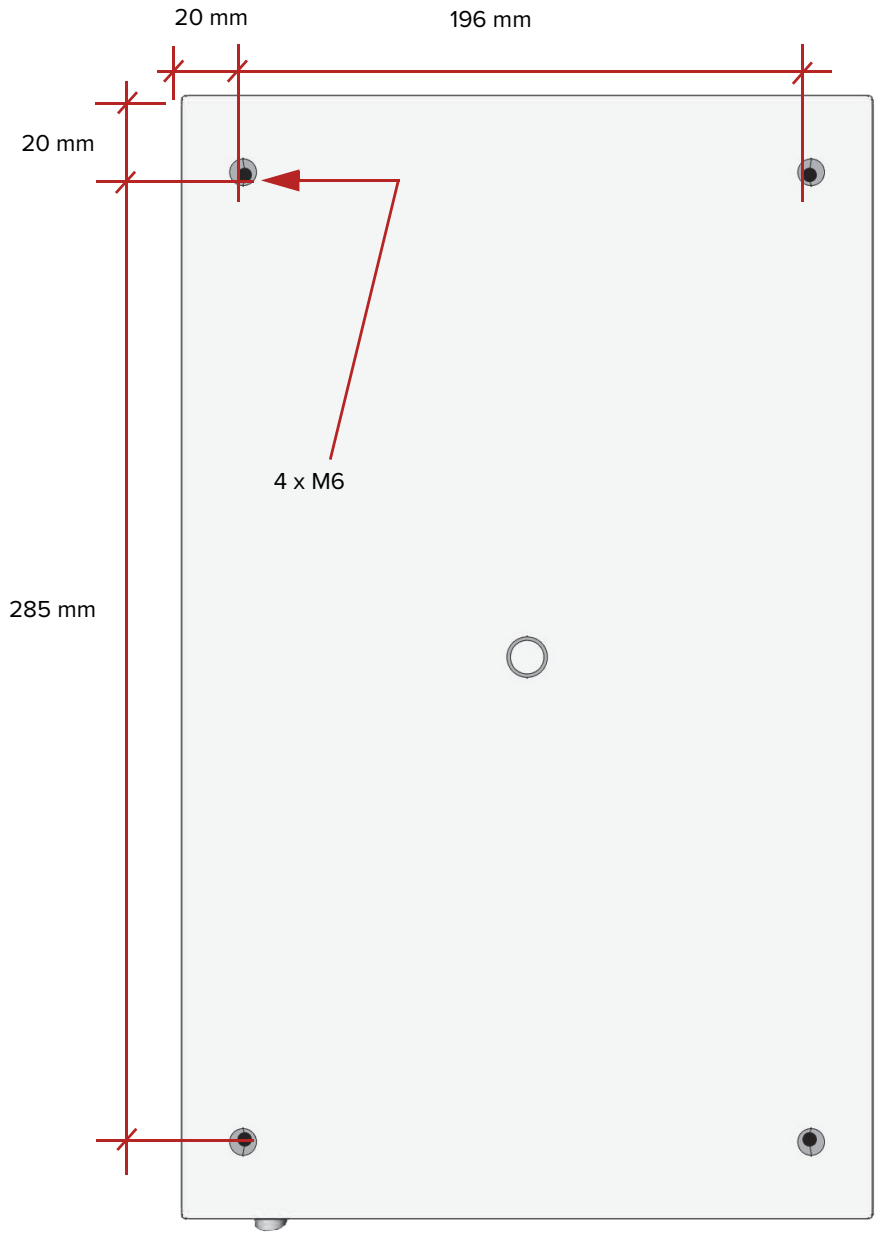
Mounting slots

Using L-clamps and mounting bolts, firmly clamp the laser to an optical table or other suitable surface. Fit the L-clamps as shown in Figure 10 with the slots in the front and back sides of the laser's bottom plate.

Mounting screw holes

As an option, fasten the laser to a surface using the four M6 mounting screw holes in the bottom plate. The precise screw hole locations are shown in Figure 11.

Figure 11 Bottom aluminum plate and screw hole locations



Installing the air cooled chassis

Air cooled SuperK EVO

The air cooled variant uses forced air flow to regulate the laser temperature. The air is drawn in through the inlet vents on the front panel and blown out through the exhaust vents on the rear panel. The system features two electrically controlled fans that adjust air flow based on the laser operating temperature. When installing the air cooled variant, ensure there is adequate clearance from any air flow obstructions.

Figure 12 Air cooled SuperK EVO – airflow clearance

Air flow considerations

The air cooled chassis must have sufficient clearance at the front and back panels for unobstructed air flow. The clearance and ambient operation temperature required is listed in Table 4.

Table 4 Air flow considerations

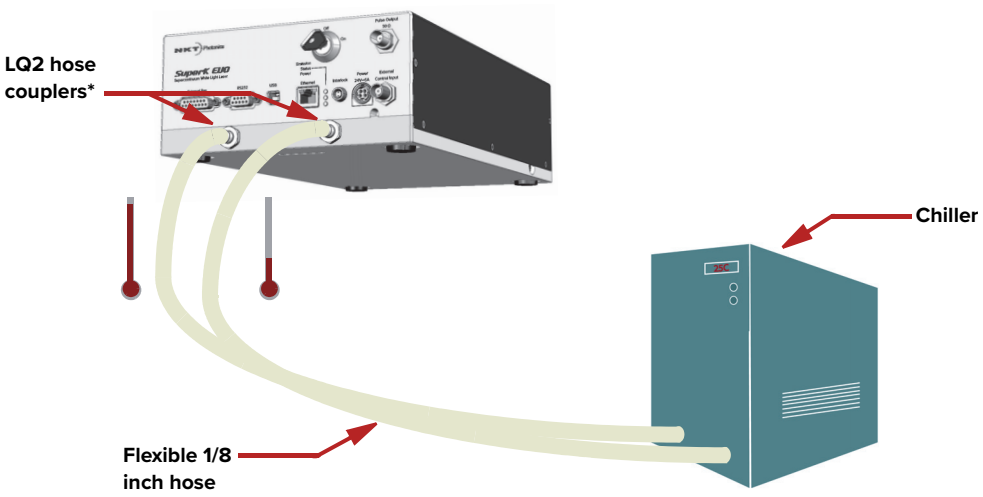
Specification	
Front Panel Gap	A minimum of 30 cm must be clear of obstructions
Rear Panel Gap	A minimum of 30 cm must be clear of obstructions
Ambient Operating Temperature	15°C to 35°C (32° F to 95° F)

Installing the water cooled chassis

Water cooled SuperK EVO

Using integrated water cooling with quick coupling hose connectors ensures efficient thermal management and a long maintenance-free lifetime of thousands of hours. The water cooled chassis allows the parameters of the laser to operate at extreme levels. Using a chiller as shown in Figure 13, ensure that the there is chilled water entering the inlet hose connection between 18 °C and 30°C and that there is always an adequate flow to maintain the requirements listed in Table 5.

Figure 13 Water cooled SuperK EVO with chiller



* Laser male hose couplers are LQ2D4702BLU 1/8 inch valved liquid cooling coupling inserts

Cooling water flow specifications

The water cooled SuperK EVO requires an industrial water chiller connected with hoses and fittings as recommended in Table 5. Always use an anti-corrosive coolant mixture and avoid tap water. The coolant can flow in either direction through the laser, meaning the supply and return from the chiller can be connected to either of the laser's hose couplers.

Table 5 Chiller and hose/fittings recommendations

Parameter	Value
Coolant temperature	18 to 30°C
Hose and fittings	Use 1/8 inch silicone hose or similar. The laser is fitted with two male LQ2 1/8 inch valved liquid cooling coupling inserts – LQ2D4702BLU. For suitable hose fittings, see the examples in the link below: https://www.cpcworldwide.com/Products/Liquid-Cooling/Everis-LQ2
Coolant flow rate	Typically ~0.5 Liters per second but it is dependent on the laser's operational parameters and the thermal efficiency of the chiller.

To protect the aluminum cooling channels, always use a coolant containing an anti-corrosive additive.

Required water (coolant) flow rate and temperature may vary and is dependent on the actual optical system parameters.

CAUTION: Only use anti-corrosive coolant suitable for use with copper tubing, some coolants may damage the laser. If in doubt, contact NKT Photonics - see "Support contact details" on page 85.

4 Connecting the Laser

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

For information on how to connect:

- the Safety Interlock – see “Connecting the Safety Interlock” on page 41
- Power – see “Connecting Power” on page 43
- The Optical Output – see “Connecting the optical output (collimator installation)” on page 44
- Optional Interfaces – see “Connecting the External Bus and pulse interfaces” on page 46

Connecting the Safety Interlock

Automatic shutdown from a door switch
To comply with safety regulations and help ensure a safe operating environment, connect the safety interlock of the laser to a switch activated by the access door to the laser’s operating enclosure. When emission is on and the door opens inadvertently, the door switch also opens, breaking the interlock circuit continuity and immediately shutting off emission.

Key reset confirmation
When the door closes again, emission remains disabled. Before proceeding, confirm the area is safe for emission by cycling the key switch (to OFF then ON) to re-engage the safety interlock. This resets the interlock relay to permit emission using CONTROL or SDK software control.

Simplified Interlock Operation

Note: this section describes the functional operation of the interlock; to connect a door switch to the interlock, follow the steps in Procedure 1.

The interlock circuit in simple terms is a closed loop circuit. When the interlock monitor function of the laser controller detects a break or open in the circuit, the controller immediately shuts down the laser. The loop can be opened by either the keyswitch relay, the door switch circuit or the external bus loop. In Figure 14, the keyswitch is turned to the *On* position which a logic circuit in the laser detects. When a reset command is sent from CONTROL software to the laser, the controller sends a set signal to an internal logic circuit energizing the normally open keyswitch relay. When the door switch is closed, and the external bus circuit is looped (shorted) using a bus defeater, the controllers interlock monitor function detects that the interlock circuit is closed and so the controller permits laser emission.

NOTE: Software control also requires an interlock reset (a GUI button) when the system is first turned on.

NOTE: See Connecting the External Bus“External Bus” on page 46 for more information on connecting the bus defeater included with the laser.

Figure 14 Interlock connected to a door switch - laser ON

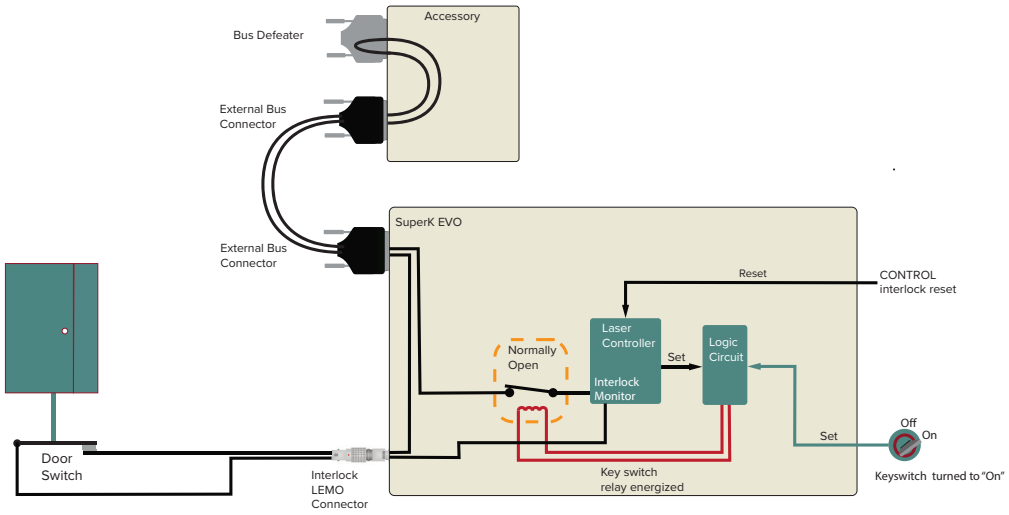
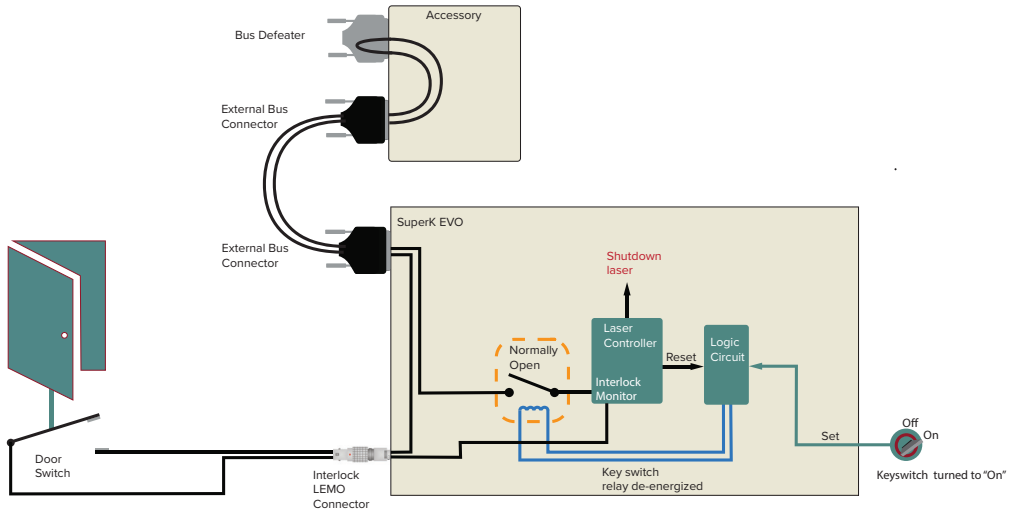


Figure 15 shows the door switch in the open position. This opens the interlock loop which the interlock monitor detects and the controller immediately sends a shutdown signal to the laser (the laser’s pump). In addition, the controller sends a reset to the logic circuit. The reset causes the logic circuit to de-energize the keyswitch and the relay opens preventing emission.

When the door closes again, use either the front panel controls or CONTROL software to reset the interlock. This sets the logic circuit (a D Flip-Flop) to energize the coil again closing the keyswitch relay as shown in Figure 14.

Figure 15 Interlock connected to a door switch - laser SHUTDOWN



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

CAUTION: Ensure the door switch connected to the interlock circuit is of an approved type. Further, install the switch so that its operation cannot be fixed in the open state using a tool to defeat 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, provide appropriate safety training and issue personal protective equipment.

Follow the steps of Procedure 1 to install the safety interlock circuit.

LEMO Plug
The laser is shipped with a pre-wired LEMO interlock plug. If you need a new LEMO plug assembly contact NKT Photonics, see "Support contact details" on page 85.

