This product is protected by intellectual property rights including one or more of the following granted or pending patents:

**Patents**

US7,809,029, US7,792,408, AU1007999, AU731781, B1.007.999, CA2.279.420, CH1.007.999, GE69.838.840.2, DK1.007.999, F10.07.999, UK1.007.999, IRE1.007.999, LUX1.007.999, Mon1.007.999, P1.007.999, S1.007.999, US6,151,429, AU736,870, AU772980, CA2.310.316, GE1040375, F1040375, UK1040375, US6,449,293

**Patent applications**

CA2.570.544, C2.0058.002.1131.7, EP05.754.189.8, N 20,070,420

Laser safety compliance:

IEC 60825-1:2007

FDA (Food & Drug Administration): 21CFR 1040.10 and 1040.11 (except for deviations pursuant to Laser Notice 50, dated June 24, 2007)

FDA accession number #1420147-000
# Table of Contents

1. General........................................................................................................................................................................ 4
2. Laser Safety ................................................................................................................................................................... 5
2.1 General Safety Aspects ............................................................................................................................................... 5
  2.1.1 Basic Operation and Use ...................................................................................................................................... 5
  2.1.2 Organizational Measures ....................................................................................................................................... 5
  2.1.3 Selection and Qualification of Personnel – Basic Responsibilities ................................................................. 6
  2.1.4 Safety Instructions Governing Specific Operational Phases .............................................................................. 6
2.2 Specific Safety Aspects ............................................................................................................................................. 7
  2.2.1 Physical Hazards ................................................................................................................................................... 7
  2.2.2 Personnel Safety .................................................................................................................................................. 8
  2.2.3 Constructive Safety Features ............................................................................................................................... 10
  2.2.4 General Safety Features .................................................................................................................................. 10
2.3 Safety Compliance List ............................................................................................................................................. 10
2.4 Labeling ................................................................................................................................................................. 11
  2.4.1 Labels used on Koheras ACOUSTIK (Non-Multiplexed version) .................................................................. 11
  2.4.2 Labels used on Koheras ACOUSTIK (Multiplexed version) .......................................................................... 12
  2.4.3 Labels used on Koheras ACOUSTIK (Common to Multiplexed and Non-Multiplexed version) .................. 13
  2.4.4 Label Positions .................................................................................................................................................. 14
3. Requirements ............................................................................................................................................................ 15
  3.1 Room Requirements ............................................................................................................................................. 15
  3.2 Operating Conditions ............................................................................................................................................ 15
4. Installation ................................................................................................................................................................. 16
5. Interface ................................................................................................................................................................. 19
  5.1 Front Panel ............................................................................................................................................................ 19
    5.1.1 Mains Switch .................................................................................................................................................... 19
    5.1.2 Key Switch ..................................................................................................................................................... 19
    5.1.3 USB Connection .............................................................................................................................................. 20
    5.1.4 Emission Button ........................................................................................................................................... 20
    5.1.5 LEDs ............................................................................................................................................................ 21
    5.1.6 Slots for Sub-modules ................................................................................................................................... 22
  5.2 Back Panel ......................................................................................................................................................... 23
    5.2.1 Mains Input .................................................................................................................................................... 23
    5.2.2 Interlock ......................................................................................................................................................... 24
    5.2.3 Ethernet Connection ........................................................................................................................................ 26
    5.2.4 Modulation .................................................................................................................................................... 27
    5.2.5 External Bus .................................................................................................................................................. 28
    5.2.6 Multiplexed Optical Output ............................................................................................................................ 29
    5.2.7 Heat Sink ..................................................................................................................................................... 30
6. Operation .................................................................................................................................................................. 31
  6.1 Precautions ......................................................................................................................................................... 31
  6.2 Turning ON the Koheras ACOUSTIK .................................................................................................................... 31
7. Computer Controlled Operation .............................................................................................................................. 32
8. Service .................................................................................................................................................................... 33
9. Electrical and Mechanical Specifications .............................................................................................................. 34
  9.1 System Dimensions (Non-Multiplexed version) ................................................................................................. 35
  9.2 System Dimensions (Multiplexed version) ........................................................................................................ 36
1 General

Introduction

Please take the necessary time to read this manual. It contains important information on safety issues concerning the usage of the Koheras ACOUSTIK multi channel frame with Koheras fiber lasers.

The safety might be seriously impaired if the instructions are not followed carefully.

This manual covers the Koheras ACOUSTIK multi channel frame, with the product numbers beginning with K852.

Depending on its configuration the Koheras ACOUSTIK comprises either a Class 3B (non-multiplexed) or a Class 4 (multiplexed) laser, and only persons who are familiar with laser safety regulations are allowed to operate any of these systems.

WARNING: invisible radiation emitted from this laser.

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

If you have any questions concerning this product, please do not hesitate to contact us at support@nktphotonics.com.

Description

Koheras ACOUSTIK is a multi channel frame designed to hold multiple Koheras BASIK fiber laser modules. Please refer to the Koheras BASIK K1x2 Instruction manual for more information about the individual fiber laser modules.

The Koheras ACOUSTIK frame is designed to be flexible so that modules can be removed or added as required by the application. Modules can be plugged in easily from the front without the need for access from any other sides.

This manual covers two types of Acoustik frames: a frame for a non-multiplexed multi-channel source in which the output from each BASIK module is directly accessible, and a different type of frame where the channels are multiplexed onto a single fiber. The non-multiplexed version is a class 3B laser device, whereas the multiplexed version is a class 4 laser.

Typical applications include seismic sensing such as oil and gas exploration and exploitation, security (perimeter and pipeline detection), and structural health monitoring.

A PC application is available for monitoring and control of the Koheras ACOUSTIK and plugged-in sub-modules. Please refer to the software manual for more information about how to use the graphical user interface.

