SuperK COMPACT

Instruction Manual
# Table of Contents

**Section 1:** General ......................................................................................................................... 2

**Section 2:** Laser Safety .................................................................................................................. 3
   2.1 General information and designated use .................................................................................. 3
   2.2 Labels used on the SuperK COMPACT .................................................................................. 3
   2.3 Safety hazards ......................................................................................................................... 5
   2.4 Laser safety goggles ................................................................................................................ 5
   2.5 Laser safety compliance list ................................................................................................... 6
   2.6 Supply power .......................................................................................................................... 6
   2.7 Key Switch ............................................................................................................................ 7
   2.8 Remote Interlock ..................................................................................................................... 7

**Section 3:** Equipment description and installation .......................................................................... 10
   3.1 Installation .............................................................................................................................. 10
   3.2 Operating conditions .............................................................................................................. 10
   3.3 Front Panel ............................................................................................................................ 11
   3.4 Rear Panel ............................................................................................................................ 12

**Section 4:** Operation and System Menu ...................................................................................... 13
   4.1 Precautions ............................................................................................................................ 13
   4.2 Laser operation ....................................................................................................................... 13
   4.3 SuperK COMPACT with FC output connector ..................................................................... 17
   4.4 SuperK COMPACT with collimated output .......................................................................... 17

**Section 5:** Display messages .......................................................................................................... 19
   5.1 Warning and error messages ................................................................................................. 19

**Section 6:** Trigger input and remote connection ........................................................................... 20
   6.1 Trigger operating modes .......................................................................................................... 20
   6.2 Remote interface connection ................................................................................................... 21
   6.3 External Trigger input ............................................................................................................. 21
   6.4 Coax trigger input ................................................................................................................... 21
   6.5 Industrial trigger input ............................................................................................................ 22
   6.6 Logic and analogue pulse output ............................................................................................. 22

**Section 7:** Service & Support ......................................................................................................... 23
   7.1 Service and storage ................................................................................................................ 23
   7.2 Fiber tip cleaning .................................................................................................................... 23
   7.3 Technical support .................................................................................................................... 24

**Section 8:** Specifications of the SuperK COMPACT ....................................................................... 25
   8.1 Electro-mechanical Specifications ......................................................................................... 25
   8.2 Optical Specifications ............................................................................................................. 25
   8.3 System dimensions ................................................................................................................. 26

**Section 9:** Accessories for the SuperK COMPACT ........................................................................ 27

**User Notes** ..................................................................................................................................... 28
Section 1: General

Introduction

Please take the necessary time to read this instruction manual, which contains important information on safety issues concerning the usage of this equipment. The safety might be seriously impaired if the instruction manual is not followed carefully.

Also, make sure to follow the instructions on how to unpack the SuperK COMPACT from the shipping box if this is not already done.

The equipment comprises a laser Class 3B. It is recommended, that only persons familiar with laser safety regulations and coherent light should operate this equipment.

Do you have any questions concerning this product, please do not hesitate to contact us.

This manual covers the SuperK COMPACT with the following model numbers:

- SuperK COMPACT, model# S024-010-000 (FC/PC output connector)
- SuperK COMPACT, model# S024-010-010 (FC/APC output connector)
- SuperK COMPACT, model# S024-010-020 (Collimator output connector)

Performance

The SuperK COMPACT has a broad spectrum ranging from app. 450 nm up to above 2400 nm. The spectral power density is divided between >20% power in the visible part of the spectrum and <80% power in the IR spectrum. A typical output spectrum (limited to 2400nm by the measurement equipment) is presented in figure 1.1.

![Graph of spectral performance of SuperK COMPACT](image)

Figure 1.1: Typical spectral performance of the SuperK COMPACT.

As performance may vary between individual laser units, please refer to the SuperK COMPACT test reports for specific information on laser output performance.

It is recommended to keep this manual in connection with the SuperK COMPACT unit for operator reference.
Section 2: Laser Safety

Introduction

Never attempt to switch on or operate the SuperK COMPACT before reading, understanding and fully familiarizing yourself with the contents of this chapter.

2.1 General information and designated use

The NKT Photonics SuperK COMPACT™ is classified as a Class 3B laser product as per the IEC/EN 60825-1:2014 laser safety standard and complies with FDA 21CFR 1040.10 and 1040.11 except for deviations provided in laser notice 50 (June 2007).

2.2 Intended usage

The SuperK COMPACT has been designed for general laboratory use and is as such not approved nor tested for use in treatment or diagnostics of human or animals and does not comply with European, US or rest of the World requirements for medical device lasers. Neither is the system appropriate for outdoor use or use in extreme conditions such as elevated/lowered temperatures, particle/chemical contaminated environment or vacuum conditions.

2.3 Laser Safety Officer

The SuperK COMPACT should only be used by staff familiar with laser safety procedures and in facilities appropriate for laser operation. NKTP recommends appointing a Laser Safety Officer (LSO) in accordance with valid local and national safety regulations. The LSO should ensure that every user of the system is familiar with the safety aspects of the laser unit and that the manual should be clear and present to operators of the laser. Furthermore, any other staff in close proximity of the SuperK COMPACT should be aware of any risk in connection with usage of the unit.