Procedure 1 Connecting the door interlock circuit

	Action
1	Install a switch that opens when the door accessing the laser enclosure is opened. Ensure the switch complies with local regulations.
2	Connect the switch to the prewired interlock plug using insulated wire. Use wire with a minimum of 26 AWG and a maximum length of five meters. For cable lengths longer than five meters, it is recommended to use shielded cable.
3	Perform a continuity test using a multimeter: *a.* First connect the multimeter leads to the interlock plug terminals. *b.* Confirm when the enclosure door is closed, the meter shows the circuit as closed. *c.* Confirm when the enclosure door opens, the meter shows the circuit as open.
4	Insert the LEMO plug into the Interlock connector of the laser.

Connecting Power

Power is supplied to the laser using the AC to DC power adapter included with the laser. Refer to the specifications in Appendix A for the electrical details of the laser and the adapter.

To connect power, follow the instructions in Procedure 2.

CAUTION: The laser immediately powers on when DC power is connected to the *Power 24 VDC* connector.

Procedure 2 Connecting power

	Action
1	Plug the connector of the power adapter into *Power* input port of the laser.
2	Connect the adapter's AC power cord to AC mains.
3	Check the Power Status LED is ON Green – See Status LEDs on page 27.

Connecting the optical output (collimator installation)

WARNING: Ensure to mount the collimator so that the beam emitted is contained in a protected area without personnel or flammable material.

Back reflection

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

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: BR is a hazard and may cause injury or damage.

Automatic BR cut-off

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

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 16 and Figure 17.
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 16.

Figure 16 Inserting a collimator into a holder

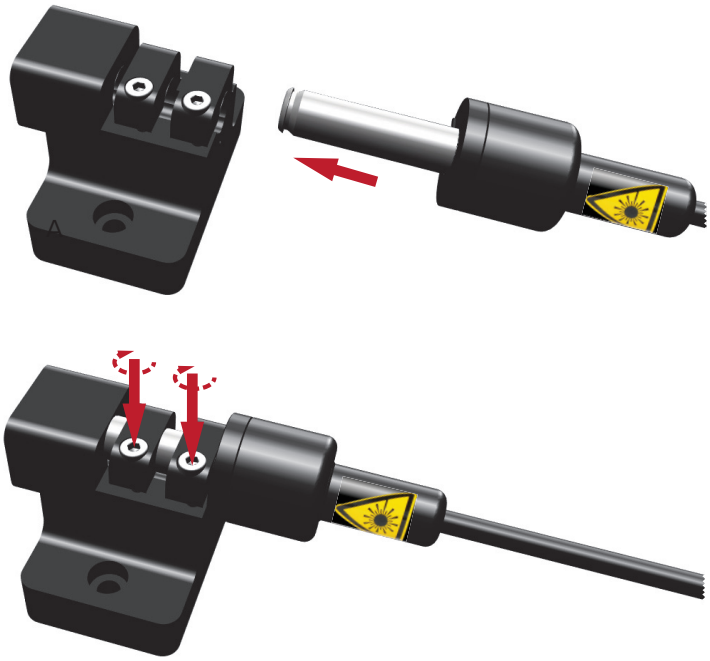


Figure 17 Collimator installed into a SuperK accessory receptacle

Connecting the External Bus and pulse interfaces

External Bus

The External Bus port is both a data communication bus interface and 12 volt supply for connected accessories. When SuperK accessories are used with the laser, they are connected to CONTROL through the External bus connection with the laser. The bus includes a logic output pin representing laser emission and importantly extends the laser's safety interlock circuit through the connected accessories.

Connecting the External Bus

If no SuperK accessories are used with the laser, connect the External Bus port to the supplied bus defeater. If accessories are used, connect accessories to the port in daisy chain configuration using the supplied External Bus cable(s). To loop back the interlock circuit, connect the bus defeater to the last connected accessory in the chain. Table 6 lists the methods to connect the External bus depending on the number of accessories.

NOTE: Always place the Bus Defeater onto the last open External Bus port for the laser to operate. Refer to Figure 18 and Figure 19 for connecting the port with and without accessories.

Table 6 Connecting the External Bus

# of accessories	External Bus connections to make
No accessories	**1.** External Bus port –– Bus Defeater
One accessory	**1.** External Bus port –– External Bus cable –– Accessory bus input **2.** Accessory External Bus output –– Bus Defeater

# of accessories	External Bus connections to make
2 or more accessories	**1.** External Bus port –– External Bus cable –– Accessory 1 bus input **2.** Accessory 1 bus output –– External Bus cable –– Accessory *n* bus input **3.** Accessory n bus output –– Accessory n+1 bus input **4.** Accessory *n+1* bus output –– Bus Defeater

Figure 18 External Bus Circuit - with no accessories used

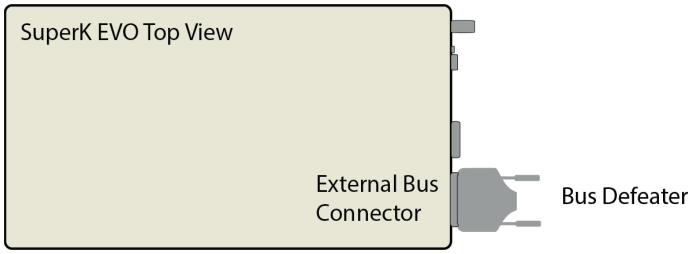
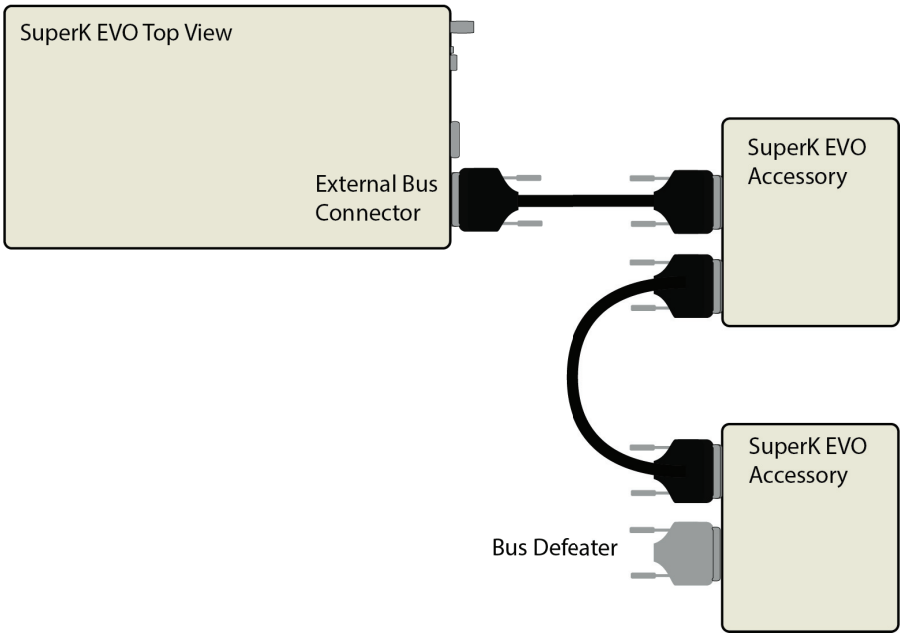


Figure 19 External Bus circuit - two or more accessories in a daisy chain



Pulsed Output

This port outputs a NIM level pulsed signal conforming to DOE/ER-0457 which represents the laser's seed pulse. To obtain the best waveform of the output signal, connect the seed *Pulse Output* using the cable and connector specifications listed in Table 7. You can for example, synchronize to the emission pulse with a subject under study. A synchronization circuit example is shown in Figure 20.

NOTE: The NIM signal is an approximately 0 to -0.9 V analog signal when properly terminated.

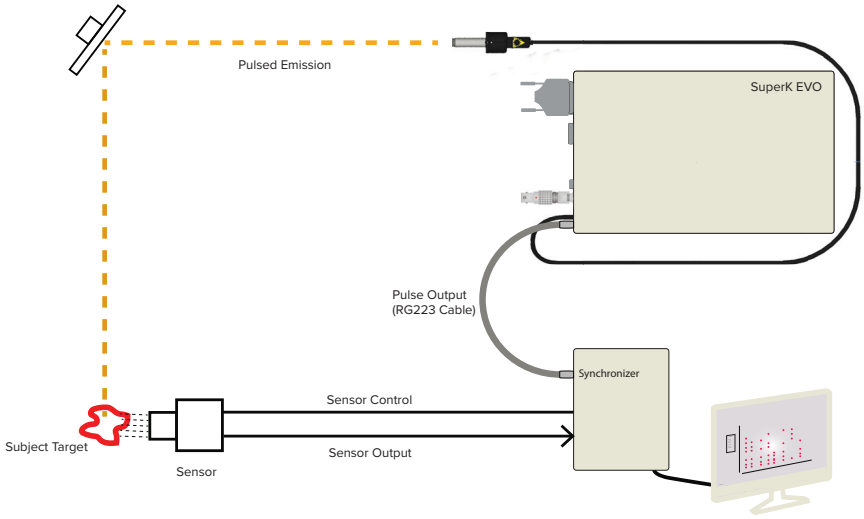
Table 7 Pulsed Output connection – NIM output pulse

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

Termination necessary

The NIM output is a current output and it therefore requires to be correctly terminated to avoid signal degradation. As noted above in Table 7, terminate the NIM output with 50 Ω.

Figure 20 Pulse synchronization

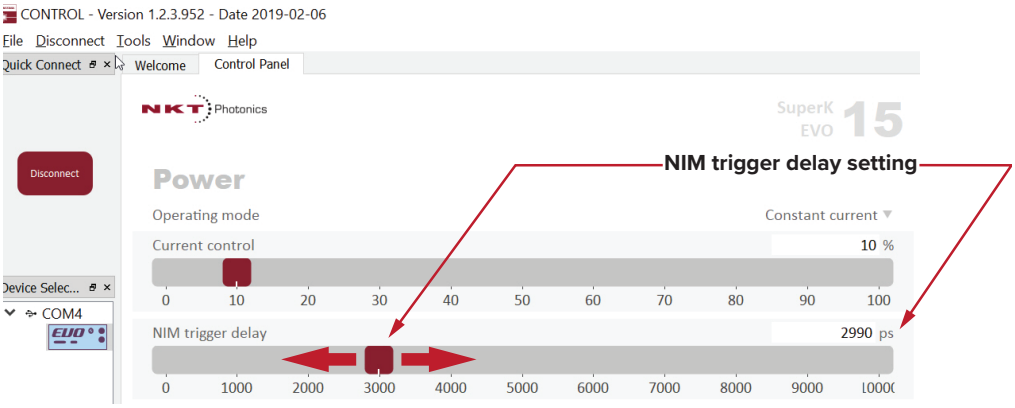


Trigger Delay

Using the CONTROL user interface, you can delay the NIM output pulse by up to 10000 ps.

In the control panel of the laser's graphical interface, slide the NIM trigger delay slider to the delay required for your synchronization application. In Figure 21, the slider is highlighted and adjusted to 2990 ps. In this case, the output pulse occurs 2990 ps later then the seed pulse.

Figure 21 Pulse (NIM) trigger delay control



SECTION 3

OPERATING THE LASER

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

5 Communicating with the Laser

This chapter focuses on how to obtain and install the CONTROL application and connect a SuperK EVO laser to a PC using either Ethernet or USB serial connectivity.

CONTROL software

The laser is shipped with the CONTROL application installer on a USB key. For an up-to-date version, you can also download the CONTROL installer from the following link:

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

CONTROL is capable of operating, configuring and monitoring NKT Photonics products including this laser and its connected accessories. Both 32 and 64 bit versions are available for PCs using Microsoft Windows 7, 8, or 10 operating system.

Installing the software

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

Connecting the Laser to CONTROL

You can connect a PC with CONTROL using either a USB serial or Ethernet connection. USB connectivity provides a simplified connection option within three meters (maximum USB cable length < 3m). Using an Ethernet connection allows you to manage your laser from remote locations limited only by your subnetwork's accessibility.

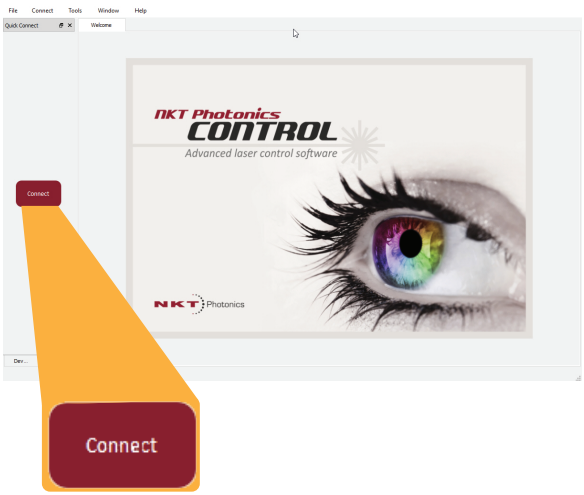
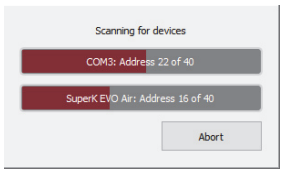
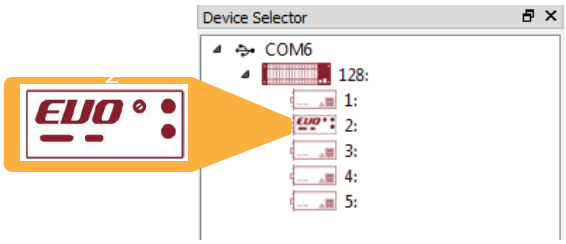
Once the PC's port is connected, launch CONTROL and click the red *Connect* button. CONTROL's automatic connect feature discovers and connects to any compatible NKTP products.

NOTE: Optionally, you can also connect a CONTROL PC to the RS-232 serial connection of the laser.

USB connection

Connect the PC directly to the laser using either the supplied USB cable or any USB Type A-B cable less than 3 meters long and follow the steps of Procedure 4.

Procedure 4 Connecting over USB

	Action
1	Connect the CONTROL PC to the laser's USB Type B port using a USB Type A to B cable – see Figure 2.[i]
2	Connect power – see Connecting Power on page 43.
3	If necessary (when first using the serial USB drivers), wait for the Windows device manager to install the USB drivers for the connection.
4	Launch the CONTROL software by either: • clicking on Windows – Start – Programs – NKT Photonics –CONTROL – or – • double clicking the CONTROL shortcut on the desktop 
5	The CONTROL window opens. Click on the red *Connect* button in the *Quick Connect* panel. 
6	CONTROL automatically scans for connected lasers and accessories available on both COM and configured Ethernet ports. 
7	In the *Device Selector panel,* click on the laser icon to bring up its controls. 

