Koheras BOOSTIK HP
CW SLM PM Amplifier

PRODUCT GUIDE
PRODUCT GUIDE
This guide includes the following NKT Photonics Lasers:

Koheras BOOSTIK HP
Continuous Wave Fiber Amplifier
This product guide is intended to provide functional, operational and installation information for the Koheras BOOSTIK HP laser amplifiers. The guide is divided into three chapters:

- **Koheras BOOSTIK HP Description** - introduces the laser, its functionality, interfaces and chassis variants.

- **Operating the BOOSTIK HP Amplifier** – provides information and procedures on how to connect, configure and manage the laser amplifier.

- **Connecting the BOOSTIK HP Amplifier** – includes the details on how to install the laser amplifier and connect optional interfaces.

**Warning:** Do not operate the amplifier (laser) before first reading and understanding all warnings, cautions and handling information stated within the document:

*Koheras BOOSTIK HP Safety, Handling and Regulatory Information*

**Note:** The paper copy of this document is included with your laser however it can also be downloaded from:


**Terminology**

This guide may refer to the Koheras BOOSTIK HP as “the amplifier” or “the laser”. In specific cases where a distinction is required, this guide will use the actual laser model names.

**Target audience**

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

**Chapters inside**

This guide includes the following chapters:

- Chapter I “Description” — Describes the laser including its general operational principles, management and interfaces.

- Chapter 2 “Operating the BOOSTIK HP Amplifier” — Provides information and procedures on how to setup a PC with the laser’s management software and connect it to the laser.

- Chapter 3 “Connecting the BOOSTIK HP” — This chapter provides the information on connecting the safety interlock, power, the optical connections, and the USB RS-232 communications interface.
• Appendices — The guide includes multiple appendices including laser specifications, support contact details, a configuration ID cross-reference and troubleshooting the amplifier.

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

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

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

Warning: The laser safety warning alerts you to potential serious injury that may be caused when using the laser.

Revision
The section records the document revision details.

<table>
<thead>
<tr>
<th>Date</th>
<th>Revision</th>
<th>Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019-11</td>
<td>1.0</td>
<td>First release - documents rewritten and overhauled from earlier releases.</td>
</tr>
<tr>
<td>2020-02</td>
<td>1.1</td>
<td>Added Table 1, “BOOSTIK HP system optical output,” on page 11.</td>
</tr>
</tbody>
</table>
CONTENTS

Guide Overview ................................................................................................................... 3
Terminology ....................................................................................................................... 3
TABLES .................................................................................................................................. 7
FIGURES ............................................................................................................................... 9

1 Description ............................................................................................................................ 11
   Configuration ID ............................................................................................................... 12
   Amplifier features ........................................................................................................... 12
   Front and rear panels .................................................................................................... 13
      Front panel .................................................................................................................... 13
      Rear panel .................................................................................................................... 15
   Optical output .................................................................................................................. 17
   Miscellaneous .................................................................................................................. 17
      Safety ........................................................................................................................... 17
   Managing the amplifier ................................................................................................. 18
      Operations interface .................................................................................................. 18
   Emission LEDs ................................................................................................................. 18
   Chassis labels ................................................................................................................... 19

2 Operating the BOOSTIK HP Amplifier .......................................................................... 21
   Front Panel Operation ................................................................................................... 21
      Switching AC power ON ......................................................................................... 22
      Connect and switch ON the seed laser ................................................................... 22
      Turn the key ON ........................................................................................................ 22
      Set the Amplifier Current Control ......................................................................... 23
      Enable Emission ....................................................................................................... 24
      Disable emission ...................................................................................................... 24
   Status and Alarms ......................................................................................................... 24
      Alarms ......................................................................................................................... 25
   Command Line Operation ............................................................................................. 27
Connecting the PC ................................................................. 27
Launch and connect a terminal window ........................................ 27
Check the amplifier information ................................................. 28
Connect and switch ON the seed laser ....................................... 28
Turn the key ON .............................................................................. 28
Set the Amplifier Current Control ............................................... 28
Enable Emission ........................................................................... 29
Disable emission ......................................................................... 29
CLI Command list ....................................................................... 30
Command syntax ......................................................................... 30

3 Connecting the BOOSTIK HP ...................................................... 31
Connecting the safety interlock ...................................................... 31
Interlock connection ................................................................... 31
Connecting an interlock switch .................................................... 32
Connecting power ....................................................................... 32
USB PC connection .................................................................... 33
Connecting the optical input from a seed laser ......................... 33
Seed input connection .................................................................. 33