It is recommended to keep this manual in the area close to the Koheras ACOUSTIK system, so operators if required can use it as reference book.
2 Laser Safety

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

Introduction

This chapter is divided into four sections:

- **General Safety Aspects**
  Explains aspects relating to the safe operation of the laser device. See section [General Safety Aspects](#).

- **Special Safety Aspects**
  Outlines the risks specific to working procedures with and on this laser device. See section [Specific Safety Aspects](#).

- **Safety compliance list**
  See section [Safety Compliance List](#).

- **Overview of safety-relevant labels**
  Shows the design and describes the safety labels. See section [Labeling](#).

- **Laser goggles.**
  See section [Laser protective goggles](#).

2.1 General Safety Aspects

2.1.1 Basic Operation and Use

**Basic Safety**

The Koheras ACOUSTIK has been designed in accordance with state-of-the-art standards and the recognized safety rules. Nevertheless, its use can constitute a risk to the user or third parties or cause damage to other material property.

The Koheras ACOUSTIK system is not approved nor tested for use in treatment or diagnostics of human and animals and does not comply with European, US or Rest of World requirements for medical device lasers.

Warning: Potential eye and skin burns! Only use the laser according to the procedures described in this manual. Using the laser outside the scope of this manual is not covered by the warranty.

The Koheras ACOUSTIK must only be used in perfect condition and according to the procedures described in this manual.

Follow the instructions in this manual, and let only safety conscious persons, who are fully aware of the risks involved, operate the Koheras ACOUSTIK.

Any functional disorders, especially those affecting the safety of the Koheras ACOUSTIK, must be rectified immediately.

2.1.2 Organizational Measures

**Laser Safety Officer**

In accordance with the valid national regulations for prevention of accidents, the user is required to appoint a responsible person as the Laser Safety Officer (LSO).

His responsibility is to effect the knowledgeable evaluation of laser hazards and to monitor and enforce their control.

The instruction manual must always be at hand where the Koheras ACOUSTIK is used. In addition to the operating instructions, observe and instruct the user in all other generally applicable legal and other mandatory regulations relevant to accident prevention.
Protective Equipment

These compulsory regulations also deal with the issuing and/or wearing of personal protective equipment. The necessity of reading the instruction manual applies especially to persons working only occasionally on the KOHERAS ACOUSTIK.

Use protective equipment, wherever required by the circumstances or by law.

Warning: Risk of serious injury through incorrect operation! Personnel entrusted to operate the Koheras ACOUSTIK must have read the instruction manual and in particular the safety instructions.

Safety Labels

Ensure that all safety-relevant labels are attached to the laser device in accordance with the label location diagrams in Section Labeling and local regulations. Make sure that these labels are always complete and perfectly legible.

If any labels are missing, immediately inform NKT Photonics A/S. In the event of safety relevant modifications or changes in the behavior of the Koheras ACOUSTIK during operation, stop the laser device immediately and report the malfunction to NKT Photonics A/S.

Never make any modifications, additions or conversions which might affect safety. This also applies to the installation and adjustment of safety devices.

2.1.3 Selection and Qualification of Personnel – Basic Responsibilities

Qualified Personnel

Make sure that only authorized personnel work on or with the Koheras ACOUSTIK. Statutory minimum age limits must be observed. Employ only trained or instructed staff and set out clearly the individual responsibilities of the personnel for operation and set up.

2.1.4 Safety Instructions Governing Specific Operational Phases

Precautions

Take the necessary precautions to ensure that the Koheras ACOUSTIK is used only when in a safe and reliable state.

In the event of malfunctions, stop the laser device immediately and lock it. Have any defects rectified immediately.

Before starting the Koheras ACOUSTIK ensure that nobody is at risk. Brief operating personnel before beginning special operations, and appoint a person to supervise the activities. Ensure that the operations area is adequately secured.
2.2 Specific Safety Aspects

Specific safety aspects are:

- Physical hazards related to the system. See Section Physical Hazards.
- Protection of the users of the system against these hazards. See Section Personnel Safety.
- Constructive protective measures against these hazards. See Section Constructive Safety Features.

Lasers and laser systems are classified according to their relative hazards. These devices have been classified under the international Standard IEC 60825-1:2007 and meet 21CFR 1040.10 and 1040.11 (except for deviations pursuant to Laser Notice 50, dated June 24, 2007).

Within this classification, the Koheras ACOUSTIK is either a Class 3B or a Class 4 (high power) laser (depending on configuration), and must therefore be regarded as a potential hazard to the human operator. The laser beam from a Class 4 laser must also be regarded as a potential fire hazard. Class 4 is the most powerful (and potentially hazardous) category of lasers. Direct and scattered radiation from Class 4 products is considered an acute hazard to the eyes and skin. Precautions include eye and skin protection, remote interlocks and warning labels.

2.2.1 Physical Hazards

Warning
The laser beam is very dangerous to the eyes and skin!

The following are hazardous,
- Direct radiation-light as it leaves the laser.
- Reflected radiation-light which has hit a surface and bounced off.
- Diffuse radiation-light, which has hit a surface, bounced off, and scattered.

Emitted Light
In case of malfunction the Koheras ACOUSTIK may provide laser radiation with power levels up to 5 Watt for multiplexed systems and up to 500 mW per individual channel in non-multiplexed systems. The operating wavelength is between 900 nm to 2100 nm. Despite the non-ionizing nature of the operating wavelengths, damage can still occur to living tissue as a result of heat produced during radiation absorption. All radiation of the Koheras ACOUSTIK lies outside the visible range. Suitable beam dumps must be used at all times when the laser product is operating.