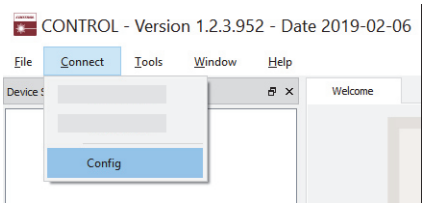
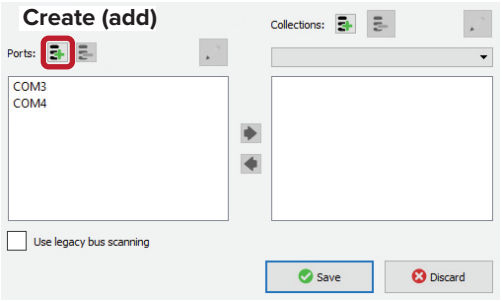
i. As an option, connect the PC using a standard RS232 serial cable to the 9-pin D-sub serial port of the laser.

Ethernet connection

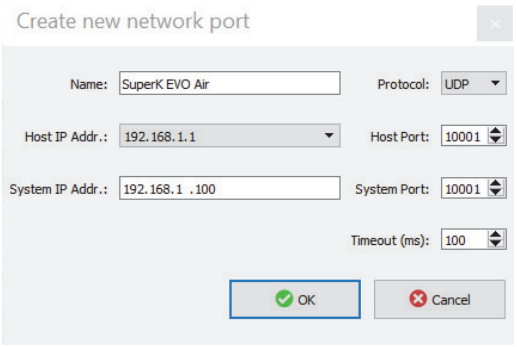
To connect the laser to a PC over Ethernet, connect the PC and the laser Ethernet ports connected to the same or separate IPv4 subnets. If the PC and laser are on separate subnets, their IP addresses must be reachable to each other. To configure the laser's IPv4 address, first connect to the laser using a

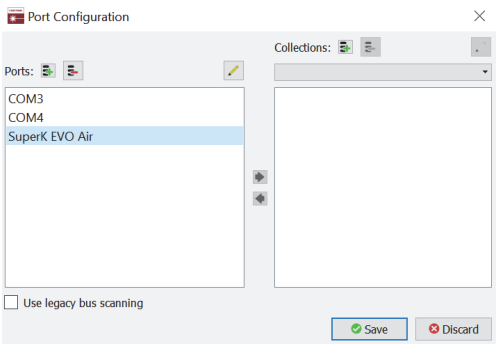
USB cable directly from a PC using CONTROL and then configure it's IP address - see "Ethernet" on page 66.

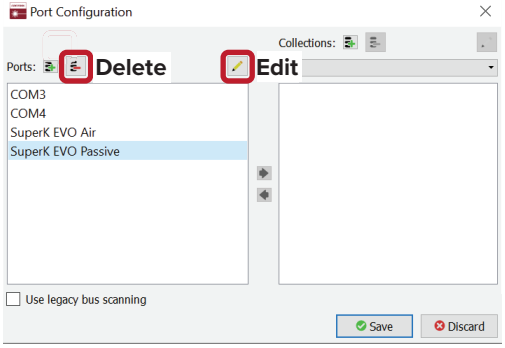
Procedure 5 Connecting a PC to the laser using Ethernet

	Action
1	Connect to the laser from your CONTROL PC using a USB cable as described in Procedure 4.
2	Using CONTROL - configure the laser's IPv4 address and port - see Ethernet on page 66.
3	From the Connect menu list select *Config* to open the Port Configuration window. 
4	In the Port Configuration window, click on the *Create new port* button. 

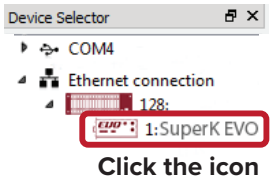
	Action
5	The *Create new network port* window appears. Configure the port parameters as described below: **Name –** Enter a name for the Ethernet connection (e.g. Lab-Laser-2). **Host IP Addr. –** Select a Host IP address (PC) from the drop down list of the computer's available network adapters. **System 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 value is 10001 and set in step 2. **NOTE:** To connect multiple lasers over IP with the same NKTP 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.
6	Click the Save button to save the configuration of the new *Ethernet connection*.
7	To delete or modify a configured port: *a.* Highlight the port and: • click the delete button. - or - • click the edit button. *b.* Click Save when finished.







	Action
8	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.
9	Click the CONTROL *Connect* drop down menu item and click on the newly created *Ethernet connection* name.
10	In the *Device Selector panel,* click on the laser icon to bring up its controls. **NOTE:** If CONTROL cannot reach the laser over Ethernet, verify that the CONTROL PC has connectivity with the laser by executing a PING test.

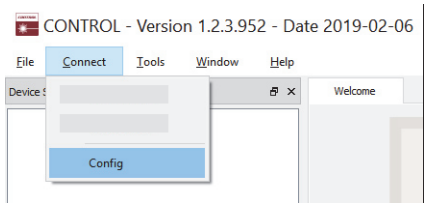


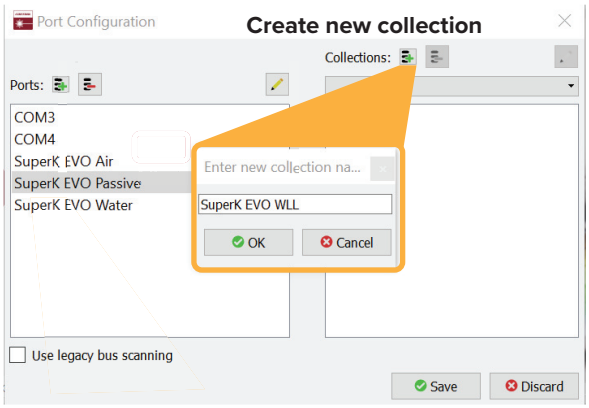
Grouping connections

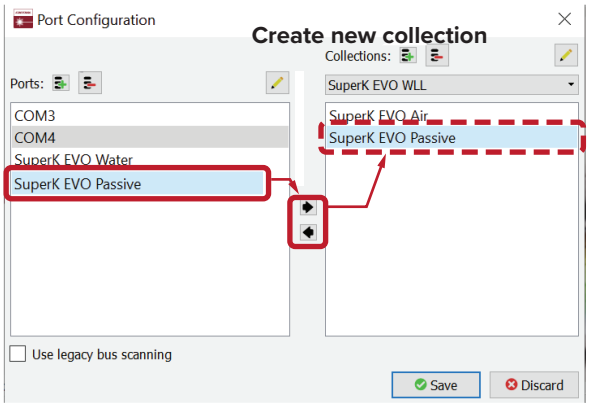
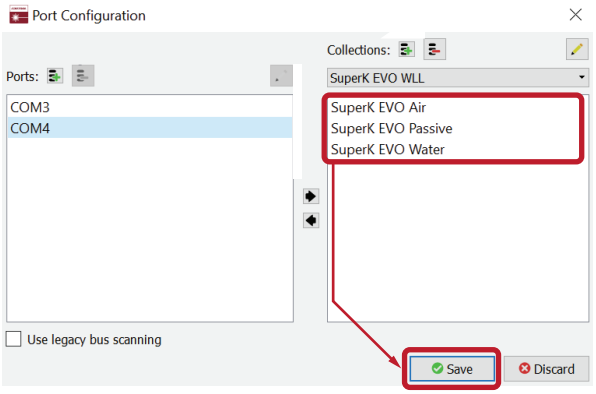
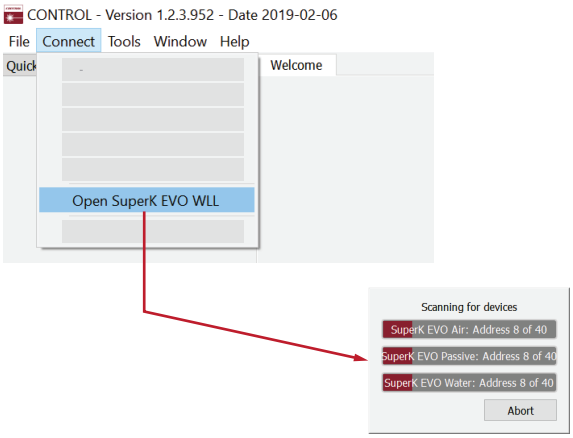
You can group configured lasers into a collection and then connect to all lasers in the group from the *Connect* drop down list. Use the *Port Configuration* dialog box to create the group and then click the *Connect* menu item and select the group from the drop down list. To create a collection group, follow the steps in Procedure 6.

Procedure 6 Grouping connections in a collection

	Action
1	Access the laser from a CONTROL PC using a USB cable or Ethernet cable as described in Connecting over USB on page 52 or Connecting a PC to the laser using Ethernet on page 53.
2	From the *Connect* drop down menu list, select *Config* to open the Port Configuration window.
3	Create Ethernet connections for the lasers to be added to the collection – see Procedure 5.
4	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	
5	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.	
6	When you have added all connections to the collection, click *Save*.	
7	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.	

6 Turning on the Laser

Safety

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

SuperK EVO Safety, Handling, and Regulatory Information

WARNING: Follow all safety regulations required for the location where the laser will be operated.

Preparation

The laser is ready to be turned on when the following steps are completed.

1. The laser is securely installed and connected according to the procedures in “Mechanical Installation” on page 35 and “Connecting the Laser” on page 41. This means the laser is installed in the recommended environment with power applied and at the very minimum, the door switch interlock and CONTROL PC connected.

2. The laser is communicating with the CONTROL application according to the procedures in “Communicating with the Laser” on page 51.

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

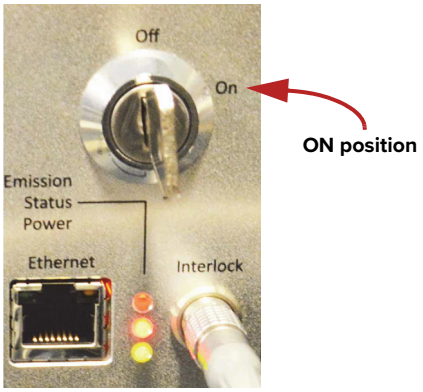
CAUTION: Do not turn on the laser if it has been exposed to temperature and humidity beyond the operating specifications. The SuperK EVO is designed to operated in a non-condensing environment from +18 to +30°C. Before turning on the laser, allow it at least 30 minutes to reach room temperature. Turning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

Controlling the laser emissions

Turning on the laser

Follow the steps in Table 7 to turn on the laser.

Procedure 7 Turning on the Laser

	Action	
1	On the front panel of the laser, turn the key switch to the ON position. When the key is in the ON position, emission can be enabled from the CONTROL software. **Note**: The interlock circuit must also be closed; the enclosure door switch is in the closed state and the bus defeater is connected.	
2	Adjust the laser power using the *Output control* slider in the *Control Panel* - see Control Panel – Operating Mode on page 73.	
3	If the all interlock circuits are closed (door and accessories), click the *RESET* button to clear the software interlock. **Note**: This is a software confirmation to proceed with turning on emission.	
4	Turn on emission by clicking the *Emission* button – see Emission button on page 65. The *Emission* button light turns from green (OFF) to RED (ON).	

Error

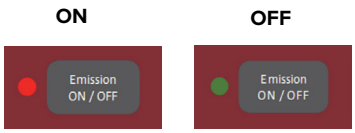
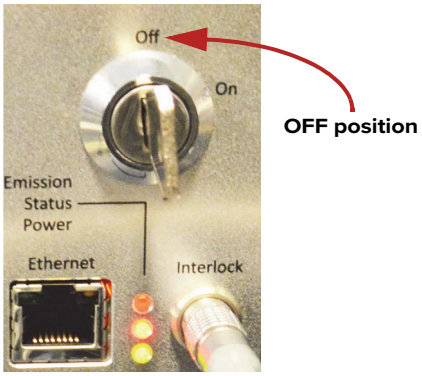
If the laser does not turn on or is unexpectedly disabled, an error condition may have occurred. Errors occur when the laser controller detects one or more operation conditions not within the normally expected range. When an alarm is raised, the laser is disabled, the emission LED is off, and status LED is lit red - see “Status LEDs” on page 27.

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

Turning off the laser

Follow the steps in Table 8 on page 59 to turn off the emission.

Procedure 8 Turning off the Laser

	Action	
1	Turn off emission by clicking the Emission button. The Emission button light turns from RED (ON) to green (OFF).	
2	Turn the key switch to the 0 position to disable the laser. **Note**: If you plan to leave the laser unattended, to prevent unauthorized operation, remove and store the key in a secure location.	

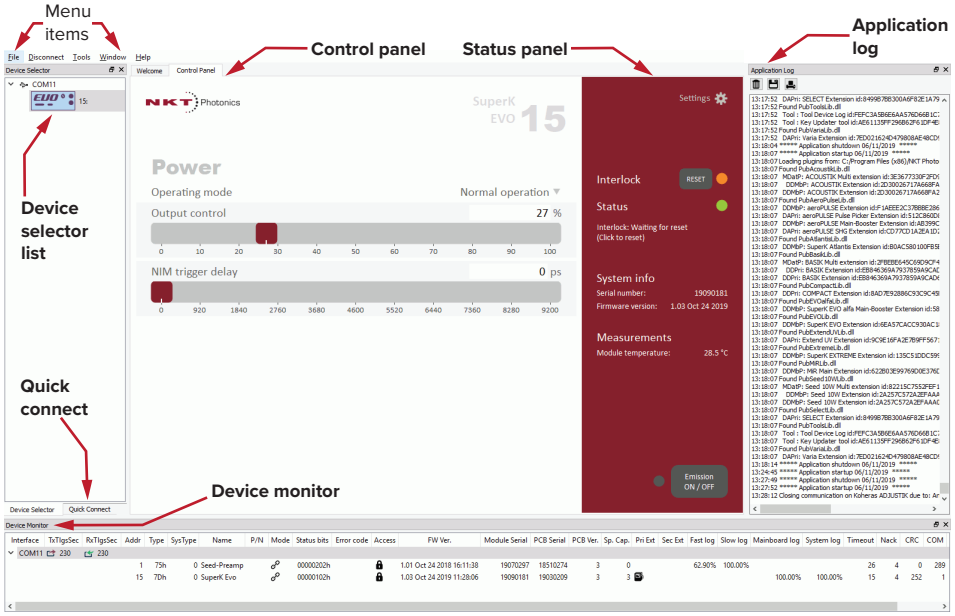
7 CONTROL Interface

CONTROL overview

The CONTROL user interface includes multiple panels and a selection of menu drop down items in the upper left corner. Using the drop down menu, you can add or remove panels. The panels can also be repositioned within the main window or into separate windows. Figure 22 shows CONTROL's 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 CONTROL on page 51.
Quick Connect	Provides a button when clicked, scans all available PC ports for connected NKTP products.	Connecting to the laser on page 63
Status Panel	This panel displays the selected device status, emission control and a CONTROL settings drop down menu.	Status panel on page 64
Menu Items	Five drop down menus with multiple functions.	CONTROL Menu on page 69
Control Panel	Includes slider controls for output control and trigger delay plus an operating mode drop down menu.	Control Panel – Operating Mode on page 73
Application Log	This panel displays a debugging log that can be saved to a file.	Application Log panel on page 74
Device Monitor	To also help debugging issues, this panel displays multiple port and device module parameters.	Device Monitor on page 75