2.4 Labels used on the SuperK COMPACT

The SuperK COMPACT is equipped with a range of labels with dedicated information regarding safety and product information. Please take time to identify each label on the SuperK COMPACT before using it for the first time.

Figure 2.1: The side of the SuperK is labeled with laser warning label and explanatory label
The warning label placed on the side of the laser alerts the user:
- This product is a Class 3B laser.
- The unit emits visible and invisible laser radiation from the optical output, marked on the front panel.
- Avoid direct exposure to the beam.

![Laser Aperture Image]

Figure 2.2: The output fiber contains a warning label placed 10 cm from the output connector.

The warning label placed on the armored output fiber alerts the user of the laser aperture at the end of the output fiber.

![Collimator Image]

Figure 2.3: The output collimator contains a warning label.

The warning label placed on the output collimator alerts the user of emission of radiation from the output end of the collimator.

Avoid eye or skin exposure to direct or scattered radiation. Always wear safety goggles matched for the wavelength spectrum while operating the laser. Make sure that there are no reflective materials in the path of the beam.

Warranty labels

There are 2 warranty labels. One is placed on the cover and the other on the collimator. If any of the seals are broken, removed or otherwise damaged, warranty on the SuperK COMPACT will be void. For service or support on the system, please refer to section 7.3: Technical support.

![Warranty Void Label Image]

Figure 2.4: Warranty void label placed on the cover of the SuperK COMPACT.
A label identifying the part number and serial number of the SuperK COMPACT is placed on the side of the top cover. Please refer to this label whenever contacting NKTP for service or support.

![Serial number identification label](image)

**Figure 2.5: Serial number identification label**

The label contains the following information:

- Manufacture of the system
- Product description
- Product number
- Product serial number
- Manufacturing date
- Regulatory compliance

### 2.3 Safety hazards

The output laser beam from the SuperK COMPACT can cause a number of hazards if not handled correctly. The following potential hazards should be considered:

- Fire hazard
- Skin burn
- Eye injury

Care should especially be taken when using a SuperK COMPACT with collimated output beam as the beam will pose a potential fire and skin/eye hazard over a larger distance than when using a COMPACT unit with FC connector output.

#### Fire Hazard

The laser beam can cause fire if the full beam or even just parts of the beam is obstructed or guided towards flammable materials such as paper, solvents or other similar combustible material. Keep the beam path free from any such parts and keep a fire extinguisher in close range of the operation area of the SuperK COMPACT.

#### Skin burn

Even though the SuperK COMPACT is only a Class 3B laser unit, focused IR light from the unit could cause potential skin burn. Avoid any contact between laser beam and skin or wear appropriate skin protection if operation close to the beam is required.

### 2.4 Laser safety goggles

Due to the broad band nature of the SuperK source it is not possible to achieve full protection from the output laser light using laser safety goggles. However, a significant level of protection can be achieved by choosing appropriate type of laser goggle and follow some simple rules of laser safety:

- Always wear laser goggles when operating the output beam in free space (e.g. using free space optics like mirrors and beam splitters/filters).
- Always have a controlled beam path and investigate any possible reflections/stray light.
- Always ensure secure positioning of the output connector (PC or collimator connector).
- Avoid any reflecting parts close to the beam path which is not a part of a specific setup.
- Avoid any easily flammable parts close to the beam path (e.g. lens tissue and solvents).

NKT Photonics recommend using a combination of several different filter-technologies (absorption and interference). Absorption filters can be edge filters as well as band pass filters. Only the combination of these filters makes it possible to solve complex requirements for broadband light source laser applications. The IR5D filter from NoIR Laser Company, LLC is among the most suitable products available. Full protection is not achieved, but many alternatives are significantly worse.

Figure 2.6 depicts the optical density of the IR5D filter indicating the transmission of visible green light.

![Figure 2.6: Optical density as function of wavelength for the IR5D filter](image)

### 2.5 Laser safety compliance list

**CE approval**

The SuperK COMPACT is CE-marked and has been tested for FCC and VCCI compliance as well.

**FDA Compliance**

The SuperK COMPACT complies with FDA part 1040.10 and 1040.11 except for deviations provided in laser notice 50 (June 2007).

**UL and CSA**

The equipment is not UL- or CSA approved.

### 2.6 Supply power

The SuperK COMPACT must be supplied with 100 – 240 VAC through a standard power cable with an IEC type C13 appliance plug, and must be connected to protective earth through this cable. A cable is supplied with the SuperK COMPACT, but it may be exchanged with a compatible type, compliant with the local regulations.

**Main Power Switch**

With the power cable inserted into the socket on the back panel the SuperK COMPACT is turned ON by means of the main power switch on the front panel. A green LED indicating "POWER ON" turns on as well as the display on the front panel.
2.7 Key Switch

The SuperK COMPACT is equipped with a key switch on the front panel. The key must be switched to the ON position before laser light can be emitted. Whenever the unit is not in use, the key should be removed and kept in a safe place. The laser unit cannot be operated when the key is in the OFF position and the key cannot be removed whenever it is in the ON position.

2.8 Remote Interlock

A remote interlock safety system is provided with the SuperK COMPACT to lower the risk of accidental exposure from the laser. An interlock socket is located on the reverse side of the SuperK module. The socket is to be used together with a remote interlock system e.g. a door interlock or similar. The principle connection diagram of the interlock is shown in Figure 2.9.