In general, the maximum permissible radiation exposure for the skin is several times greater than for the eye. Safety measures with regard to the radiation hazard are therefore mainly based on dangers for the eye. Not only are the direct laser beam hazardous, but unchecked reflections of laser light also constitute a potential hazard.
2.2.2 Personnel Safety

Personnel Protection

The Koheras ACOUSTIK is a Class 4 laser or a Class 3B laser depending on its configuration.

Warning:
Risk of serious injury! Always wear protective eyewear when there is a chance of exposure to radiation from the laser. Before putting on the protective eyewear, check them for any obvious defects. As the filter in the protective eyewear provides protection for only a narrow band of wavelengths, make sure you are wearing the appropriate protective eyewear for the laser device in question. Check with your Laser Safety Officer or other safety personnel for guidance in selecting the appropriate eyewear.

Radiation Safety

The Koheras ACOUSTIK emits high power near-infrared radiation (900-2100 nm), which constitutes a hazard to personnel during periods of operation.

Protective Eyewear

The ANSI (American National Standards Institute) standard for safe use of lasers requires that a set of protective goggles blocking the appropriate laser wavelength should be worn while operating or servicing Class 4 lasers.

Clearly label the goggles with an optical density and the specified wavelength. To avoid confusion, keep these goggles separate from other safety glasses and personal protective equipment.

Using the wrong type of goggles is dangerous. It can be worse to have improper eyewear and a false sense of security than to have no eyewear and take precautions based on the absence of protection. Even if you are wearing protective goggles, never look directly into the beam; intense laser radiation is capable of destroying the protective filter.

Eye Protection

Warning:
Potential eye burns! Only use the laser according to the procedures described in this manual. Safety interlocks are only to be overruled by authorized personnel.

The following guidelines describe some of the actions necessary to avoid injury caused by the laser beam. Always follow these guidelines and take additional precautions if necessary.

- When eyewear is necessary, make sure it provides full protection, that is, it must have sufficient optical density (OD) to reduce exposure from an enabled laser beam (either direct beam or specular reflection) to a level below the maximum permissible exposure (MPE. The MPE and OD requirement must be evaluated for each enabled laser beam).
- Laser eyewear protection must be labeled with wavelength-dependent OD information.
- Make sure that all personnel in the vicinity of the laser wear protective eyewear.
- Permit only qualified personnel to operate the laser.
- Never intentionally look directly into any laser beam.
- Avoid indirect viewing of direct or reflected laser radiation. Specular reflections (from reflective surfaces) can be as dangerous as the direct laser beam. Do not view the beam through optical instruments unless the optics is designed to filter the laser wavelength.
- Take precautions to ensure that there are no reflecting objects in the path of the laser beam.
- Do not deviate from standard operating procedures when working with laser equipment.
- Use lasers only in approved applications and locations. Take adequate precautions to prevent unauthorized personnel from entering the area.
where a Class 4 laser is operating. Do not use lasers around untrained personnel. Ensure that all personnel in the area observe proper safety precautions.

- Report all incidents of exposure to your supervisor.
- Clearly display warning signs indicating the laser enclosed area with an additional warning light outside the door.
- Adhere to local and national regulations governing the safe use of lasers.

Depending on system variant the Koheras ACOUSTIK system provides infrared laser emission between 900 and 2100 nm. Protective eyewear must provide sufficient protection for these wavelengths. The laser protective goggles must provide minimum OD 3+ protection.

A suggestion for protective eyewear could be goggles with FG1 filter from LaserShield. More information can be found at: http://www.noirlaser.com/filters/fg1.html

**Skin Protection**

**Warning:**
Potential skin burns! Direct and reflected laser radiation can burn exposed skin. Only use the laser according to the procedures described in this manual. Safety interlocks are only to be overruled by authorized personnel.

- Although the skin can withstand considerably higher radiation intensity than the eyes, tissue may be burned to a greater or lesser degree, depending on the radiation time and the irradiation intensity.
- Avoid contact between the skin and the beam, or specular reflections of the beam. Reflections of the beam may be as dangerous as the beam itself. Wear appropriate protective clothing to protect the skin whenever necessary.

**Fire Protection**

**Warning:**
Fire hazards! Class 4 lasers are, by definition, fire hazards. The laser beam can cause flammable materials to ignite or explode. Always keep a fire extinguisher in the laser area in case a fire occurs.

Because of the high output power from the Class 4 laser, a wide range of materials can be set on fire. Therefore, take appropriate fire prevention measures when the beam path is open:

- Combustible materials may be ignited by the laser beam or by electrical components inside the laser system. Flammable items must be isolated from the laser beam and from the laser system.
- Paper (circuit diagrams, leaflets, or even posters on the wall), curtains that are not coated with fire retardant, wooden panels or similar materials can be easily set on fire by direct or reflected laser radiation.
- Use only beam stops made of non flammable materials (not asbestos!).
- Many fluids and solvents (e.g. cleaning agents used for maintenance) are combustible. The intense beam of the laser can ignite vapors from these materials. Prevent the laser beam from contacting flammable materials used in the laser area.
- Move containers of flammable materials as far from the laser system as possible and shield them from the beam with opaque materials. Never place these solutions and vapors in the beam path or near the system.
2.2.3 Constructive Safety Features

Safety Features

The laser device is equipped with the following constructional safety features:

- Appropriate Class 4 or Class 3B label affixed to laser device enclosure (see section Labeling).
- All parts of the laser where laser radiation may possibly escape are marked with the appropriate adhesive danger signs (according to IEC 60825).
- The Koheras ACOUSTIK is provided with a connector ("Interlock") on the back panel of the laser housing, where an external interlock switch can be installed. The interlock switch shuts down the laser remotely, for instance, if a door connected with the switch is opened.