Figure 22 CONTROL panel navigation



Relocating panels

You can be drag the different panels of CONTROL to any location within the main interface or into a separate floating panel. Procedure 9 describes how to relocate a panel within the main window:

Procedure 9 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 23.
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 24)

Figure 23 Relocating panels within CONTROL

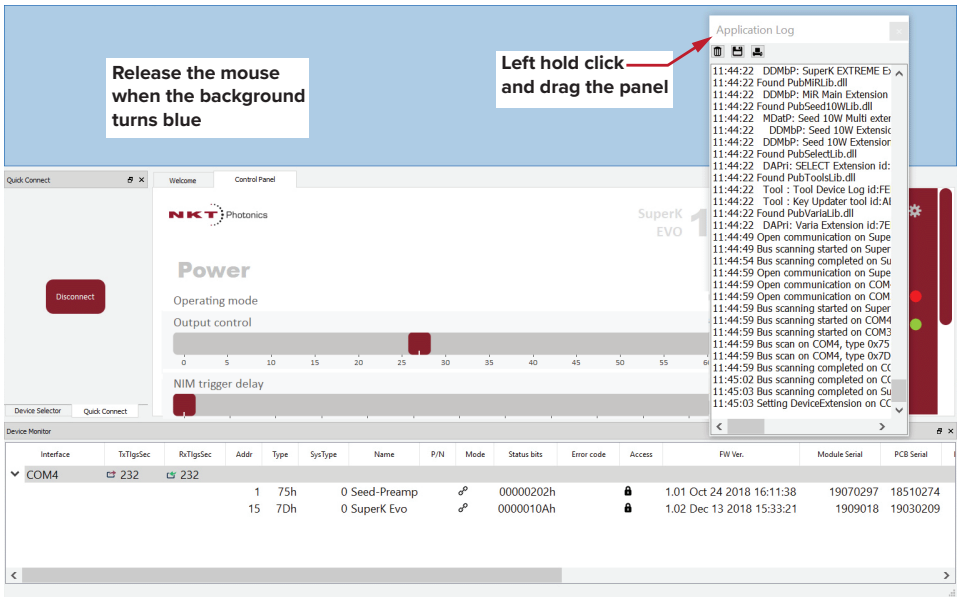
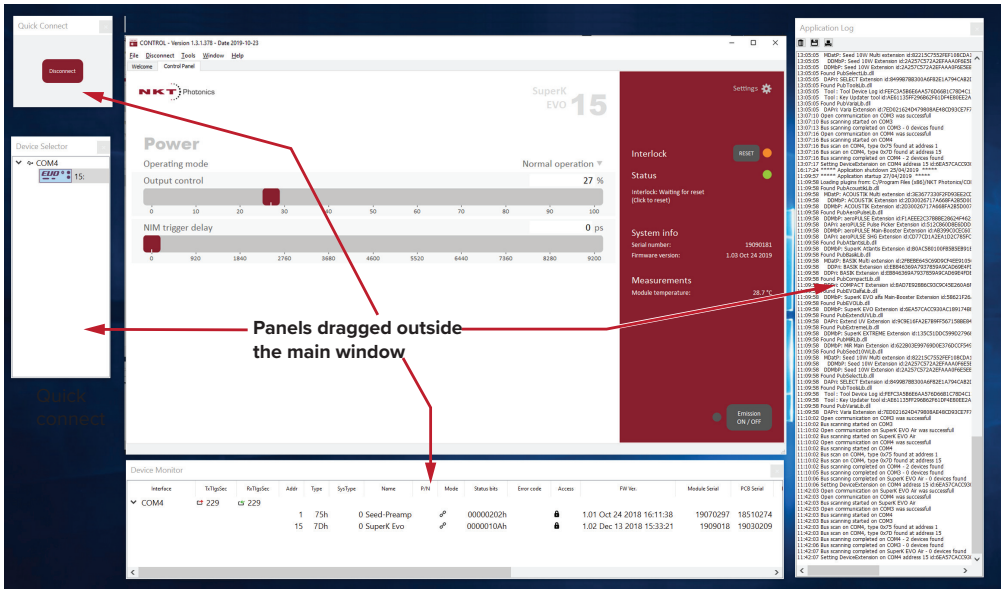


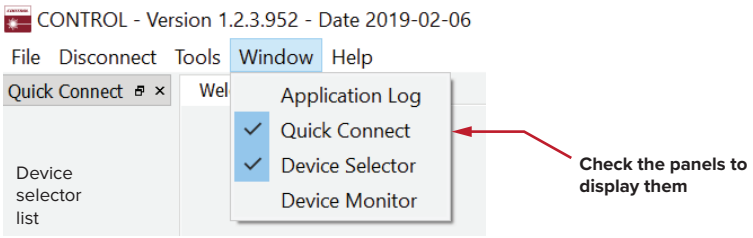
Figure 24 Dragging panels outside the main window



Toggling the panels visible

Click *Menu* > *Window* and check or uncheck the items in the drop down menu. Checking (clicking it) an item shows the panel and unchecking the item (clicking it again) removes it from view.

Figure 25 Toggling panel visibility



NOTE: You can also close the panels by clicking the X in the upper right corner of the panel.

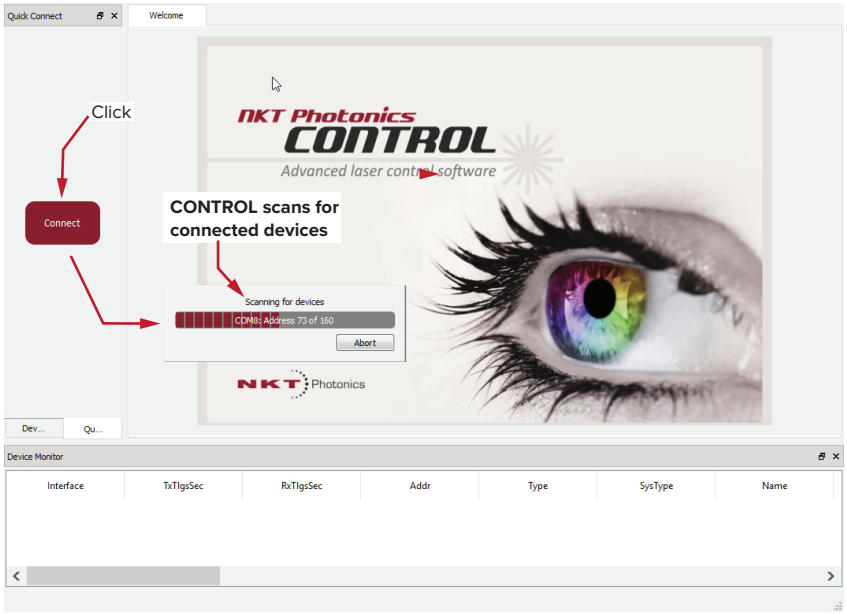
Connecting to the laser

When CONTROL is launched, a “Welcome” panel is displayed as in Figure 26. By default, on the left is the *Quick Connect* panel. Click the *Connect* button and CONTROL scans all available ports for NKTP devices that it can connect to. Once CONTROL finishes the scan, a list of the devices is presented.

See either “Connecting over USB” on page 52

or “Connecting a PC to the laser using Ethernet” on page 53.

Figure 26 Quick Connect

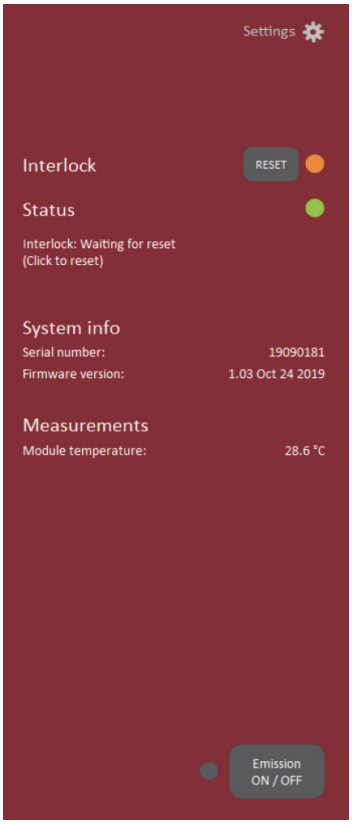


NOTE: Devices must already be connected to the CONTROL PC for quick connect to find them. A connected device means the laser USB connector is connected and a Windows COM port is assigned to it. For Ethernet connected lasers, the Ethernet parameters must already be configured. See “Connecting the Laser to CONTROL” on page 51.

Status panel

The status panel provides status indicators, error messages, emission control function and a CONTROL settings menu.

Figure 27 Status panel



Status Indicators

The panel displays the following indicators:

Interlock
Indicates the status of the Interlock circuit and whether emission can be turned on or not. The indicator is either:

- ON RED – the interlock circuit is open or shorted to ground – No emission allowed
- ON AMBER – the interlock circuit is closed but a software reset is needed (press the RESET button)
- OFF GREY – the interlock circuit is closed and reset – emission allowed

To clear the ON RED indicator, the interlock 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 the indicator turns ON RED:

Fault Message	Action
Interlock opened while emission on	a) Cycle the key switch to OFF and then ON b) Close the external interlock circuit
Watchdog timeout	Reconnect NKTP CONTROL and reset the interlock by cycling the key switch.

See “Connecting the Safety Interlock” on page 41.

Interlock Reset (button) The *Interlock Reset* button confirms that it is safe to permit emission. Pressing the button, clears the software interlock reset. If the interlock circuit opens, the software interlock is also set to prohibit emission. Once the hardware interlock circuit is closed and reset again, confirm that the operational area is safe before pressing the software *Interlock Reset* button.

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

- Laser Serial Number
- Laser Firmware Revision

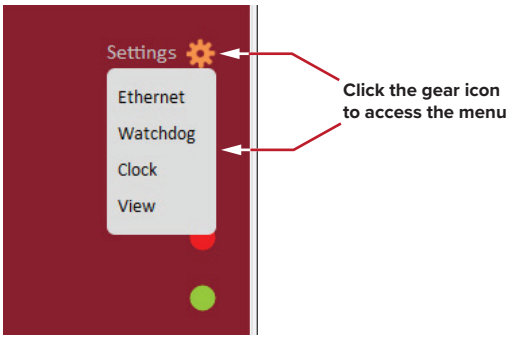
Measurements The *Measurements* section displays the laser’s pump temperature.

Emission button The emission button turns laser emission ON or OFF – See “Controlling the laser emissions” on page 58. The button indicator turns ON RED when laser emission is generated. Otherwise, it is OFF Grey.

CONTROL Settings

CONTROL settings are accessible by clicking the gear icon in the upper right corner of the status panel. Clicking the icon displays a drop down menu of setting items as shown in Figure 28:

Figure 28 CONTROL settings



Setting Item	Function	See
Ethernet	Configures network settings for Ethernet connectivity.	Ethernet on page 66.
Watchdog	Enables or disables a watchdog between CONTROL and connected devices.	Watchdog on page 67
Clock	Sets the time and date that CONTROL uses for time stamping log messages.	Clock on page 68
View	Enables and disables items displayed in the Status panel.	View on page 68

Ethernet

Configures the network settings of the laser when using an Ethernet connection. Over a USB/serial connection, configure the settings in this panel first before setting up an Ethernet connection for the laser in CONTROL – see Procedure 5 on page 53.

Figure 29 Ethernet setting

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.

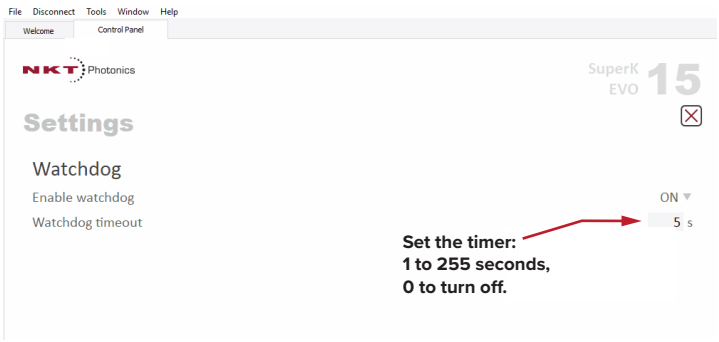
MAC Address
The unique *MAC address (Ethernet hardware address)* of the EVO is displayed only and cannot be set.

Watchdog

As an added safety feature, the watchdog automatically turns off laser emission if communications with CONTROL are lost. The feature can be enabled or disabled and has an adjustable timeout. When communication is lost with the laser, the watchdog timer counts down from the timeout setting value (1 to 255 seconds). Upon expiry, the watchdog shuts down laser emission by internally opening the interlock circuit.

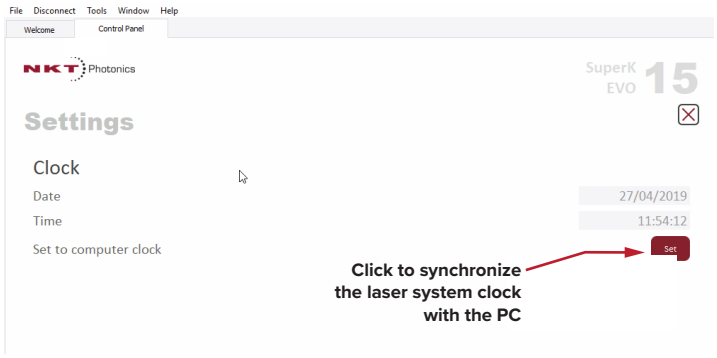
NOTE: Setting the timeout to 0 seconds turns OFF the watchdog.

Figure 30 Watchdog



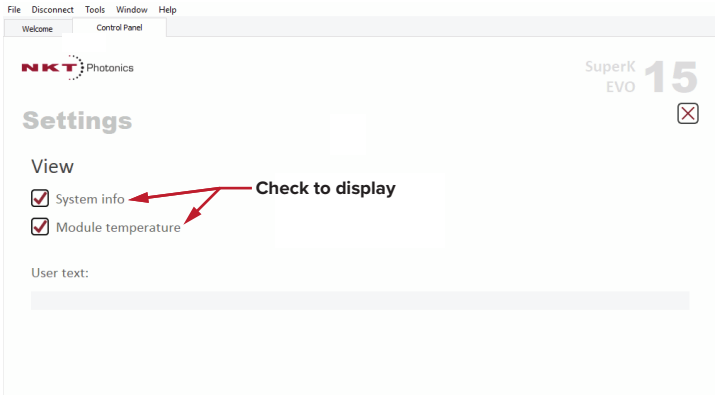
Clock You can view and set the laser system time and date using this setting panel. Click the *Set* button to synchronize the laser system clock with the PC time and date. The clock setting is used when time stamping the recorded system logs.