The external bus socket also placed on the back panel can be used to connect accessories to the module. External interlocks placed on these accessories are connected to the module through the external bus. If a SuperK Accessory is not present, the laser cannot be operated unless the supplied interlock defeater for external bus (External Bus Terminater) is inserted in the external bus port. See figure 2.7.

![Interlock Defeater for External Bus (External Bus Terminater)](image)

**Figure 2.7: Interlock Defeater for External Bus (External Bus Terminater)**

**LEMO**

The SuperK COMPACT is delivered with a LEMO connector Type 0B to interface to the interlock connection.

![LEMO Type FGG.0B.302 connector for interlock socket.](image)

**Figure 2.8: LEMO Type FGG.0B.302 connector for interlock socket.**

**Operation**

**Inserting the LEMO connector:**

Push the connector into the socket until the locking mechanism ‘clicks’. The red dot on the connector and socket indicates the correct orientation.

![Inserting the LEMO Connector](image)

**Figure 2.10: Inserting the LEMO Connector**
Disengaging the connector:
Grab the connector by the sliding release sleeve (the textured area) and pull it away from the socket. The release sleeve will slide over the main body of the connector and accordingly disengage the locking mechanism.

![Image of LEMO interlock connector](image)

**Figure 2.11: Removing the LEMO interlock connector**

**Warning**

The two leads of the LEMO connector must be closed through an external interlock. Due to safety, if the interlock circuit is not closed the laser will not operate. If the interlock connections are left open they will prevent the laser from operating.

It is **not** recommended to operate the laser without an appropriate interlock connection to e.g. a door or enclosure around the system. If users bypass this safety feature, NKT Photonics bears no responsibility on damage, loss or harm caused by accidental laser exposure.

**Safety interlock**

The remote interlock circuit operates on 5V D.C. The total resistance (including cable and switch) should not exceed 40 Ω. Typical signal current in remote circuit is 43 mA.

Interlock circuit specifications:

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage range:</td>
<td>Min. 0 V; max. 12 V</td>
</tr>
<tr>
<td>Voltage, operational (Norm):</td>
<td>5 V</td>
</tr>
<tr>
<td>Current, operational (Nom):</td>
<td>43 mA</td>
</tr>
<tr>
<td>Short circuit current (Max):</td>
<td>80 mA</td>
</tr>
</tbody>
</table>

![Diagram of interlock system](image)

**Figure 2.9: Principle connection diagram for a remote interlock system in connection with a SuperK COMPACT.**

Figure 2.9 shows a diagram of a simple remote switch interlock system. When the switch is open (A) the electrical circuit is open, and the laser emission is shut off.
When the switch is closed (B) the circuit is closed and it is possible to have laser emission. The remote switch interlock enhances safety, as it shuts off laser emission if the door switch to the room or enclosure where the system is located is opened.

If the interlock circuit is opened during operation, the interlock circuit must be reset before laser emission can be initiated again.

The Interlock cable can be up to 5 meters long and it can be a non-shielded type. If a cable longer than 5 meters is required, we recommend using a shielded type of cable.
Section 3: Equipment description and installation

3.1 Installation

**Unpacking**
Upon unpacking the system, please allow time for the module to reach ambient temperature conditions before installation as the module may have a temperature outside the specified temperature range due to transportation.

**Installation**
Install the SuperK COMPACT in a horizontal position resting on all four feet placed underneath the unit. There should be at least 7.5 cm (or 3 inch) of free space in front and behind the unit. This is to ensure access of cables and allow airflow for cooling. Do not stack anything on top of the unit. Keep the unit away from warm or cold sources.

**Electrical connection**
The SuperK COMPACT requires access to a power socket and a power cable with an IEC type C-13 plug. No other connections are required in order to operate the SuperK COMPACT.

3.2 Operating conditions
The SuperK COMPACT is specified to operate in the range of 15-30°C in a non-condensing environment. The output fiber should not be coiled to less than 10 cm diameter. Do not expose the units to vibrations or mechanical shock during operation.
3.3 Front Panel

The SuperK COMPACT can be operated entirely via the front panel interface.

![Front panel of the SuperK COMPACT system.](image)

---

<table>
<thead>
<tr>
<th>(A) On / Off SWITCH</th>
<th>Turns the electrical power on/off to the laser.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(B) KEY SWITCH</td>
<td>Enables/disables interlock or laser emission from the SuperK COMPACT. The key must be turned to “ON” for the SuperK COMPACT to be able to emit light.</td>
</tr>
<tr>
<td>(C) SELECTION WHEEL</td>
<td>Used to navigate the control menus.</td>
</tr>
<tr>
<td>(D) CONTROL BUTTONS</td>
<td>Three control buttons are present on the front panel. The Return button, the Emission button, and the Enter button.</td>
</tr>
<tr>
<td>(E) INDICATOR LEDS</td>
<td>Three indicator LEDs are present on the front panel. The green power LED will light when power is supplied to the module; the red emission LED will light when emission is on; the yellow pulse overrun LED will light when the current pulse width cannot support the set frequency.</td>
</tr>
<tr>
<td>(F) DISPLAY UNIT</td>
<td>System information display. See Section 5 for details.</td>
</tr>
<tr>
<td>(G) OUTPUT FIBER</td>
<td>The output fiber is a non-linear crystal fiber with a 0.20 NA (@1060nm). The fiber is terminated with either an FC/PC, FC/APC connector, or a collimator unit. A black fiber boot indicates an FC/PC connector and a green fiber boot indicates an FC/APC connector. The non-linear crystal fiber is placed in an armored jacket in case of a collimated output.</td>
</tr>
</tbody>
</table>
3.4 Rear Panel

The rear panel of the SuperK COMPACT contains access for communication, power, interlock connection and trigger input/output.