2.2.4 General Safety Features

General Safety

The Koheras ACOUSTIK has key-switch controlled laser operation. The laser device can only be switched on with the key-switch. This prevents inadvertent or unauthorized starting of the laser. It cannot be operated with the key in the OFF position and the key cannot be removed in the ON position.

2.3 Safety Compliance List

CE Approval

The Koheras ACOUSTIK is CE-marked and complies with FCC and VCCI as well.

FDA Approval

The Koheras ACOUSTIK complies with FDA part 1040 except for deviations provided in laser notice 50.

UL and CSA Approval

The equipment is not UL- or CSA-approved. The system does not have a main inlet and no voltages inside the system are higher than 60 VDC (nominal).
2.4 Labeling

This section contains a description of the safety labels on the Koheras ACOUSTIK and shows their location on the equipment. Ensure that all warning labels are affixed to the system as outlined in this chapter prior to operating the system.

The Koheras ACOUSTIK contains the following labels:

- Invisible Classification label, figure 2-1 (non-multiplexed) & 2-3 (multiplexed)
- Specification label, figure 2-2 (non-multiplexed) & 2-4 (multiplexed)
- Laser label, figure 2-5 (common)
- Item label, figure 2-6 (common)
- Laser Aperture label, figure 2-7 (common)

2.4.1 Labels used on Koheras ACOUSTIK (Non-Multiplexed version)

Invisible

The invisible classification label warns about invisible laser radiation emitted from the Koheras ACOUSTIK system. The non-multiplexed version of the Koheras ACOUSTIK is a Class 3B laser product. Exposure to eye and skin must be avoided from both direct and scattered radiation.

![Invisible Classification label](image)

Figure 2-1: Invisible Classification label

Specification

The Specification label provides information about what kind of laser emission is radiated from the Laser Aperture and that the Koheras ACOUSTIK product complies with the IEC 60825-1 standard.

![Specification label](image)

Figure 2-2: Specification label
2.4.2 Labels used on Koheras ACOUSTIK (Multiplexed version)

**Invisible**

The invisible classification label warns about invisible laser radiation emitted from the Koheras ACOUSTIK system. The multiplexed version of the Koheras ACOUSTIK is a Class 4 laser product. Exposure to eye and skin must be avoided from both direct and scattered radiation.

*Figure 2-3: Invisible Classification label*

**Specification**

The Specification label provides information about what kind of laser emission is radiated from the Laser Aperture and that the Koheras ACOUSTIK product complies with the IEC 60825-1 standard.

*Figure 2-4: Specification label*
2.4.3 Labels used on Koheras ACOUSTIK (Common to Multiplexed and Non-Multiplexed version)

**Laser Source**

The Laser label indicates that Koheras ACOUSTIK frame can hold one or multiple laser sources.

![Figure 2-5: Laser label](image)

**Item**

The Item label provides information about:

- the manufacturer of the system (NKT Photonics A/S, Blokken 84, DK-3460 Birkerød)
- a short name of the Koheras ACOUSTIK variant, e.g. ACOUSTIK
- the product number (P/N) for the actual system, e.g. K852-100-000
- the serial number (S/N) for the actual system containing 8 digits, e.g. 13370159
- the design version (Ver), e.g. 01
- when the actual system was manufactured, e.g. 01-2014 for January 2014
- where the product is manufactured, e.g. in Denmark
- that the product is covered by NKT Photonics property rights
- compliance with the EU consumer safety and environmental requirements (CE-mark)
- Laser Notice No. 50, which indicates that the product complies with FDA requirements

![Figure 2-6: Item label](image)

**Aperture Label**

The Laser Aperture label indicates the location of the Laser Aperture. The Laser Aperture label warns users that laser light is emitted from this Laser Aperture.

![Figure 2-7: Laser Aperture label](image)
2.4.4 Label Positions

The positions of safety and item labels on the top cover and back are shown on figure 2-8 and 2-9.

Figure 2-8: Safety labels on the top cover of the Koheras ACOUSTIK

Figure 2-9: Laser Aperture and Item label on the back of the Koheras ACOUSTIK
3 Requirements

3.1 Room Requirements

Mechanical Specs
- For installation, maintenance and transport the Koheras ACOUSTIK requires entrances with inside spans of minimum 700 mm
- Shipment casing: 610 x 650 x 680 (w x h x d) mm

Figure 3-1: Transport casing

Ambient Conditions
- Allowable operating system temperature range: +15°C to +55°C
- Protection from dust (Pollution degree 2, Office environment)
- Allowable relative humidity: 20 to 80 % (non-condensing)

3.2 Operating Conditions

Room Requirements
The Koheras ACOUSTIK frame with its sub-modules is either a Class 3B or Class 4 laser product and the operation room and operation conditions need to comply with the following requirements:
- CFR21 1040.10 & Laser Notice LN50
- IEC / EN 60825-1

Alternatively the Koheras ACOUSTIK should be operated in accordance with local regulations for a Class 3B/Class 4 laser source.

Warning
Make sure that at all times during system operation the beam path is known and controlled. Wear suitable protection and make sure everybody in the laser area is aware of the fact that the system is being operated.

Electrical Supply Requirements
Supply voltage is 100-240 VAC, maximum 240 W per 16 channels.
4 Installation

Unpacking the Koheras ACOUSTIK

Check if the shipment case has any visible damage. Unpack the system according to the description below.

Note

Do not dispose any of the shipment materials as these must be used in case it is required to return the product. The warranty and service only covers if the unit is returned in the original packaging and packed according to the instruction in this manual.

1. Remove the lid of the transport casing.
   a. Use torx bit (T20) enclosed in the shipping folder.

   ![Side view of shipment casing](image)

   **Figure 4-1: Side view of shipment casing**

   b. Unscrew the screws in the top of the box, on the sides of the shipment casing and remove the lid.