Figure 31 Clock settings



View This menu toggles on and off the display of *System Info* and *Module temperature* within the *Status* panel. Check the box next to each item to display it. Uncheck the box to remove the item from being displayed.

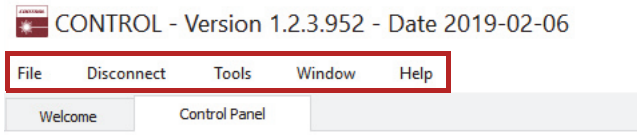
Figure 32 View



CONTROL Menu

There are five drop down menu items at the top left of the main CONTROL window. highlighted in Figure 33. Clicking on each item, reveals its drop down menu.

Figure 33 Menu items



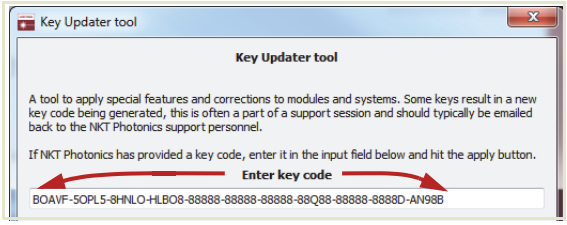
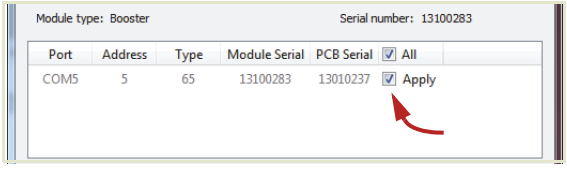
Menu Item	Function	See
File	Click *File>Exit* to exit the CONTROL program	N/A
Disconnect	Click *Disconnect>Close All to* disconnect the currently connected device from CONTROL.	N/A
Tools	Select from one of three special tools to use with your laser. Tools available are: • Key Updater Tool • Log Downloader • Extensions Overview	 Key Updater tool on page 69 Log Downloader on page 70 Extensions Overview on page 72
Window	Sets whether certain panels are visible or not.	Toggling the panels visible on page 63
Help	Displays the current version of CONTROL and provides access to the included CONTROL user help.	N/A

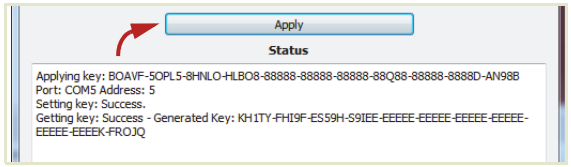
Key Updater tool

The Key Updater tool applies special features and corrections to modules and systems of the laser.

To use the Key Updater tool follow Procedure 10.

Procedure 10 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 can generate a new locally generated key code. These locally generated keys are usually required during a support session and are sent to NKT Photonics support personnel.

Log Downloader

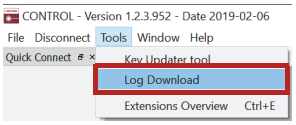
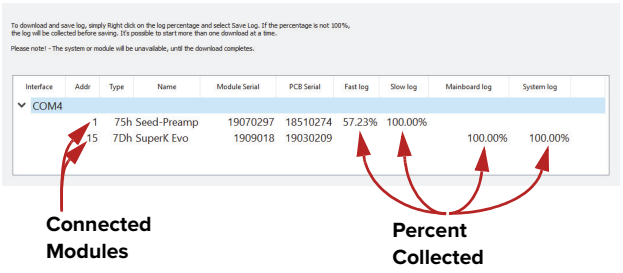
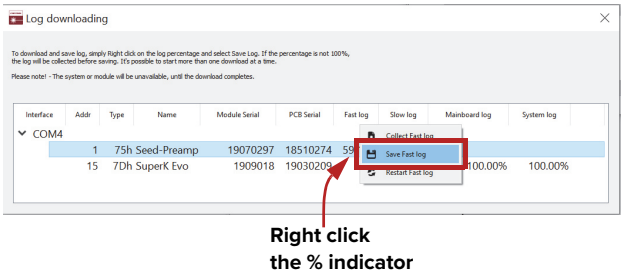
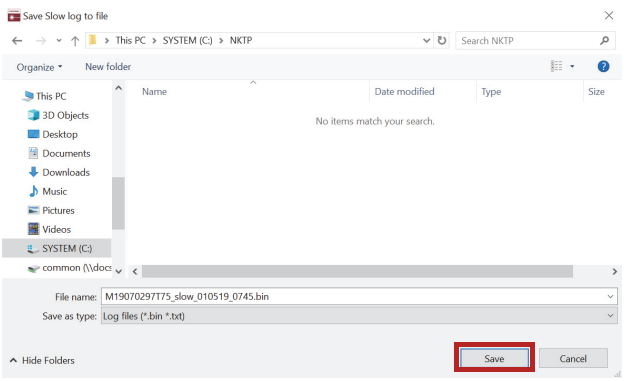
If your laser requires support from NKT Photonics, our support engineers may request you send them log files collected by the laser. You can use the log downloader tool to save laser log files to your CONTROL PC.

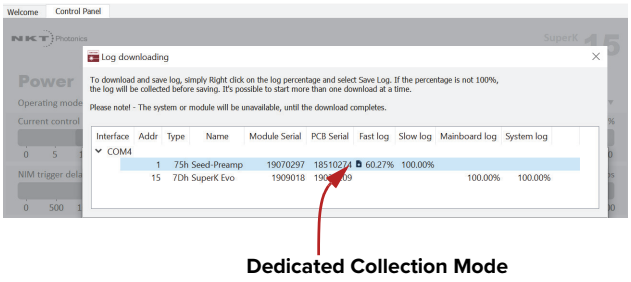
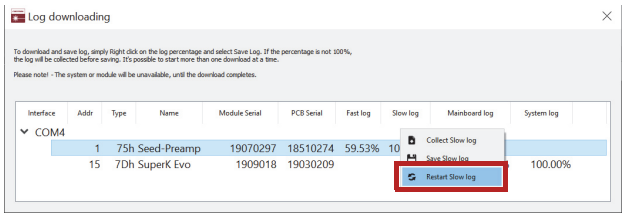
NKTP CONTROL automatically downloads log files from modules of any connected devices. The log files are stored in a local database of the CONTROL PC. However, certain NKTP modules, including the SuperK EVO mainboard, do not support automatic download of log files. For these modules, you can use the Log 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 11.

Procedure 11 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.	
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. If the percentage shows less than 100%, the log is first collected. See Collect log below. • **Collect log** – Starts a dedicated log collection mode that disables all other CONTROL activity.	
4	If you select *Save* log, a dialog box prompts for a filename and folder to store the log in.	

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

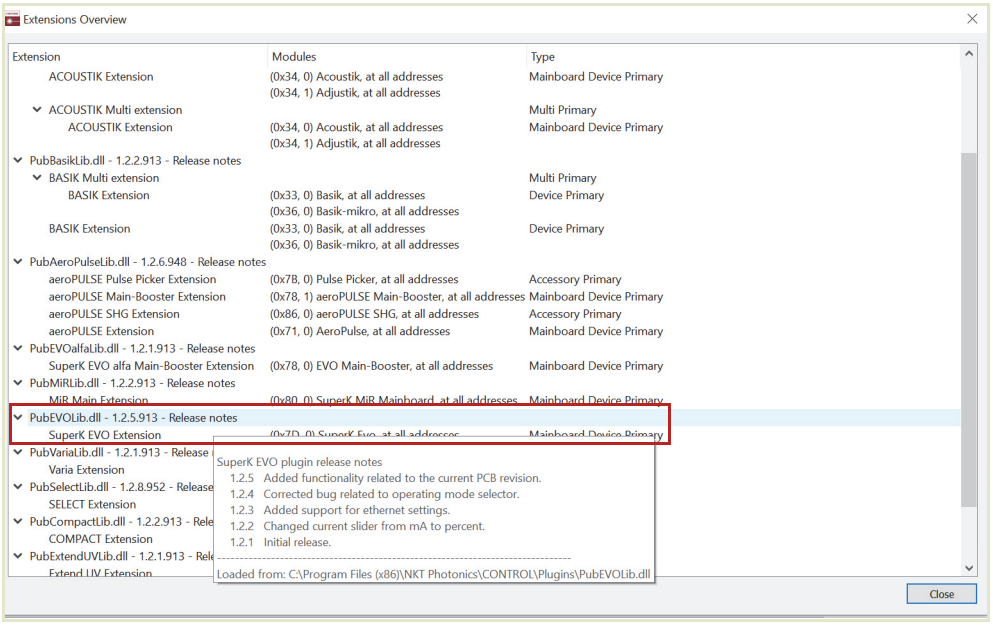
Extensions Overview

Use this tool to view the installed extensions (similar to 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, open the Tools menu and click on Extensions Overview. The Extensions Overview window is launched as shown in Figure 34.

Figure 34 Extensions Overview



NOTE: To show a short description of the release notes as seen in Figure 34, hover the mouse pointer over the “Release notes” text

The PubEVOLib.dll details highlighted in Figure 34 shows the version of the .dll file (1.1.2.303), the included extensions (SuperK EVO Extension) and which module types they support.

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

Control Panel – Operating Mode

The control panel configures the following:

- *Operating mode* – enables the External control input port to operate in one of three modes – see Table 8.
- *Output control* – adjusts the current flow of the laser pump in percentage of maximum current.
- *NIM trigger delay* – sets the delay of the NIM output pulse in picoseconds (see “Synchronizing external equipment” on page 26.

Operating modes

Control of the laser emission depends on the operating mode chosen. To select one of the modes listed in Table 8, click on the operating mode selection menu located on the right side of the panel – See Figure 8.

Figure 35 Operating mode

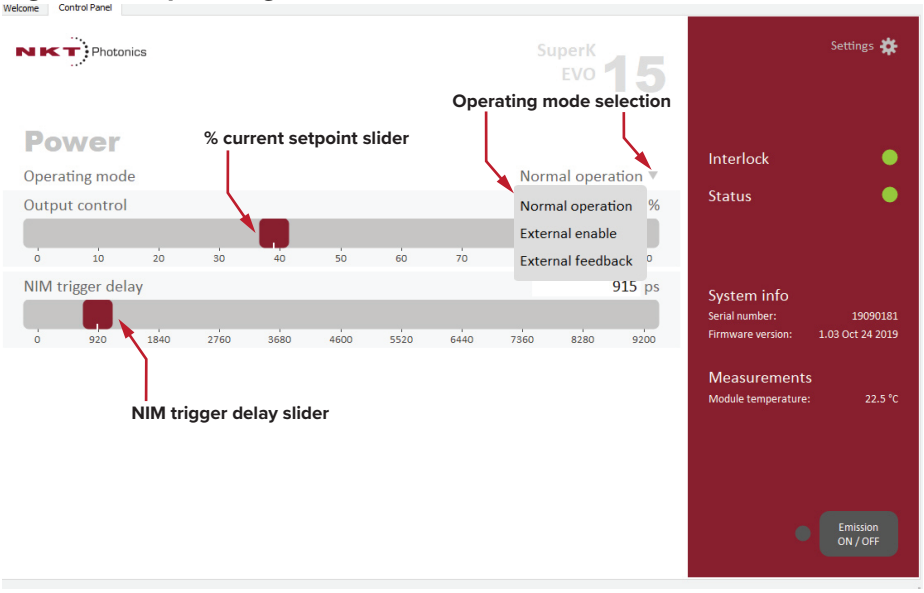


Table 8 Operating modes

Mode	Description
Normal Operation	In this mode, the External control input port is disabled: • Current level of the laser pump is set by the *Output control* slider. • Enabling and disabling emission is controlled by both the *Emission* ON/OFF button and Interlock.
External enable	In this mode the External control input port is enabled: • Current level of the laser pump is set by the *Output control* slider. • Enabling and disabling emission is controlled by the *Emission* ON/OFF button, interlock and a logic signal applied to the External control input port – see External enable on page 78.
External feedback	In this mode the External control input port is enabled: • Current level in the laser pump is varied by applying a varying analog input voltage at the External control input port – see Power stabilization using external feedback on page 77. • The *Output control* slider setting is the set point level for the external feedback control. • Enabling and disabling emission is controlled by the Emission ON/OFF button and Interlock circuit.

Application Log panel

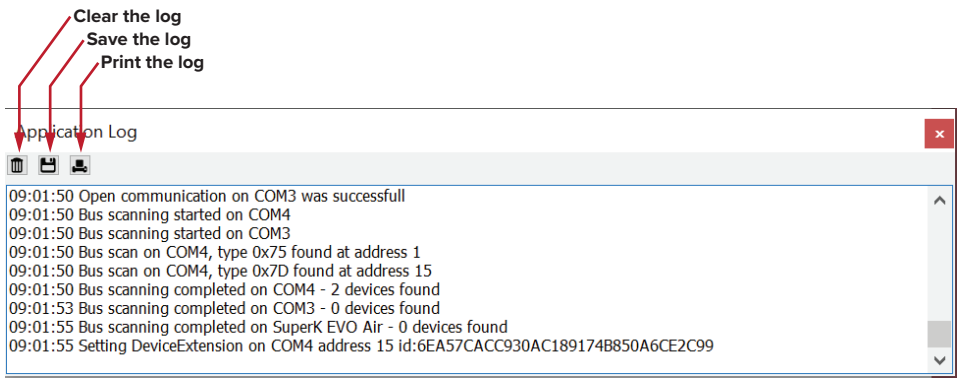
The *Application Log* panel displays and logs communication messages. The log is useful for debugging connection issues between CONTROL and NKT Photonics devices.

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. 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 it.

Figure 36 Application Log window



Device Monitor

The device monitor shows a live streaming display of transmit and receive parameters for the laser's communication ports and any connected device modules.

The display parameter values are continuously updated and are useful to help debug issues with connected devices. The parameters are described in Table 9.

Table 9 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.
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.

Parameter	Description
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.

8 Configuring External Control

This chapter includes information for:

- "Configuring external feedback" – describes how to connect a feedback circuit to the laser to stabilize the output power level.
- "Configuring External enable"– describes how to connect an external logic signal to the laser to turn ON or OFF the laser emission.