![Rear panel of the SuperK COMPACT system.](image)

**Figure 3.2: Rear panel of the SuperK COMPACT system.**

<table>
<thead>
<tr>
<th>(A) Power socket</th>
<th>100V-240V/50Hz-60Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td>(B) Interlock socket</td>
<td>Connector for interlock cable (LEMO connector)</td>
</tr>
<tr>
<td>(C) USB</td>
<td>USB interface. See Section 6 for details</td>
</tr>
<tr>
<td>(D) External Bus</td>
<td>Sub D-15 connection to SuperK Accessories or Interlock Defeater for External Bus (Bus Terminator)</td>
</tr>
<tr>
<td>(E) Coax trig input</td>
<td>BNC connector for coaxial external trigger</td>
</tr>
<tr>
<td>(F) Industrial trig input</td>
<td>Input for isolated external trigger</td>
</tr>
<tr>
<td>(G) Logic pulse output</td>
<td>BNC output port for logic signal with the laser frequency</td>
</tr>
<tr>
<td>(H) Analog pulse output</td>
<td>BNC analog output signal of pulse emission signal</td>
</tr>
<tr>
<td>(I) RS-232</td>
<td>Port for communication via RS-232</td>
</tr>
</tbody>
</table>
Section 4: Operation and System Menu

4.1 Precautions

Warning

Make sure at all times during system operation, that the beam path is known and controlled. Wear suitable protection and ensure everyone in the laser area is aware that the system is in operation. Ensure that remote interlock is in place.

The SuperK COMPACT is not equipped with a back reflection isolator. Make sure to minimize external back reflections into the laser. External back reflections can compromise performance and ultimately damage the laser.

4.2 Laser operation

Use the following procedure to turn on the SuperK COMPACT once it is installed (see section 3.1):

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The power switch and key switch are set to “OFF”.</td>
</tr>
<tr>
<td>2</td>
<td>Connect the interlock cable (LEMO connector) to the socket labeled “Interlock” on the back panel as described in section 2.8.</td>
</tr>
<tr>
<td>3</td>
<td>Connect the power cable to the connector labeled “100V - 240V, 50 Hz - 60 Hz” on the rear panel.</td>
</tr>
<tr>
<td>4</td>
<td>Remove dust protection cap from the fiber connector and be aware of the light path out from it. Insert into appropriate connector fixture (FC adaptor or Collimator receptacle).</td>
</tr>
<tr>
<td>5</td>
<td>Consider cleaning the fiber facet before operation using appropriate fiber cleaning methods. Please refer to section 8: Service.</td>
</tr>
<tr>
<td>6</td>
<td>Turn on the Power by means of the main power switch on the front panel. The LED for &quot;POWER&quot; will turn ON (green) and the display will show the message: “Key switch off”.</td>
</tr>
<tr>
<td>7</td>
<td>Turn the key switch clockwise. The display will show the message: “Reset interlock : [ ]”</td>
</tr>
<tr>
<td>8</td>
<td>Press the Return button [ ]. The display will show the message : “Laser off”. The laser is now ready for operation.</td>
</tr>
<tr>
<td>9</td>
<td>Turn on emission by pressing the emission button. The emission LED will turn on (Red). Light is emitted from the laser.</td>
</tr>
</tbody>
</table>

Table 4.1: Step-by-step procedure for turning on the system.
The SuperK COMPACT may be operated in different modes. Table 4.2, 4.3, 4.4 and 4.5 describes the operating procedures for the different operating modes.

The laser can run with internal trigger mode. The resolution of the different modes is dependent on the maximum frequency available and the hardware. If a more precise setting of frequency/repetition rate is wanted, the laser must be run in external trigger mode. To operate the laser using the internal trigger mode use the following procedure:

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Follow steps 1-8 in table 4.1. The laser emission is off and the display shows the message “laser off”.</td>
</tr>
<tr>
<td>2</td>
<td>Press enter to enter the system menu, then select “operating mode”.</td>
</tr>
<tr>
<td>3</td>
<td>From the operating mode menu select “internal trigger”.</td>
</tr>
<tr>
<td>4</td>
<td>From the operating mode menu select “frequency” and set the frequency using the selection wheel and enter button.</td>
</tr>
<tr>
<td>5</td>
<td>Leave the system menu by pressing the Return button [→].</td>
</tr>
<tr>
<td>6</td>
<td>Turn on emission by pressing the emission button. The emission LED will turn on (Red). Light is emitted from the laser.</td>
</tr>
<tr>
<td>7</td>
<td>To turn off emission press the emission button.</td>
</tr>
<tr>
<td>8</td>
<td>It is also possible to change the repetition rate during emission.</td>
</tr>
</tbody>
</table>

Table 4.2: Operating in internal trigger mode.
Use the following procedure to operate the SuperK COMPACT using the external trigger:

<table>
<thead>
<tr>
<th></th>
<th>Check that the external trigger source delivers a trigger signal between 0-4 volt with a frequency less or equal to the maximum laser frequency.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Connect the external trigger source to the “COAX TRIG INPUT” (see figure 8).</td>
</tr>
<tr>
<td>3</td>
<td>Follow steps 1-8 in table 4.1. The laser emission is off and the display shows the message ‘laser off’.</td>
</tr>
<tr>
<td>4</td>
<td>Press enter to enter the system menu, then select “operating mode”.</td>
</tr>
<tr>
<td>5</td>
<td>From the operating mode menu select “external trigger”.</td>
</tr>
<tr>
<td>6</td>
<td>From the system menu select “Coax trig level” and set the trigger level.</td>
</tr>
<tr>
<td>7</td>
<td>Leave the system menu by pressing the Return button [ ].</td>
</tr>
<tr>
<td>8</td>
<td>Turn on emission by pressing the emission button. The emission LED will turn on (Red). Light is emitted from the laser.</td>
</tr>
</tbody>
</table>

**Table 4.3: Operating in external trigger mode.**

Use the following procedure to operate the SuperK COMPACT using the external trigger burst mode:

<table>
<thead>
<tr>
<th></th>
<th>Check that the external trigger source delivers a trigger signal between 0-4 volt.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Connect the external trigger source to the “COAX TRIG INPUT” (see figure 3.2).</td>
</tr>
<tr>
<td>3</td>
<td>Follow steps 1-8 in table 4.1. The laser emission is off and the display shows the message ‘laser off’.</td>
</tr>
<tr>
<td>4</td>
<td>Press enter to enter the system menu, then select “operating mode”.</td>
</tr>
<tr>
<td>5</td>
<td>From the operating mode menu select “external triggered burst”.</td>
</tr>
<tr>
<td>6</td>
<td>From the system menu select “Coax trig level” and set the trigger level.</td>
</tr>
<tr>
<td>7</td>
<td>From the system menu select “Burst pulses” and set the number of pulses.</td>
</tr>
<tr>
<td>8</td>
<td>From the operating mode menu select “frequency” and set the frequency using the selection wheel and enter button.</td>
</tr>
<tr>
<td>9</td>
<td>Leave the system menu by pressing the Return button [ ].</td>
</tr>
<tr>
<td>10</td>
<td>Turn on emission by pressing the emission button. The emission LED will turn on (Red). Light is emitted from the laser.</td>
</tr>
</tbody>
</table>

**Table 4.4: Operating in external trigger burst mode.**
Use the following procedure to operate the SuperK COMPACT using the external gate mode:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Check that the external trigger source supplies a trigger signal between 0-4 volt.</td>
</tr>
<tr>
<td>2</td>
<td>Connect the external trigger source to the &quot;COAX TRIG INPUT&quot; (see figure 8).</td>
</tr>
<tr>
<td>3</td>
<td>Follow steps 1-8 in table 4.1. The laser emission is off and the display shows the message 'laser off'.</td>
</tr>
<tr>
<td>4</td>
<td>Press enter to enter the system menu, then select &quot;operating mode&quot;.</td>
</tr>
<tr>
<td>5</td>
<td>From the operating mode menu select &quot;external gate on&quot; or &quot;external gate off&quot;</td>
</tr>
<tr>
<td>6</td>
<td>From the system menu select &quot;Coax trig level&quot; and set the trigger level.</td>
</tr>
<tr>
<td>7</td>
<td>From the operating mode menu select &quot;frequency&quot; and set the frequency using the selection wheel and enter button.</td>
</tr>
<tr>
<td>8</td>
<td>Leave the system menu by pressing the Return button [ ]. The display will show the selected frequency and number of pulses in the burst.</td>
</tr>
<tr>
<td>9</td>
<td>Turn on emission by pressing the EMISSION button. The emission LED will turn on (Red). Light is emitted from the laser when the trigger level is high (low).</td>
</tr>
</tbody>
</table>

Table 4.5: Operating in external gate mode.

Please refer to section 6.1 for further information on the different operating trigger modes like software burst mode etc.

**Warning**

When operating at low repetition rate changing to a higher repetition rate a “Pulse Overrun” situation may occur. E.g. changing from 1 kHz to 20 kHz could momentarily trigger a “Pulse Overrun” situation due to the sudden change in pulse acquisition. If this is observed, it is recommended to increase the repetition rate in smaller steps of e.g. 5 kHz. In generally if a “Pulse Overrun” situation is encountered it is recommended to turn down the repetition rate until the “Pulse Overrun” warning disappears.

This can also happen in some variation of burst mode settings. We recommend to lower the number of pulses or lower the rep rate.

Continuously “Pulse Overrun” warning in internal trigger mode will require service from NKTP HQ.
4.3 SuperK COMPACT with FC output connector

Handling and connecting the fiber output connector (FC/PC or FC/APC).

The FC/(A)PC connector is provided as a convenient means of terminating the fiber and allowing the use of standard receptacles or holders to launch the light via free space into other optical components/equipment.