2. Open the large cardboard box containing the Koheras ACOUSTIK.

   ![Top view of the Koheras ACOUSTIK in the open cardboard box](image)

   **Figure 4-2: Top view of the Koheras ACOUSTIK in the open cardboard box**

   If multiple Koheras ACOUSTIK systems have been ordered, the large cardboard box can hold up to two 16 channel systems.
Cables, manuals, etc. are located in the cut-out on one side of the cardboard box.

3. Lift the Koheras ACOUSTIK out of the cardboard box.

Please notice that depending on the size of the Koheras ACOUSTIK frame and types and numbers of sub-modules the system weighs from 10 to 40 kg, so be careful when lifting the system. One person should not attempt to lift or carry the system alone. Two persons, one on each side of the shipping box, can lift up the system from the crate.

![Figure 4-3: Koheras ACOUSTIK in plastic bag](image-url)

4. Carefully place the Koheras ACOUSTIK on the position where it is intended to be used. Ensure that the system is positioned solidly without risk of falling down before continuing.

5. Open the plastic bag enclosing the Koheras ACOUSTIK. Carefully remove the plastic bag without bumping the Koheras ACOUSTIK on the table. Remove the Silica Gel Desiccant placed on top of the Koheras ACOUSTIK, which has prevented moisture from getting into the system during shipment.

The Koheras ACOUSTIK is now fully unpacked and the set-up procedure can be initiated.

**Warranty Label**

It is not allowed to open the Koheras ACOUSTIK. The Koheras ACOUSTIK is equipped with a warranty label on the top cover, see figure below. The warranty is void if the system is opened.

![Figure 4-4: Warranty label](image-url)
Rack Mount

The Koheras ACOUSTIK is designed to be installed in a 19" rack. The frame is 3U (units) height. Systems can be placed on top of each other, i.e. in a 42U rack there is room for up to fourteen Koheras ACOUSTIK systems on top of each other.

If a 19" rack is deep enough it could be possible to load a 19" rack with Koheras ACOUSTIK systems both from the front and back and hereby doubling the number of Koheras ACOUSTIK systems in the rack, i.e. theoretically up to twenty-eight Koheras ACOUSTIK systems in a 42 rack.

However as the power consumption increases with the number of Koheras ACOUSTIK systems forced air flow is likely required to pass through the fins of the heat sink on the back of the systems.

Notice

Use all four mounting holes, two on each side, when a Koheras ACOUSTIK frame is installed in 19" rack.

Fans

To generate an air flow fans may have to be installed in the rack. As fans generate vibrations and the Koheras BASIK laser module is sensitive to vibrations, some kind of vibration isolation should probably be considered for the fans.
5 Interface

5.1 Front Panel

The front panel of the Koheras ACOUSTIK contains the following.

![Front panel of Koheras ACOUSTIK](image)

<table>
<thead>
<tr>
<th>Front Panel Functions</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Mains switch</td>
<td>With mains power connected to the back, the mains power can be switched On/Off using the Mains switch on the front. Press ‘I’ in to power on the system and press ‘0’ in to shut down the system.</td>
</tr>
<tr>
<td>B. Key Switch</td>
<td>Laser emission is disabled if the key switch is moved to the ‘Off’ position and cannot be activated again until the key switch is moved to the ‘On’ position. The key switch can also be used for resetting of the Interlock circuit by shifting the key position from Off to On.</td>
</tr>
<tr>
<td>C. USB connection</td>
<td></td>
</tr>
<tr>
<td>D. Emission Button</td>
<td></td>
</tr>
<tr>
<td>E. LEDs</td>
<td></td>
</tr>
<tr>
<td>F. Slots for sub-modules</td>
<td></td>
</tr>
</tbody>
</table>

5.1.1 Mains Switch

Mains Switch

5.1.2 Key Switch

Key Switch
5.1.3 USB Connection

Communication between the Koheras ACOUSTIK and a computer can be made either via Ethernet on the back or USB on the front of the system. If a computer is connected to the Koheras ACOUSTIK via the USB connection on the front, communication cannot be made via the Ethernet connection.

5.1.4 Emission Button

With the Emission button on the front panel emission can be initiated from all internal laser modules. Emission can only be obtained if allowed by the interlock circuit, i.e. an Interlock must be applied to the Interlock input, the Key switch must be in the ‘On’ position and the interlock circuit must be reset, e.g. by toggling the Key switch from ‘Off’ to ‘On’.

When the Emission button is clicked, the Emission LED will switch on immediately (red). For safety reasons actual laser emission will not be obtained until after a 1.5 second delay.

Clicking the Emission button when one or more laser channels are emitting, will shut off laser emission from all channels.
## 5.1.5 LEDs

The front panel holds three LEDs which indicate different states.

![Figure 5-6: LEDs](image)