A Specifications ............................................................................. 35

B Service and support Information ............................................... 39
Servicing the laser ....................................................................... 39
Opening the laser chassis ........................................................... 39
WARRANTY VOID IF REMOVED Label ..................................... 39
Support contact details ............................................................... 40
Support Email ............................................................................. 40
Online support web-page ............................................................. 40
Shipping address ........................................................................ 40

C Troubleshooting and Errors ....................................................... 41
Troubleshooting .......................................................................... 41
Table 1: BOOSTIK HP system optical output ........................................................................... 11
Table 2: Optical output types ...................................................................................................17
Table 3: Emission LEDs .......................................................................................................... 18
Table 4: Module labels ........................................................................................................... 19
Table 5: CLI terminal emulator settings ...................................................................................27
Table 6: CLI command list ...................................................................................................... 30
Table 7: Pin assignments ......................................................................................................... 31
Table 8: Power specifications .................................................................................................. 32
Table 9: USB-B port pin assignments ..................................................................................... 33
Table 10: Optical specifications ............................................................................................. 35
Table 11: Mechanical dimensions .......................................................................................... 36
Table 12: Operating and storage environment ......................................................................... 36
Table 13: Electrical ................................................................................................................ 36
Table 14: Mechanical dimensions .......................................................................................... 36
Table 15: Safety and regulatory compliances .......................................................................... 36
Table 16: Laser Troubleshooting ............................................................................................. 41
FIGURES

Figure 1: Koheras BOOSTIK HP with Koheras ADJUSTIK seed laser ...................... 11
Figure 2: BOOSTIK HP front panel layout ................................................................. 13
Figure 3: BOOSTIK HP rear panel layout ................................................................. 15
Figure 4: Front panel display and controls ................................................................. 21
Figure 5: BOOSTIK HP initializing ........................................................................... 22
Figure 6: Initialized ................................................................................................... 22
Figure 7: Seed laser on ............................................................................................. 22
Figure 8: Key in ON position ................................................................................... 23
Figure 9: ACC selected ............................................................................................ 23
Figure 10: ACC set to a low current setting ............................................................ 23
Figure 11: ON BLUE LED emission indicator – ...................................................... 24
Figure 12: Selecting STATUS .................................................................................. 25
Figure 13: Status display – no alarms ................................................................. 25
Figure 14: Selecting ALARMS .............................................................................. 25
Figure 15: ALARMS display – Interlock alarm ..................................................... 25
Figure 16: DB-15 pin numbering ............................................................................. 31
Figure 17: Mechanical dimensions ................................................................. 37
Figure 18: Optical output type dimensions ........................................................ 38
Figure 19: Warranty seal ...................................................................................... 39
1 Description

The Koheras BOOSTIK HP system is a Continuous Wave Fiber Amplifier (CW) system. The amplifier produces ultra-bright, near-diffraction-limited, infrared laser light, delivered to a flexible output fiber and collimating optics.

The amplifier contains reliable, high-brightness diode lasers that pump a double-clad, ErYb-doped or Yb-doped optical fiber. Microprocessor controlled electronics power the diode lasers and control the fiber amplifier operation. A heat sink and fan provides the necessary cooling for reliable operation. All components of the amplifier are housed within a rack mountable chassis and includes front panel controls and display.

The Koheras BOOSTIK HP emits TEM00 continuous wave radiation in the 1064nm or 1550nm range with a maximum continuous optical power of 1 to 15 W (depending on model) at nominal current.

The amplifier can be equipped with a Koheras ADJUSTIK laser as part of an integrated Koheras BOOSTIK HP system. The Koheras ADJUSTIK acts as a seed laser when combined with the amplifier. When the amplifier is used in a Koheras BOOSTIK HP system, the laser’s optical output is defined by an ultra-narrow line width in the Hertz range and exceptionally low frequency and intensity noise. These characteristics make the laser suitable for applications such as quantum optics, computing and other phenomena like optical trapping, optical lattice, Bose-Einstein condensate, atom interferometer, and squeezing.

Figure 1 Koheras BOOSTIK HP with Koheras ADJUSTIK seed laser

Note: Other lasers that meet the input optical specifications can also be used as a seed laser with the amplifier.