**Warning**

*It is emphasized that if the SuperK connectorized fiber is mated to another connectorized component, then there is an increased risk of damage to the connector. This is because the SuperK COMPACT will deliver significant peak power from the fiber and any loss, dirt or stress in the connector due to mating, can promote damage.*

**The exit fiber and the connector is NOT covered by the warranty.**

It is not guaranteed that this damage can be avoided, if connector mating is used, but one can reduce the risk by adhering to the following:

**Cleaning facet**

Before connecting the output, please ensure that the fiber facet is clean and free of dust particles. A dirty fiber facet, may result in severe damage to the fiber facet resulting in a significantly distorted beam profile. Dust from the fiber facet may be removed be a number of approved fiber cleaning methods. Lens cleaning tissue (lint free wipes) or similar appropriate material may be applied.

4.4 SuperK COMPACT with collimated output

The SuperK COMPACT can also be supplied with an armored fiber delivery, terminated by a collimator, see figure below. The collimator consists of two parts:

- Collimator housing: outer diameter 28 mm
- Collimator tube: outer diameter 12 mm

![Figure 4.3: The optical output with collimator.](image)

**Warning**

*Do not open the collimator. This might destroy the entire laser system. The warranty is void if the collimator is opened.*

**Warranty Sign**

The output collimator is equipped with a “Warranty Void if removed” sign (figure 4-4). The sign indicates that the collimator should under no circumstances be attempted to be taken apart. There are no serviceable parts inside the collimator.

![Figure 4.4: Warranty Void sign on collimator](image)
The output beam is collimated with an achromatic lens to maximize coupling of light into a single mode fiber. However, with a single lens it is impossible to simultaneously maximize the coupling at all wavelengths of the output spectrum. Per default the coupling is optimized for maximum average coupling across the visible spectrum. Consequently, the beam is slightly larger for the infrared than for the visible wavelengths; see table below for details.

<table>
<thead>
<tr>
<th>Wavelength</th>
<th>Beam size at collimator</th>
<th>Distance from collimator to where beam has expanded to 1 cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>600 nm</td>
<td>Approx. 1 mm</td>
<td>Approx. 4 m</td>
</tr>
<tr>
<td>1500 nm</td>
<td>Approx. 3 mm</td>
<td>Approx. 6 m</td>
</tr>
</tbody>
</table>

*Table 4.6: Beam size after collimator for two wavelengths*

**Fixation of collimator**

During operation the collimator must be fixed for safety. For best performance, we recommend the SuperK collimator holder (part no. A000-000-002) shown below. If using other holders, we recommend gentle fixation on the collimator tube using plastic screws instead of metal screws to minimize risk of scratches on the collimator.

*Figure 4.5: NKT Photonics collimator holder, part no. A000-000-002*

**Warnings**

*If the collimator is scratched it might not fit into the collimator input in the SuperK accessories.*

A small fraction of the beam power is absorbed in the collimator by stray light. If the thermal contact between the collimator and the surroundings is poor, the collimator can become significantly warmer than the surroundings. Thus, it is recommended to enable firm thermal contact between the collimator and the surroundings.
Section 5: Display messages

5.1 Warning and error messages

Before and during operation, the SuperK COMPACT laser will show various messages in the display. Some of these indicate errors or other circumstances that prevent the unit from functioning - others are merely information to the operator. The warnings, alarms and messages are explained below.

<table>
<thead>
<tr>
<th>Message</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emission</td>
<td>Emission is on. Emission LED activated (red).</td>
</tr>
<tr>
<td>Laser off</td>
<td>Emission is off. Emission LED off.</td>
</tr>
<tr>
<td>Door interlock</td>
<td>Emission is not possible, because the external interlock loop is open. Check the external interlock loop connected by the LEMO connector at the interlock socket (see Figure 3.2).</td>
</tr>
<tr>
<td>External interlock</td>
<td>Emission is not possible, because the external interlock loop through the external bus port is open. Check the Bus Termination. If an Accessory is connected to the bus, it can be an opening in the interlock circuit on the Accessory. Check the external bus interlock loop.</td>
</tr>
<tr>
<td>Key switch off</td>
<td>Emission is not possible, because the key switch is set to ‘OFF’.</td>
</tr>
<tr>
<td>Interlock opened while emission is on</td>
<td>Emission stopped, because the interlock opened while emission is on. This can be caused be either of the above.</td>
</tr>
</tbody>
</table>

Table 5.1: List of common display messages
Section 6: Trigger input and remote connection

6.1 Trigger operating modes

The selected operating mode determines when and how often the light source generates an optical pulse. The operating mode can be selected in the front panel menu or via the USB/RS-232 port.

Most operating modes use some additional settings: Frequency (repetition rate) and/or Burst count. These can be altered in the front panel menu or via the USB/RS-232 interface.

Internal trigger

The light source emits pulses at the user selected repetition rate. The resolution of the different modes is dependent on the maximum frequency available and the hardware. Trigger inputs are not used.

External trigger

One of the trigger inputs are used for triggering optical pulses. One optical pulse is generated for each electrical trig pulse.

Software burst

The light source emits a specified number of pulses (Burst count) at the specified repetition rate only when ordered to do so by an external host via the USB or RS-232 interface.

Externally triggered burst

When the light source senses a positive edge on one of the trig inputs, the light source emits a specified number of pulses (Burst count) at the specified repetition rate.

External gate on

When one of the trig inputs receives a logic "high" signal, the light source emits pulses continuously at the specified repetition rate, until the trig signal goes low. The light source may emit one extra pulse after the trig signal has gone low.