Power stabilization using external feedback

When a variable voltage is applied to the *External Control Input* connector and the connector is enabled within CONTROL, the output power level of the laser is directly varied according the voltage level. Using this connector, the output level can be stabilized using an feedback signal. A description of the interface is described in the section: "Laser emission stabilization using feedback" on page 25.

Microprocessor control within the laser, samples the voltage at the *External Control input* and proportionally steps up or down the output emission level of the laser. A feedback circuit may employ a photodiode sensing device that generates a current proportional to the laser radiance. You can feed the photodiode current into an op-amp to convert it into a voltage level for measurement at the *External Control Input* connector. The external feedback circuit uses a 470k Ω pull-up resistor at its input. If no signal is applied at the input, the optical output is set to the minimum level. The output from a custom feedback circuit or otherwise must conform within the parameters specified in Table 10. Note that once the laser is in feedback mode, the internal feedback circuit varies the pump current in relation to the input feedback voltage.

Table 10 External control input parameters

Parameter	
DC Voltage Range	0 – 4.1 VDC
Maximum Modulation Rate	100 Hz

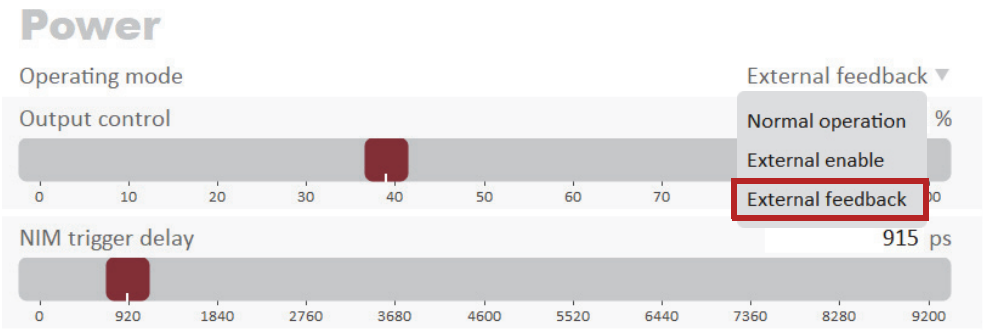
NOTE: The sample rate of the microprocessor detector is 200 Hz, therefore input modulations occurring faster than 100 Hz cannot be accurately detected.

NOTE: With a feedback signal at 0 VDC, laser output level is at the minimum, at 4.1 VDC, laser output level is at the maximum. For optimal performance, it is recommended to provide a feedback signal that varies in the upper scale of the input range. It is unsuitable to use a feedback signal at the limits of the input range, this results in incorrect operation.

Configuring external feedback

To vary the laser output level using an external analog signal, set the laser to *External feedback* mode. Figure 39 shows the Operating mode drop down menu, select *External feedback*.

Figure 37 Setting External feedback mode



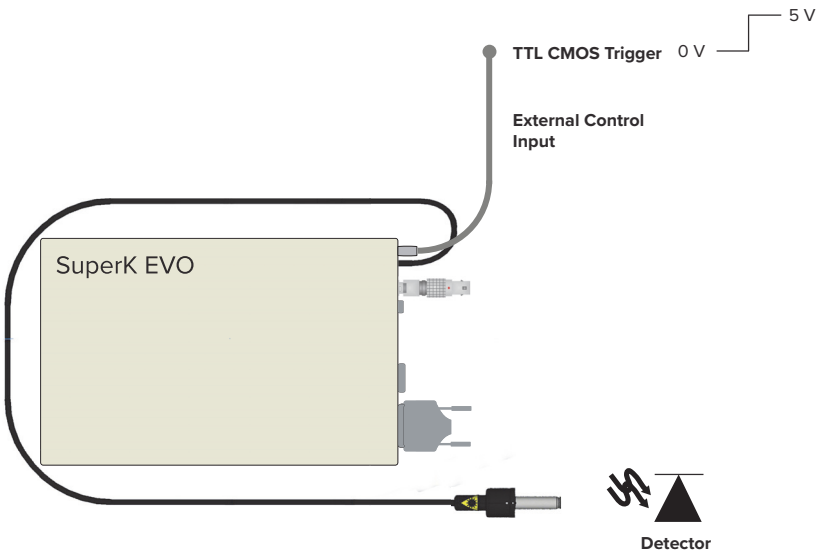
NOTE: When *External feedback* mode is selected and no digital signal is applied at the *External Control Input* connector, the laser resumes normal operation.

External enable

You can apply a TTL or CMOS level logic signal at the *External Control Input* to enable and disable laser emission using the *External enable* feature. When the feature is enabled, a logic high applied at the port turns ON laser emission with a fast rise time. When a logic low is applied, the output emission is turned OFF. The feature works by enabling or disabling the main amplifier. Figure 38 shows a trigger signal applied at the *External Control Input*. When the trigger signal rises to a logic high, the output emission shown in the graph of the detector output rises correspondingly with a fast rise time. The booster output can rise up to its 100% output power level within 80 ms, and without overshooting.

WARNING: The laser emission is still ON when the booster is OFF, however residual laser emission are still produced.

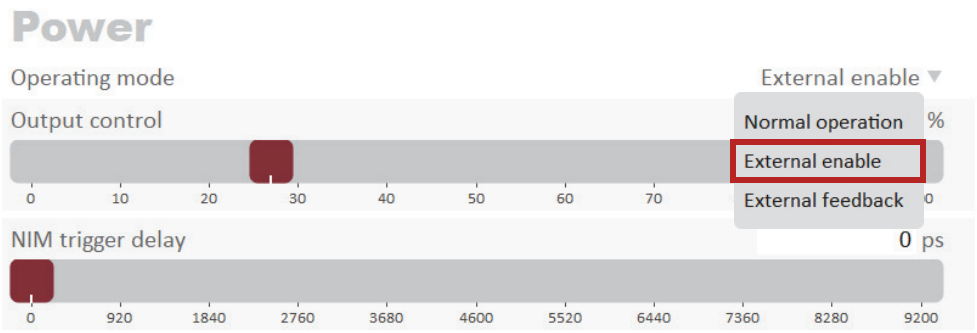
Figure 38 External Enable Trigger vs optical output rise



Configuring External enable

Set the laser to *External enable* mode with a logic signal applied to the port. Figure 39 shows the Operating mode drop down menu, select *External enable* to turn on the feature.

Figure 39 Setting External enable mode



NOTE: If *External enable* mode is selected and no digital signal is applied at the External Control Input connector, the laser resumes normal operation.

APPENDICES

The appendices include:

A Specifications

Table 11 Optical

Parameter	All SuperK EVO models [i]
Repetition Rate	20 – 78 MHz
Spectral Coverage	410 – 2400 nm
Total Power	< 10 W
Total VIS Power	< 2000 mW
Total Power Stability	± 1% RMS
Polarization	Unpolarized
Beam Output	Gaussian, Single Mode
Typical M^2	< 1.1
Optical Output	Collimated or FC/APC
Length of Output Cable	1.5 m
Beam Diameter	~1 mm at 633 nm ~2 mm at 1060 nm
Beam Divergence (over 400 - 1100 nm)	< 3 milliradians

i. Values listed are a general range encompassed by all models. For exact optical specifications, refer to the test report that is shipped with your laser or the latest datasheet at www.nktphotonics.com.

Table 12 Interfaces

All chassis models	
PC and micro processor interfaces	RS-232 serial COM - 9 Pin D-Sub Female Connector USB 2.0 - Type B Female Connector Ethernet - RJ-45 Female Connector
Pulse Output (Synchronization)	NIM Logic - BNC Female Connector
External Bus	RS-485 Bus - 15pin D-Sub Female Connector
External Control Input	NIM logic - BNC Female Connector
Door Interlock	2 pin Connector - LEMO Part Number FGG.0B.302
Polarization	Unpolarized
Beam Output	Gaussian, Single Mode
Typical M^2 (>430nm)	< 1.1
Optical Output	Collimated or FC/APC
Length of Output Cable	1.5 m

Table 13 Mechanical dimensions

Chassis Model	Passive	Air Cooled	Water Cooled
Size (H x W x D)	80 x 200 x 372 mm (3.15 x 7.87 x 14.65 in)	166.5 x 200 x 325 mm (6.54 x 7.87 x 12.80 in)	93 x 200 x 346 mm (3.66 x 7.87 x 13.63 in)
Weight	6 kg (13.23 lb)	12 kg (26.46 lb)	8 kg (17.64 lb)
Operating Temperature	18°C to 30°C (59°F to 86°F)	18°C to 35°C (32°F to 95°F)	18°C to 35°C (59°F to 95°F)
Operating Humidity (non-condensing)	20 to 80%	20 to 80%	20 to 80%
Storage Temperature	-10°C to 60°C (14°F to 140°F)	-10°C to 60°C (14°F to 140°F)	-10°C to 60°C (14°F to 140°F)
Maximum Output Cable Length	1.5 m (59 in)	1.5 m (59 in)	1.5 m (59 in)

Table 14 Electrical

Chassis Model	Passive	Air Cooled	Water Cooled
AC to DC Power Adapter	Input 100-240 VAC 50-60 Hz 2.5 A Output +24 VDC 6.25 A	Input 100-240 VAC 50-60 Hz 2.5 A Output +24 VDC 6.25 A	Input 100-240 VAC 50-60 Hz 2.5 A Output +24 VDC 6.25 A
Maximum Power Consumption	Less than 90 W	Less than 120 W	Less than 120 W

Table 15 Compliances

Emissions and Immunity	Safety
BS EN 61326-1:2013	BS EN 60825-1:2014 (laser class 4)
	BE EN 61010-1:2010

CE

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

B Service and Support Information

Servicing the laser

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

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

Opening the laser chassis

There are no user serviceable components inside the SuperK EVO chassis. Should your laser malfunction, and it cannot be serviced on site, it must be shipped to the NKT Photonics Headquarters in Denmark.

The laser may experience damage during shipping. To minimize the chance of shipping damage, follow the packing procedures in Appendix G.

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.

Figure 40 Warranty void label

Support contact details

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

Support website

1. Go to:

   https://www.nktphotonics.com/lasers-fibers/support/technical-support-and-customer-service/

2. Scroll down and click or press:

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

Shipping address

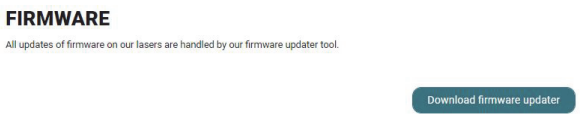
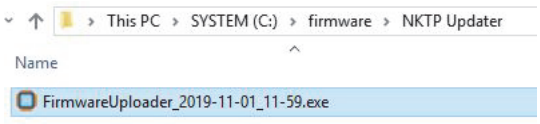
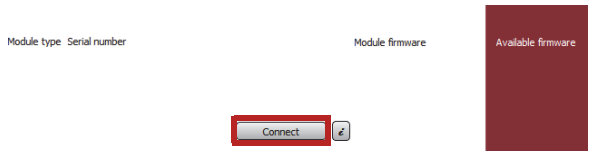
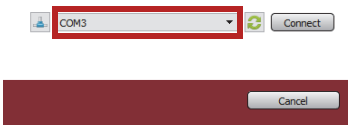
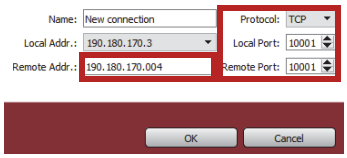
NKT Photonics A/S
Blokken 84
DK-3460 Birkerød
Denmark

C Firmware Upgrade

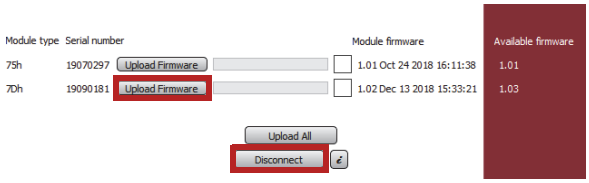
Upgrading the firmware

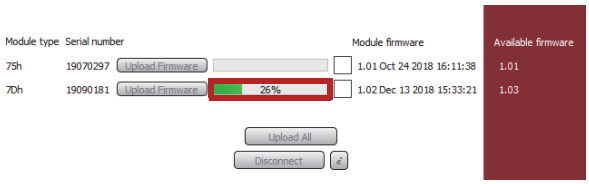
NKTP upgrades firmware periodically to support new functionality and occasional fixes. Follow the steps of Procedure 12 to upgrade your laser to the latest firmware.

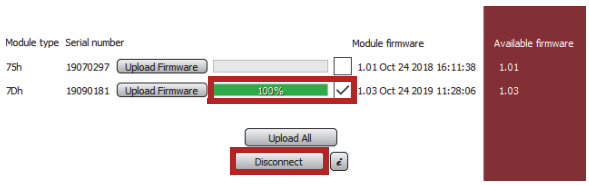
Procedure 12 Upgrading the firmware

	Action	
1	Download the Firmware updater tool from the NKTP support website to a PC : https://www.nktphotonics.com/lasers-fibers/support/software-drivers/	
2	The tool is an executable, after extracting the file, double click the tool's .exe icon to open it.	
3	When the updater opens, click on the *Connect* button.	
4	**USB connection** – click the drop down *Communication list* and select the USB port connected to the laser and click the *Connect* button and go to Step 6. **Ethernet connection** – click the network connection button on the left of the USB drop down list and go to step 5.	
5	*Append network connection* – In the *Remote Addr* text field, input the laser's IP address and port settings (see Ethernet on page 66) and click *OK*. In the main window, click the *Connect* button.	
6	To check if the list of Module type codes correspond with your laser model, click the button in the main upgrade window. A new window appears with a list of all possible module type codes, their descriptions and their latest FW. Confirm the Module types match your laser.	

	Action
7	For each *Module type* listed, compare its *Module firmware* revision with the firmware revision listed under *Available firmware*. If the available firmware revision is higher, the laser can be upgraded. To upgrade: • for each *Module type*, click the *Upload Firmware* button. - or - • click the *Upload All* button to upgrade all modules
8	During the firmware upgrade, the progress bar indicates the progress of the upload in percent.
9	Click the *Disconnect* button when all firmware upgrades required are completed. This is indicated by a 100% progress bar and a check mark in the box next to the module upgrade.







D Accessories

This appendix provides a brief overview of the accessories available for your laser. Table 16 lists the accessories and their functions and provides a link to descriptions of the SuperK EVO advanced accessories.