<table>
<thead>
<tr>
<th>Power</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Off</td>
<td>System is switched off.</td>
</tr>
<tr>
<td>Red</td>
<td>Power supply is not OK. The Power LED emits red light for a short period of time during start-up and powering down.</td>
</tr>
<tr>
<td>Green</td>
<td>Mains power is applied to the system, the system is switched on and power supply is OK.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Status</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orange (flashing)</td>
<td>System mainboard is scanning for available modules plugged into the system and accessories connected to the External Bus.</td>
</tr>
<tr>
<td>Orange</td>
<td>Interlock error or Interlock needs to be reset.</td>
</tr>
<tr>
<td>Off</td>
<td>Interlock is reset but no emission from any modules or firmware is being uploaded to the system mainboard.</td>
</tr>
<tr>
<td>Green (flashing)</td>
<td>Laser emission from sub-modules but one or more modules haven’t stabilized.</td>
</tr>
<tr>
<td>Green</td>
<td>Laser emission from sub-modules and all modules are stabilized.</td>
</tr>
<tr>
<td>Red (flashing)</td>
<td>Firmware is being uploaded to modules plugged into the Koheras ACOUSTIK frame or to the External Bus.</td>
</tr>
<tr>
<td>Red</td>
<td>Either one or multiple sub-modules plugged into the frame have shut down themselves. Other modules/channels will continue to operate, i.e. they will not be shut down by the Koheras ACOUSTIK system mainboard. Alternative the Koheras ACOUSTIK system mainboard has shut down all modules/channels. In both cases use the graphical user interface to see the actual error code.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Emission</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Off</td>
<td>No laser emission from any module plugged into the Koheras ACOUSTIK frame.</td>
</tr>
<tr>
<td>Red</td>
<td>One or more laser channels are switched on and provide laser emission.</td>
</tr>
</tbody>
</table>
5.1.6 Slots for Sub-modules

A 3U Koheras ACOUSTIK frame features 16 slots for internal sub-modules.

Non-Multiplexed System

In non-multiplexed systems the sub-modules are visible and accessible directly from the Koheras ACOUSTIK front.

Figure 5-7: Visible modules in non-multiplexed systems

Multiplexed System

In Multiplexed systems the sub-modules are hidden behind a front cover.

Figure 5-8: Front cover hiding sub-modules in multiplexed systems

Module Addresses

All modules plugged into the Koheras ACOUSTIK must have unique addresses. To ensure this, the system mainboard has a power-up procedure, which gives every module, plugged into the frame their own unique address. The address is determined by the location of the module. Starting from left towards right (seen from the front), the modules are given addresses from 1 and up corresponding to the position of the module in the frame.
5.2 Back Panel

The back panel of the Koheras ACOUSTIK contains the following.

Back Panel Functions

A. Mains input  
B. Interlock  
C. Ethernet  
D. Modulation  
E. External Bus  
F. Multiplexed Optical Output  
G. Heat sink  

5.2.1 Mains Input

Mains Input  
The system is supplied with an IEC type C14 mains inlet for 100-240 VAC, 50/60 Hz power supply. The mains input features two 4AT 250V fuses. The power consumption for a fully equipped Koheras ACOUSTIK frame is maximum 240 W.

Figure 5-9: Back panel of Koheras ACOUSTIK  

Figure 5-10: Mains input connection
**Power Plug**  
Use a power cable, compliant with local regulations, with an IEC type C13 connector in one end to interface with the Mains input on the Koheras ACOUSTIK.

![Power plug](image)

**Earth Connection**  
For personal safety, make sure to provide a power connection with protective earth connection.

**5.2.2 Interlock**

Depending on the configuration of the Koheras ACOUSTIK the system will either be a Class 3B or a Class 4 laser. It is thus equipped with a door switch interlock connection in accordance with the laser safety regulations. The “Interlock” connector on the back panel (connector B, figure 5-8) contains terminals for an external door switch or interlock.

![Interlock](image)

**Warning**  
Due to safety regulations it must be connected to a door switch interlock to prevent accidents.

The figure below shows a diagram of a door switch interlock system. When the door is open (A) the electrical circuit is open, and the laser emission is shut off. When the door is closed (B) the circuit is closed and laser emission is possible.

![Diagram of door switch interlock circuit](image)
The door switch interlock enhances safety, as it shuts off laser emission if the door to the room where the system is located is opened.

**Warning**

Do not short-circuit the Interlock input. This will allow laser emission from the Koheras ACOUSTIK without the door switch interlock, which is against safety regulations. NKT Photonics A/S disclaims liability for any issues arising due to bypassing the Interlock safety mechanism.

**Interlock Plug**

A cable plug for the Interlock connection on the back of the system is provided with the Koheras ACOUSTIK. This plug is a LEMO connector type FGG.0B.302.

![Interlock Plug](image)

**Interlock Power Fail**

Please ensure that there is no short connection from the interlock signals to ground/chassis as this will generate an Interlock power fail, which will disable the system. If there is an Interlock power fail, then switch off the supply voltage, locate the short connection from the interlock signal to ground and remove it. Turn on the Koheras ACOUSTIK system and reset interlock.

**Cable**

The Interlock cable can be up to 5 meters long and it can be non-shielded. If it should be more than 5 meters long, it should be a shielded type of cable.
5.2.3 Ethernet Connection

Ethernet Communication between a computer and the Koheras ACOUSTIK can be made via the Ethernet connection on the back. If a computer is connected to the USB connection on the front, it is not possible to communicate with the Koheras ACOUSTIK via the Ethernet connection.

![Ethernet connection](image)

The system must either be connected directly to a computer via an Ethernet cable (A), or via an Ethernet switch or router (B).

A)

![Ethernet interconnections](image)

B)

MAC and IP Addresses MAC and IP addresses can be read out via the USB connection with the graphical user interface. With the graphical user interface it is furthermore possible to change the IP address via the USB interface.

Cable The Ethernet cable should be shielded.
5.2.4 Modulation

Modulation

The Koheras ACOUSTIK frame has connections for both wavelength and amplitude modulation of sub-modules (this is only effective if these features are actually present in the sub-modules).

For more information about modulation of sub-modules, please refer to their respective instruction manuals.

Modulation Connector

A male 9-pin Sub-D connector is used for the modulation inputs/outputs.