External gate off

When both of the trigger inputs receives a logic "low" signal, the light source emits pulses continuously at the specified repetition rate, until one trigger signal goes high. The light source may emit one extra pulse after the trig signal has gone high.

Note:

Although most of the operating modes can be used to keep pulses from being generated, the light source must still be regarded as having emission on. Stopping pulses by using the trig signals in a certain way, is not considered a safe way to keep emission off.
6.2 Remote interface connection

A USB and an RS-232 interface is located on the backside of the SuperK COMPACT unit for communication with the unit through a computer. The serial communications port on the SuperK COMPACT is a standard USB port, designed for connecting to a standard PC USB-port. In order to connect the SuperK COMPACT to a computer for remote operation please use a standard USB cable with A to B connectors as indicated in figure 6.1. For RS-232 operation use a D-Sub9 connector with standard RS232 pin out.

![Figure 6.1: USB Cable A to B](image)

SuperK CONTROL

If you are interested in communicating with the laser system using as computer, we recommend the NKT Photonics CONTROL software. CONTROL is compatible with all latest generation NKT Photonics lasers and accessories. The software can be located on our webpage for download.

SDK

If you are interested in communicating with the laser system using the remote interface, a special software development kit (SDK) is available. The software can be located on our webpage for download.

6.3 External Trigger input

The trigger inputs are used for all modes except the Internal Trigger and Software Burst modes. The function of the trigger signal depends on the mode that is used. In order to accommodate most applications, there are two different kinds of inputs. The operator selects which input to use by applying a trig signal to one input, and nothing to the other. Signal is trigged on rising edge.

**Warning**

Do not attempt to trigger with a signal above 200 kHz as this may slow down performance of the SuperK COMPACT due to firmware limitations. The output repetition rate will also be limited by the maximum repetition rate of the system.

6.4 Coax trigger input

The coax trig input is a logic input with a 50 Ω impedance. The actual trig level (the voltage level at which the light source is triggered) is adjustable from the front panel menu (or the SuperK CONTROL), from 0 to +4 V. There is a hysteresis of approximately 1 %, to reduce noise sensitivity.

- **Input impedance:** Nom. 50 Ω
- **Input voltage (peak):** Min. −7 V; max. 7 V
- **Input power (RMS):** Max. 0.8 W / 29 dBm
6.5 Industrial trigger input

This input is isolated electrically from the light source, which allows the operator to connect the input to a wide variety of equipment. The input voltage range is high, and the input impedance is considerably higher than the coax trig input impedance. However, this input is not as fast as the coax trig input. The trig voltage level is fixed (not adjustable).

- Minimum pulse width: 5 µs
- Max. input voltage (RMS): ± 30 V
- "On" signal threshold (max): + 3.9 V
- "Off" signal threshold (min): + 1.18 V
- Input impedance @ 5 V: ≈ 1.7 kΩ
- Input impedance @ 24 V: ≈ 1.45 kΩ
- Isolation voltage: 350 V
- Connector type: 5.08 mm terminal connector

6.6 Logic and analogue pulse output

Two types of output trigger are available: an analogue trigger output signal and a logic trigger output signal.

**Analogue output**

The analog pulse output is an amplified representation of the optical signal, while the logic pulse is a digital representation of the analogue signal generated subsequently. This may be used for detection of optical pulses, with minimum timing jitter, i.e. for timing critical purposes.

- Pulse width: ≈ 10 ns
- Pulse voltage: System dependant (max. 2 V)
- Output impedance: 50 Ω
- Connector type: BNC

**Logic output**

The logic pulse output generates a positive logic signal whenever the light source emits an optical pulse. This can be used for triggering and pulse counting.

- Pulse width (min): 1 µs
- Pulse voltage (nom): ≈ 2.5 V @ 50 Ω load
- Low-level output voltage (nom): 0 V
- Output impedance: 50 Ω
- Connector type: BNC
Section 7: Service & Support

7.1 Service and storage

General service
There are no user serviceable components inside the SuperK. In case of malfunction, NKT Photonics should be consulted.

The unit is sealed with a label "WARRANTY VOID IF REMOVED". There is a potential risk of damage to the unit and/or personnel if this is compromised. It is therefore strictly prohibited to remove the chassis cover.

A SuperK COMPACT should be returned to NKTP for service in its original casing or similar. When in doubt, contact Technical Support prior to packaging.

Cleaning of the Chassis
If cleaning of the SuperK unit is required the chassis may be cleaned with a damp cloth. Do not use solvents for cleaning the chassis.

Storage
If required the SuperK COMPACT should be stored in a dry and cool place. The optical output should be protected using supplied caps. Avoid exposing the unit to any vibrations or mechanical shocks.

7.2 Fiber tip cleaning

Fiber tip cleaning
Only use cleaning tools that are specifically designed to be used with optical fibers. Always use extreme caution when cleaning fibers.

Examples of appropriate cleaning tools are lens cleaning tissue (lint free wipes) as shown in figure 7.1 or an Optical Fiber Cleaning Tool as shown in figure 7.2.

Figure 7.1: Lens cleaning tissue (lint free wipes).

Figure 7.2: Example of an Optical Fiber Cleaning Tool.