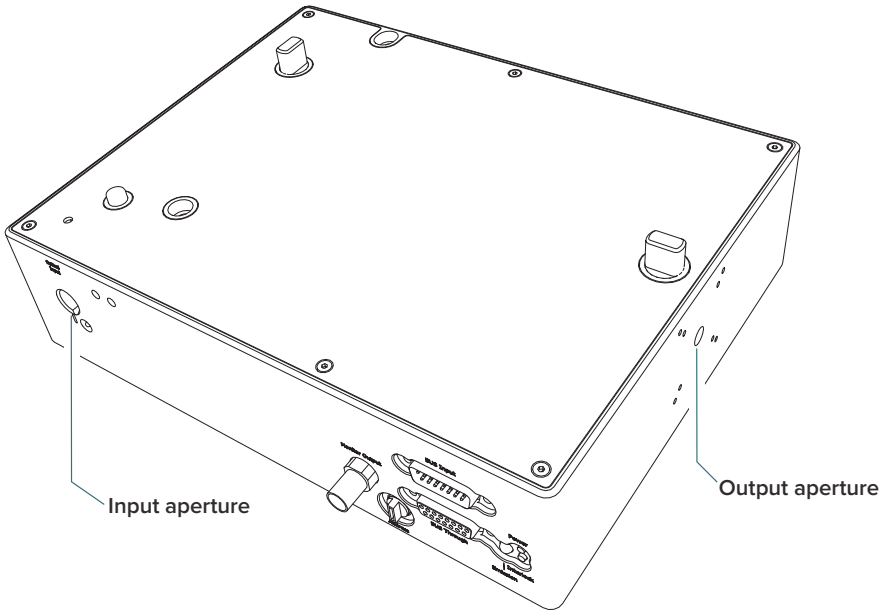
Table 16 SuperK EVO accessories

Advanced accessories	Function	Part number	
VARIA	Variable bandpass filter	A301-100-000	“SuperK VARIA” on page 90.
SELECT	Multi-wavelength AOTF	A203-XXX-000 or A203-XXX-010	“SuperK SELECT” on page 91.
LLTF	Narrow laser line filter	A371-500-000 or A371-200-000	“SuperK LLTF” on page 93.
SPLIT	Broadband filter	A102-200-000 or A102-500-000	“SuperK SPLIT” on page 94.
CONNECT	Delivery fiber	A401-000-000 or A401-200-000 or A401-500-000	“SuperK CONNECT and Fiber Deliver System” on page 95.
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 EVO laser. A portion of the beam from the SuperK EVO 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 EVO 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 41.

Figure 41 VARIA



VARIA specifications

The bandpass filter specifications of the VARIA are shown in Table 17.

Table 17 VARIA specifications

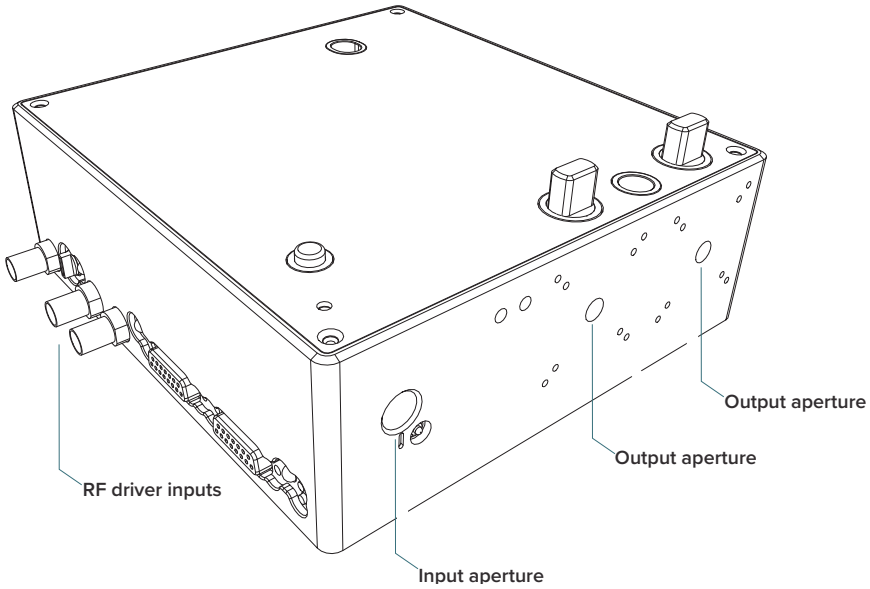
Specification	Function
Bandpass filter range (wavelength)	400 to 800 nm
Minimum linewidth	10 nm
Transmission efficiency	Approximately 80%
Filter suppression	Approximately 50 dB

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 EVO 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 EVO is shown in Figure 42.

Figure 42 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 43 on page 92. 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 18 lists the available AOTFs that can be fitted to a SuperK SELECT.

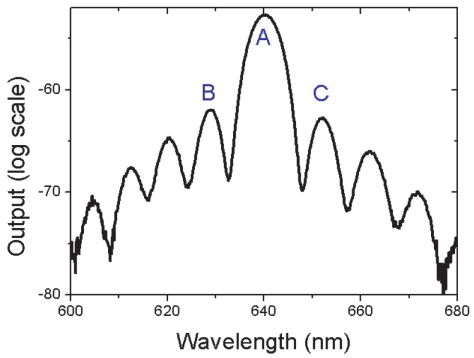
Table 18 SELECT AOTF types[1]

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 43. 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 43 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 19. 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 EVO is illustrated in Figure 44.

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 44 SuperK LLTF Contrast

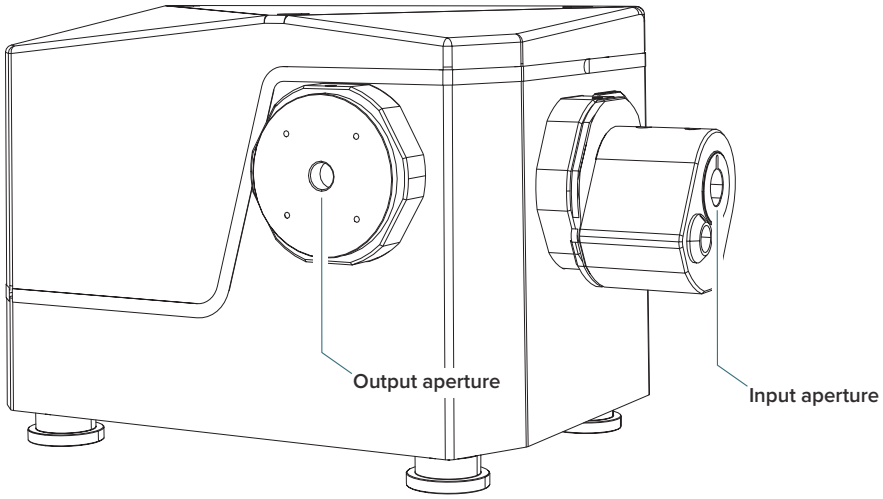


Table 19 LLTF Contrast model specifications

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 –

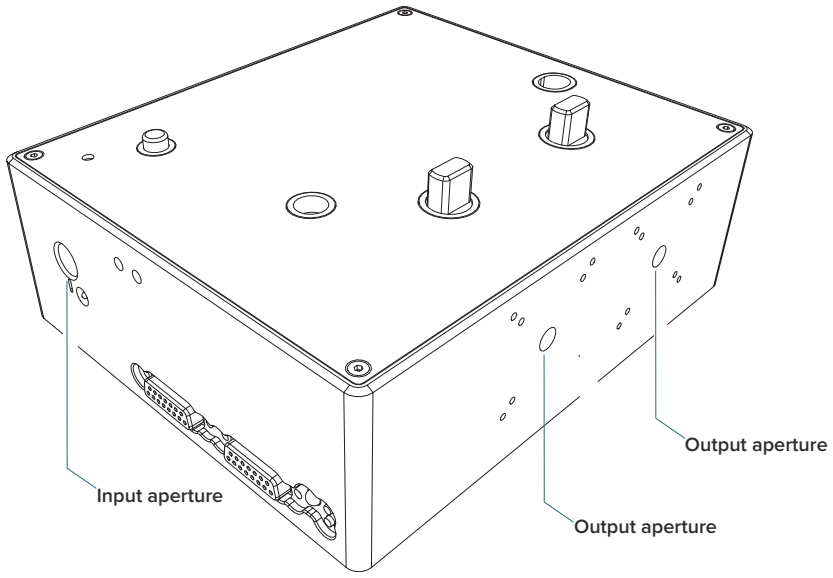
- nIR/IR – Near Infrared and Infrared

NOTE: A SPLIT can be ordered with custom wavelength splits, see Table 20 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 45.

Figure 45 SuperK SPLIT



SuperK SPLIT specifications

The specifications of the SPLIT are shown in Table 20.

Table 20 SPLIT wavelength ranges

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

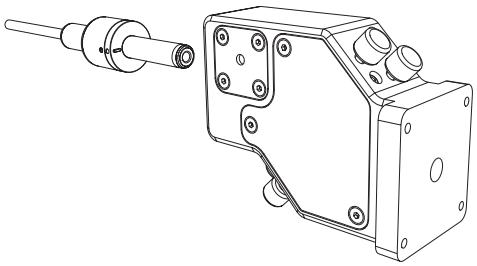
NOTE: For further details, refer to the *SuperK SPLIT Product Guide*.

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 46.

Figure 46 SuperK Fiber Delivery System using a CONNECT



E CONTROL Software

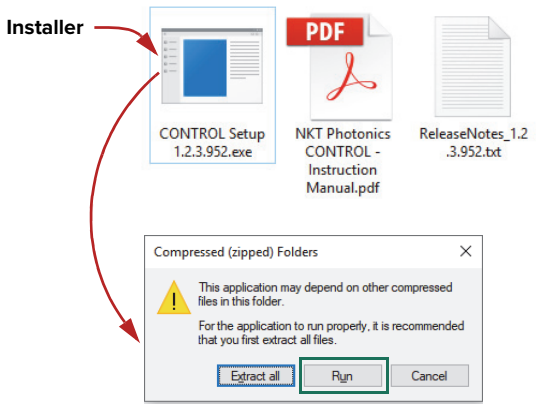
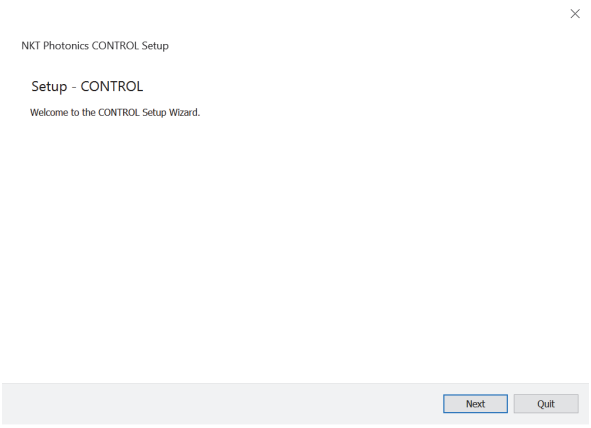
Installing CONTROL

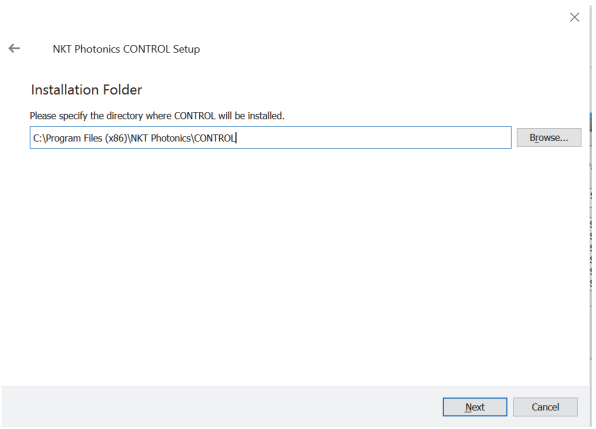
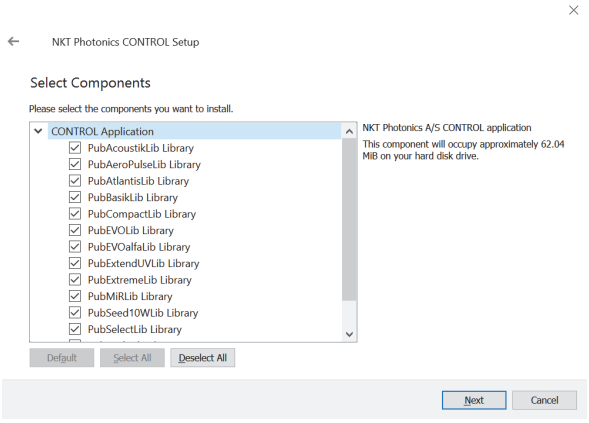
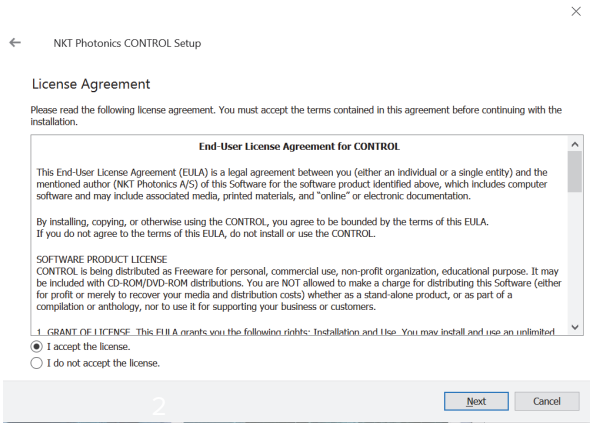
Download the software from:

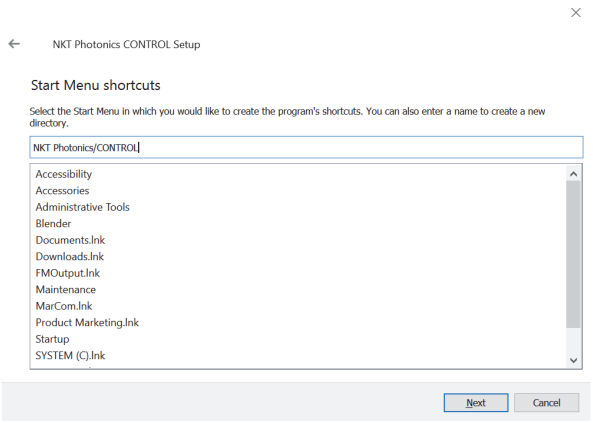
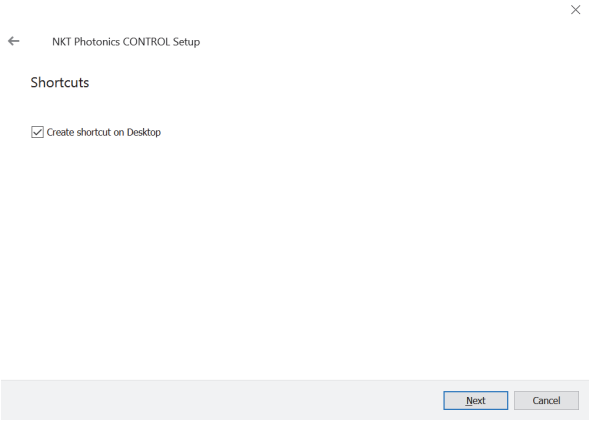
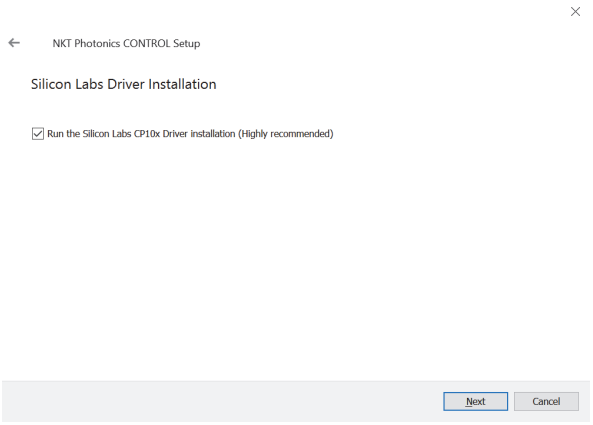
https://www.nktphotonics.com/lasers-fibers/support/software-drivers/