![Modulation Connector Image]

Figure 5-17: Modulation connector

<table>
<thead>
<tr>
<th>Pin no.</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Trigger</td>
<td>Trigger input/output for synchronized modulation of the lasers.</td>
</tr>
<tr>
<td>2</td>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>3</td>
<td>Amplitude-</td>
<td>Negative branch of differential input/output for amplitude modulation.</td>
</tr>
<tr>
<td>4</td>
<td>AGND</td>
<td>Analog ground</td>
</tr>
<tr>
<td>5</td>
<td>Wavelength-</td>
<td>Negative branch of differential input/output for wavelength modulation.</td>
</tr>
<tr>
<td>6</td>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>7</td>
<td>Amplitude+</td>
<td>Positive branch of differential input/output for amplitude modulation.</td>
</tr>
<tr>
<td>8</td>
<td>AGND</td>
<td>Analog ground</td>
</tr>
<tr>
<td>9</td>
<td>Wavelength+</td>
<td>Positive branch of differential input/output for wavelength modulation.</td>
</tr>
</tbody>
</table>

Trigger

For future use.

Amplitude Modulation

The Amplitude+- in the electrical interface is a differential input used for amplitude modulation or power control of the laser. The Amplitude+- pins are input only.

The Amplitude+- input can either be driven by a 2x5 Vpp input signal, where 0 V or below between the two branches will lead to no output power and a positive differential voltage at +5 volt leads to a power level corresponding to the power setpoint. Alternative the negative branch can be tied to ground and the positive branch can be driven between 0 V and +5 V.

Modulation is enabled and disabled via the graphical user interface AcoustiKontrol. It is recommended to disable Modulation when it is not used, as noise may be picked up by the input and hereby create undesired phase noise.

Wavelength Modulation

The Wavelength modulation may serve either as an input or an output. The signal is a differential signal, where a negative voltage leads to a lower wavelength and a positive voltage leads to a higher wavelength.

If it is used as an input, it should be driven by a differential signal with amplitude up to 2x5 Vpp. It is recommended to disable Wavelength Modulation when it is not used, as noise may be picked up by the input and hereby create undesired phase noise.

If it is used as an output, it will be a differential output with amplitude up to 2x5 Vpp and with a common mode voltage at 2.5 V.
Modulation Plug

A female 9-pin Sub-D connector should be used as cable plug for the Modulation connector.

Cable

The Modulation cable can be up to 3 meters long and it should be a shielded type of cable. The shielding must be connected to the housing of the Modulation plug.

5.2.5 External Bus

The External Bus on the back of the Koheras ACOUSTIK system is a digital bus interface and 12 volt supply for external accessories.

---

**Figure 5-18: External Bus connector**

---

**Pin Connections**

The table below provides the pin-out on the External Bus.

<table>
<thead>
<tr>
<th>Pin no.</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NC</td>
<td>Not connected.</td>
</tr>
<tr>
<td>2</td>
<td>RS485-</td>
<td>The negative/inverted part of the RS485 communication signal.</td>
</tr>
<tr>
<td>3</td>
<td>Interlock loop+</td>
<td>Positive connection of interlock loop. Should be connected to Interlock loop- (pin no. 4) to enable laser emission from the system.</td>
</tr>
<tr>
<td>4</td>
<td>Interlock loop-</td>
<td>Negative connection of interlock loop. Should be connected to Interlock loop+ (pin no. 3) to enable laser emission from the system.</td>
</tr>
<tr>
<td>9</td>
<td>Emission</td>
<td>Logic output. High when the Koheras ACOUSTIK system has laser emission ON. With an 240 Ω internal series resistor the Anode from a LED can be connected directly to this pin and the Cathode to GND (pin no. 5,6, 13 or 14) to indicate laser emission externally.</td>
</tr>
<tr>
<td>10</td>
<td>RS485+</td>
<td>The positive/non-inverted part of the RS485 communication signal.</td>
</tr>
<tr>
<td>11</td>
<td>Not in use</td>
<td>For future use. Do not connect anything to this pin.</td>
</tr>
<tr>
<td>12</td>
<td>Interlock</td>
<td>Logic output. High (5V) when interlock circuit is not open and has been reset. This signal can be used to control safety related precautions on the External Bus.</td>
</tr>
<tr>
<td>5, 6, 13, 14</td>
<td>GND</td>
<td>0 volt / ground.</td>
</tr>
<tr>
<td>7, 8, 15</td>
<td>+12 V</td>
<td>+ 12 volt supply voltage for external accessories. Max. 4 A.</td>
</tr>
</tbody>
</table>
External Bus Defeater

If no accessories with bus interface are used, the bus has to be terminated with an External Bus defeater providing a short connection on pin 3 and 4 (Interlock loop).

Figure 5-19: External Bus defeater

Cable

The External Bus can be connected to multiple external accessories. Each External Bus cable length must be 3 meter long or less. All External Bus cables must be shielded.

5.2.6 Multiplexed Optical Output

On Koheras ACOUSTIK systems without optical multiplexing the optical outputs of the individual laser modules are placed at the front of the Koheras ACOUSTIK. On Koheras ACOUSTIK systems with optical multiplexing the multiplexed optical output is located on the back of the system.

Figure 5-20: Multiplexed Optical Output

Output Connector

The optical connector for the multiplexed optical output can be of different types. The part number for the Koheras ACOUSTIK frame indicates which type of optical connector is used in a given frame.

K852-xxx-yyy, where x can be any number and y indicates:
0: No Multiplexed Optical Output
1: FC/APC Multiplexed Optical Output
2: SC/APC Multiplexed Optical Output

Polarization

For PM systems the light is emitted in the slow axis, which is aligned to the key of the connector.

Each optical output features a lid, which provides dust and safety protection when no fiber is connected to the output.

Warning

A clean patch cable with matching connector must always be connected to the output to prevent damage to the optical connector inside the Koheras ACOUSTIK system.
5.2.7 Heat Sink

**Heat Transfer**

The bulk part of the back of the Koheras ACOUSTIK consists of cooling fins for transferring heat from the system to the environment.