Signs of damage
Signs of a damaged fiber facet may be one of the following:

- Power suddenly decreases (from e.g. 100 mW to 60-70 mW)
- The spectrum (as recorded from an Optical Spectrum Analyzer) is
significantly degraded compared to the original spectrum found in the measurement report.
- Light from the facet is not emitted in the usually hexagonal pattern but rather in a random pattern with a large variation in colors (see Figure 7.3).

![Correct and Incorrect Beam Profiles](image)

Figure 7.3: **Left:** Correct beam profile. The emitted beam has a noticeable hexagonal shape. **Right:** Incorrect beam profile as a result of a damaged fiber facet. Emitted beam is random in direction and colors.

If the fiber facet is damaged the connector must be re-polished before operation of the SuperK COMPACT can continue. Failing to do so could result in incorrect measurements/usage or even damage to the laser unit itself.

**Warning**

Please note that the fiber from the SuperK COMPACT is a Photonic Crystal Fiber (PCF). Thus the connector should NOT be removed, as special equipment and procedures are required to mount a new connector onto the fiber.

**Polishing**

The end of the fiber is collapsed at a length of 150-200 micron. Thus, there is room to polish the fiber end, but one has to be careful not to over polish and we recommend to send the unit for repair to do this. The procedure is:

1) Clean the connector and carefully polish the connector end shortly.
2) Clean the connector and then switch the source on. Observe the exit beam on a screen. If it is not a nice single mode emission, re-polish another short time.
3) Continue this "quick polish, check beam" process until a nice beam is obtained.

If one does not obtain a nice beam regardless, then the connector might be damaged. In this case, the unit should be returned to NKT Photonics for repair. Please note that this type of repair is not covered by warranty.

### 7.3 Technical support

NKT Photonics can be contacted for technical information regarding issues with use of the SuperK COMPACT or associated accessories.

**Contact information:**

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

Phone (general): +45 4348 3900
Fax (general): +45 4348 3901

E-mail: [mailto:support@nkt photonics.com](mailto:support@nkt photonics.com)
Section 8: Specifications of the SuperK COMPACT

8.1 Electro-mechanical Specifications

**Environmental**
- Temperature, operating: 15-30 °C
- Temperature, storage, non condensing: 5-50 °C
- Humidity, non condensing: 20-80 % RH

**Power**
- Power consumption, nominal with no accessories connected: 40 W
- Power consumption, maximum: 150 W
- Line: 100 – 240 VAC
- Frequency: 50-60 Hz
- Fuses (5 × 20 mm): Type: T 2A, 250 V

**Weight**
- 3,5 kg

Table 8.1: Electro-mechanical specifications

8.2 Optical Specifications

- Min. Total Output Power: > 110 mW
- Min. Visible Output Power (450-850 nm): > 25 mW
- Wavelength range: 450 – 2400 nm
- Spectral Stability (600-1040 nm): < 0.12 db/hr
- Spectral Stability (1100-1500 nm): < 0.14 dB/hr
- Max. Repetition rate: > 20 kHz
- Output Pulse Length: < 2 ns
- Length of out fiber cable: 1.6 ± 0.1 m

Table 8.2: Optical specifications
8.3 System dimensions

Dimensions: All dimensions in mm
SuperK SPLIT allows the SuperK spectrum to be divided into two spectral outputs. In its standard form, the SuperK SPLIT provides two outputs: Visible and nIR. However, the choice of the split in the spectrum can be user-defined to be anywhere in the SuperK spectrum. Additionally, standard mounts within the SPLIT allow the insertion of narrow band filters, polarisers or attenuators at each output exit for further flexibility.

SuperK CONNECT is a high performance fiber delivery system complete with broadband fibers and a range of termination options such as FC/PC connectors or collimators. Interfacing is handled by the CONNECT fiber coupling unit that ensure easy and stable single-mode coupling that can be disconnected and reconnected without alignment.

SuperK VARIA is a cost effective and flexible alternative to a monochromator, effectively turning the SuperK into a powerful single-line laser with a 440 nm tuning range and variable bandwidth. The center wavelength of the pass band can be tuned between 400 and 840 nm and the bandwidth is variable between 10 and 100 nm, making the VARIA the most flexible filter solution on the market. Increasing the bandwidth of the filter increases power throughput and reduces speckle in imaging applications. Moreover, a high out-of-band suppression of 50dB makes the SuperK VARIA ideal for FLIM and other applications using high sensitivity detectors.

SuperK SELECT is a tunable wavelength filter based on acusto-optic tunable filter technology (AOTF). AOTFs tune over one octave of optical frequency and the SuperK SELECT allows the integration of two AOTF crystals to provide wide spectral coverage. Together with a range of unique features, the SuperK SELECT provides an easy to use, flexible and accurate tuning accessory to access any wavelength in the SuperK spectrum.

LLTF Tunable High Contrast Filter is a continuously tunable high-resolution bandpass filter that effectively converts a NKT Photonics’s supercontinuum source into a widely tunable picosecond laser. The filter transmits, with high efficiency, a single laser line while blocking unwanted lines with excellent out-of-band suppression.

The SuperK EXTEND-UV is a deep-UV supercontinuum spectral extension unit for our SuperK EXTREME and COMPACT supercontinuum lasers. Get tunable UV light from a robust fiber laser source with 270-480 nm range and 2-80 µW output power.