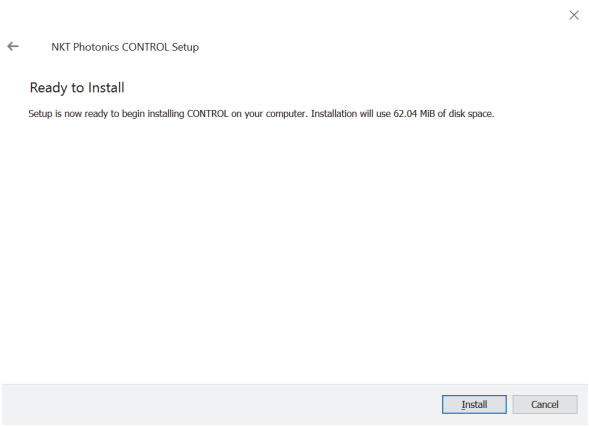
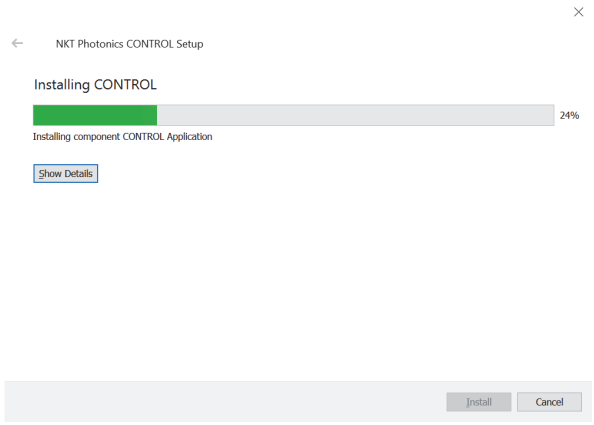
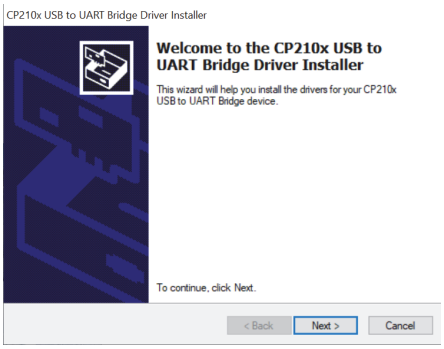
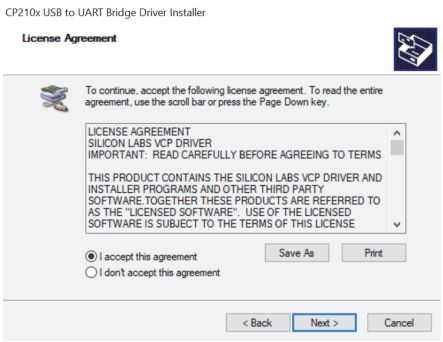
Follow the steps of Procedure 13.

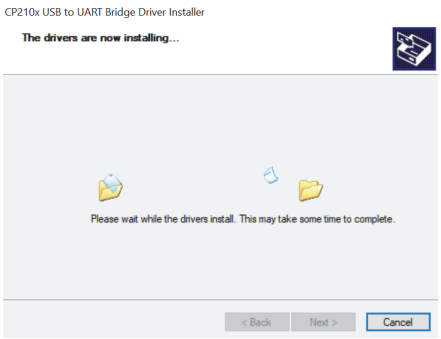
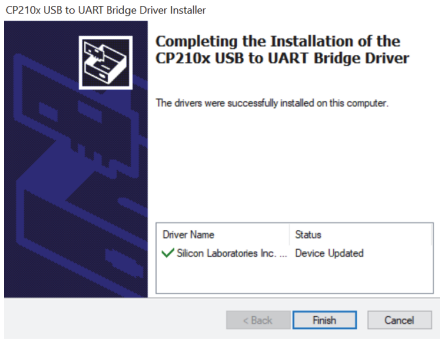
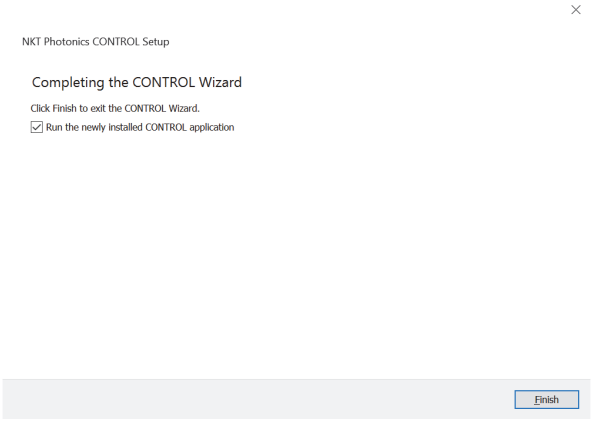
Procedure 13 Installing CONTROL

	Action	
1	On your PC, launch the installer package and click the *Run* button.	
2	The installation wizard appears. Click *Next* to continue.	

	Action	
3	Click *Next to* accept the default installation directory or select another directory by clicking the *Browse* button and then clicking *Next* once the new directory is selected.	
4	Uncheck any components not required. By default, all components are checked and installed. Click *Next* to continue.	
5	Read the End-User License Agreement, and select: “I accept the license.”. Selecting: “I do not accept the license” ends the installation wizard. Click *Next* to continue.	

	Action	
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.	
7	Check the box to create a desktop shortcut to access CONTROL. Click *Next* to continue	
8	Check the Silicon Labs driver installation (recommended) and click *Next*.	

	Action	
9	Click *Install* to install NKTP CONTROL software on your PC. Click *Cancel* to abort the installation.	
	The wizard displays a progress meter for the installation. **NOTE:** a normal install should only take a few seconds.	
10	Click *Next* to install the UART drivers for the PC USB port.	
11	Read the end-user *License Agreement*, and select “I accept this agreement”. Selecting “I don’t accept this agreement” aborts the driver installation. Otherwise, check the “I accept this agreement” button and click *Next* to install the driver.	

	Action	
12	A drivers installation window appears. Wait for the installation to finish.	
13	The Silicon Labs drivers is installed successfully. Click *Finish* to end the installation wizard.	
14	CONTROL is now installed. Check the *Run...* box to launch CONTROL when the *Finish* button is clicked. Click *Finish*.	

F Troubleshooting and Errors

Troubleshooting

Table 21 Laser troubleshooting

Symptom	Possible cause	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 EVO 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 4. Ethernet or IP network issue	1. Check the AC mains and the AC power cord/power supply. 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. 4. Ping the laser from the CONTROL PC or connect another PC to the lasers Ethernet connector and ping the CONTROL PC. Check that the laser's IP settings are correct for the connected subnetwork.
No Emissions	1. Key Switch is OFF 2. Interlock Circuit is open 3. The laser experiences a failure due to an alarm condition.	1. Turn the Key to the ON 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 22, "Errors codes and recovery action," on page 104.

Error codes and recovery

Table 22 lists the errors and their appropriate responses.

Table 22 Errors codes and recovery action

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 problem persists** disable watchdog mode
7,12	Ensure the ambient temperature in the environment surrounding the laser is within the specified range. See A . Also ensure the cooling requirements such as air or water flow are met depending on the chassis. See “Mechanical Installation” on page 35.
48	*1.* Move the beam delivery collimator head against a power meter. *2.* Set to 0% power (slider all the way to the left in CONTROL software) *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 “Connecting the optical output (collimator installation)” on page 44 **If the alarm persists:** – or – **If the laser emission are disabled**: Contact NKT Photonics. See B .
3,49,50,55	*1.* Set to 0% power (slider all the way to the left in CONTROL software) *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 B .
Any other code	Contact NKT Photonics. See B .

G Unpacking and Packing the Laser

Unpacking the laser

NOTE: NKT Photonics recommends that you save the original packaging in a secure dry location. The packaging is designed to help prevent damage to your laser for future shipping or storage requirements.

Carefully unpack the laser following the instructions in Procedure 14.

CAUTION: The laser is calibrated precisely at the factory, avoid jarring the laser when unpacking it.

Accessory kit

Once you have unpacked the laser, check that all the components of the accessory kit, as shown in Figure 47, are included.

Figure 47 Accessory kit components

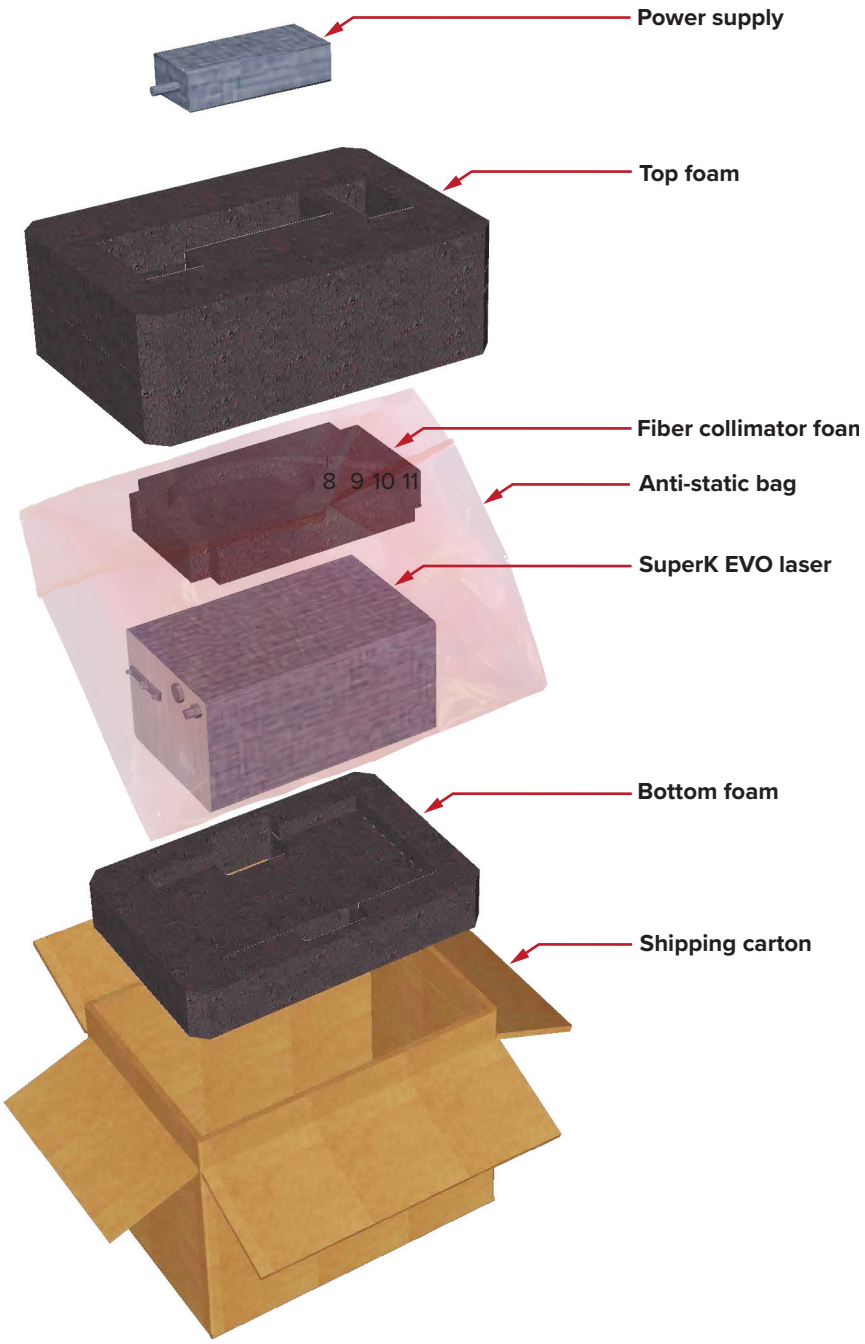
NOTE: Paper documents not shown: emission output *Test Report* sheet, and *Safety, Handling and Regulatory Information* document.

Procedure 14 Unpacking the laser

	Action[i]
1	Open the top flaps of the packing carton by cutting the packing tape along the seams of the flaps.
2	Remove the power supply from the top foam packing and then holding the foam, slide it out from the box.
3	Remove the anti-static bag containing the laser and its accessories (accessory foam) from the carton.
4	Open the anti-static bag and remove the accessory foam and the laser from the bag.
5	Carefully remove the collimator with its armored fiber cable from the accessory foam.
6	Put all the packing material back into the carton and store it in a safe dry location.

i. Refer to Figure 48

Figure 48 SuperK EVO packaging



Prepare and pack the laser for shipping

CAUTION: NKT Photonics recommends to use the laser's original packaging. Using any other packaging may increase the chance of shipping damage to occur. Contact NKT Photonics support if you require replacement packaging.

Carefully pack the laser following the instructions in Procedure 15.

Procedure 15 Packing the laser

	Action[i]
1	Remove all packing material from the shipping carton except for the bottom foam.
2	Put the accessory foam on top of the laser and carefully place the collimator and armored fiber cable into the foam.
3	Put the laser and accessory foam into the anti-static bag and then seal the bag.
4	Place the anti-static bag containing the laser into the shipping carton, sliding it into the bottom foam.
5	Place the top foam into the carton over the laser.
6	Place the power supply into the top foam and then seal the carton flaps with tape using an H-pattern.

i. Refer to Figure 48

Item: 800-612-01
Customer Revision: 1.4
NKT Photonics Revision: 4-0
Release Date: 10-2023

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

support@nktphotonics.com