The Koheras ACOUSTIK is designed to enable insertion of Koheras ACOUSTIK systems into both sides on a 19” rack, so that systems are physically placed back-to-back for minimum consumption of space.

**Air Flow**

Depending on the number of modules in the Koheras ACOUSTIK frame, how dense Koheras ACOUSTIK systems are placed in a rack, and the ambient temperature, forced air flow of the Koheras ACOUSTIK may be required.
6 Operation

6.1 Precautions

Warning
Make sure at all times during system operation that the laser aperture is at a known and controlled location. Wear suitable protection and ensure everyone in the laser area is aware that the system is being operated. Ensure that door interlock is in place.

Clean Patch Cable
Due to the high power transmitted through the single mode fiber surface of the optical connector(s) it is important to keep the connector face extremely clean. This is particularly important for multiplexed systems, where the power level is higher compared to individual outputs. For this reason a clean patch cable must be connected to the output at all time when used. In this way the connector at the far end of the patch cable is the one that most likely will be exposed to impurities.

Please note which fiber type is used in the laser and match the patch cord accordingly.

Wipe with clean lens tissue soaked in alcohol and dry with another piece of dry clean lens tissue. Keep unit turned off while cleaning.

6.2 Turning ON the Koheras ACOUSTIK

Turning On
Use the following procedure to turn the system on.

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Connect the Interlock according to safety regulations. See the <a href="#">Interlock</a> section.</td>
</tr>
<tr>
<td>2.</td>
<td>Terminate the External Bus with an External Bus Defeater at the last accessory connected to the External Bus. If there is no accessory connected to the External Bus, an External Bus defeater should be put directly on the External Bus connector on the back of the Koheras ACOUSTIK.</td>
</tr>
<tr>
<td>3.</td>
<td>Connect the optical output from the Koheras ACOUSTIK to where it should be used.</td>
</tr>
<tr>
<td>4.</td>
<td>Provide 100-240 VAC connection to the Power input and turn on the supply with the mains switch on the front. The Power LED should turn green.</td>
</tr>
<tr>
<td>5.</td>
<td>The Status LED flashes orange for some seconds. This indicates that the system mainboard scans the digital bus for available modules plugged into the system and accessories on the External Bus. Internal modules are set to have addresses from 1 and up corresponding to its position in the Koheras ACOUSTIK frame. When the scanning and re-addressing is complete the Status LED constantly emits orange light.</td>
</tr>
<tr>
<td>6.</td>
<td>Turn the key switch on the front panel to the 'On' position to reset Interlock and to enable laser emission. The Status LED turns off.</td>
</tr>
<tr>
<td>7.</td>
<td>Clicking on the Emission button will initiate laser emission from all laser channels. The Status LED flashes green light until all modules provides stable laser operation. When all modules have stabilized the Status LED emits constant green light. Optical output power, wavelength, etc. can subsequently be controlled from the graphical user interface.</td>
</tr>
</tbody>
</table>

The Koheras ACOUSTIK is now ready for use.
7 Computer Controlled Operation

**Graphical User Interface**

The Koheras ACOUSTIK can be controlled from a computer via a graphical user interface.

Please refer to the manual for the graphical user interface for details on installing and operating this software.

**Software Development Kit**

The Koheras ACOUSTIK utilizes a binary protocol. For detailed information about how to communicate with the system via this binary protocol, please refer to the NKT Photonics Software Development Kit for details. The Software Development Kit can be requested from NKT Photonics A/S.

**Ethernet Cable**

To connect the Koheras ACOUSTIK to a computer use standard shielded Ethernet cables, see Ethernet section for details.

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*Figure 7-1: Ethernet cable*
8 Service

The Koheras ACOUSTIK does not contain any user serviceable parts. If the system starts to malfunction, consult NKT Photonics A/S. The unit is sealed with a label “WARRANTY VOID IF REMOVED” and the chassis should under no circumstances be opened. This does not, however, affect the fundamental flexibility of the design: Koheras BASIK laser modules can be installed, removed or interchanged freely in the Koheras ACOUSTIK frame according to the requirements of the application.

Battery Removal

Before discarding the Koheras ACOUSTIK, please remove the CR2032 Lithium battery located on the system mainboard under the top cover.
# 9 Electrical and Mechanical Specifications

Specifications below are only for the Koheras ACOUSTIK frame itself. For specifications of sub-modules please refer to their separate specifications.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Conditions</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature range</td>
<td>Heat sink temperature</td>
<td>15 to 50</td>
<td>°C</td>
</tr>
<tr>
<td>Humidity</td>
<td>Non condensing</td>
<td>20 to 80</td>
<td>%RH</td>
</tr>
<tr>
<td>Supply voltage</td>
<td></td>
<td>100 to 240</td>
<td>VAC</td>
</tr>
<tr>
<td>Power consumption</td>
<td>3U chassis with Ext. Bus</td>
<td>Max. 240</td>
<td>W</td>
</tr>
<tr>
<td>Line frequency</td>
<td></td>
<td>50/60</td>
<td>Hz</td>
</tr>
<tr>
<td>Height</td>
<td>See drawing below</td>
<td>130</td>
<td>mm</td>
</tr>
<tr>
<td>Width</td>
<td></td>
<td>483</td>
<td></td>
</tr>
<tr>
<td>Depth</td>
<td>Frame for non-multiplexed system</td>
<td>303/348</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Frame for multiplexed system</td>
<td>381/426</td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>Excluding sub-modules</td>
<td>Approx. 10</td>
<td>kg</td>
</tr>
</tbody>
</table>
9.1 System Dimensions (Non-Multiplexed version)
9.2 System Dimensions (Multiplexed version)