BOOSTIK HP systems, using the amplifier, have a center wavelength of either 1550.12 nm (E15 model) or 1064.00 nm (Y10 model). However, the system may have a custom center wavelengths in the ranges of either 1550-1570 nm or 1050-1090 nm. The output power of the systems depend on the variant and is listed in Table 1 below.

Table 1 BOOSTIK HP system optical output

<table>
<thead>
<tr>
<th>Model</th>
<th>Optical Output Power (W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>E15</td>
<td>2, 5, 10</td>
</tr>
<tr>
<td>Y10</td>
<td>2, 5, 10, 15</td>
</tr>
</tbody>
</table>
Note: Other applications for a BOOSTIK HP system include using it as a linear optics pump source (SHG, DFG, OPO) and for laser-based metrology.

Configuration ID  Koheras modules are defined by their configuration ID which includes the options. Refer to Appendix F for a list of Koheras BOOSTIK HP configuration IDs.

Amplifier features  The amplifier includes the following key features:

- Interlock and Key switch – shuts the laser off upon unauthorized or accidental access and prevents unauthorized operation.
- Front panel controls and display – operation menu with selection dial and navigation buttons
- Enable/Disable button with emission LED indicator
- Remote PC control – Command Line Interface over a serial USB connection
- FC connectors for both optical input and output
- 19 inch rack mounting flanges with chassis handles
Front and rear panels

Front panel  Figure 2 shows the front panel of a BOOSTIK HP amplifier chassis

Figure 2  BOOSTIK HP front panel layout

USB type B port
Connect the port to a PC to manage the laser from CONTROL.

LED display panel
The display panel provides a control and monitoring interface for the laser. All laser operations can be undertaken using the display.

Enter button
Enters a display panel menu item or confirms a new value for a parameter.

Emission control button
Pressing the button enables or disables emission from all lasers inserted in the chassis. The button features a rectangular blue LED which flashes during amplifier stage warm-up and is continuously ON when emissions are fully enabled.

Warning: When the LED is flashing or ON, dangerous laser emissions are emitted. Take all proper safety precautions necessary. The Koheras BOOSTIK HP Safety, Handling and Regulatory Information document provides multiple safety information that should be adhered to along with applicable regional safety regulations.

Optical output
The optical output for the BOOSTIK HP can be one of the following.
• FC/APC connector
• Collimated FC/APC connector
• Collimator
• Collimator/Isolator assembly

The type of optical output included with the amplifier depends on the amplifier wavelength, power and output number specifications. See “Optical output” on page 17 for further information.

Rack mounting handles
Use the handles as grips when transporting the amplifier or mounting it in a 19 inch equipment rack.

Key switch
The key switch must be ON to enable emission. Turn the key to the OFF position and remove the key to prevent unauthorized laser operation.

**Note:** If the interlock disables the laser the key switch must be cycled to the OFF position and then ON again to reset the safety interlock.

Selection dial
The selection dial moves the front panel prompt between menu items and modifies the amplifier current settings.

Exit button
Exits from a lower level menu to the top menu level.

Optical input
1 meter FC/APC connector pig tail. However the BOOSTIK HP can be specified with multiple outputs and inputs for integration with for example an Koheras ACOUSTIK chassis with multiple Koheras BASIK modules.
**Rear panel**  
Figure 3 shows the rear panel is made up of multiple connectors and a large cooling fin array to maintain the BASIK modules at an optimum operational temperature.

The panel provides connectivity for control signals, safety interlock, accessories, and AC mains.

*Figure 3  BOOSTIK HP rear panel layout*

1. AC mains ON/OFF switch  
2. Cooling fans  
3. Interlock connector  
4. AC mains input

i. Interlock pin assignments – see Appendix Connecting the safety interlock

**Note:** The pin assignments of the Interlock are described in “Connecting the BOOSTIK HP” on page 31.

**AC mains switch**  
Press (1) to turn on the amplifier and (0) to turn it off.

**Cooling fans**  
The fans blow hot air out from the chassis, ensure there is adequate clearance for proper airflow.

**AC mains input**  
AC inlet - standard IEC C-14 mains inlet connector - see “Connecting power” on page 32.

**Interlock**  
Male DB-15 connector – connect to a safety interlock switch which is operated by the access door to the laser operational area. “Connecting the safety interlock” on page 31.

**Warning:** DO NOT BYPASS the interlock by jumping the pins on the connector. Laser regulations require that the interlock is connected to a safety door switch. When the door switch circuit is open the laser is immediately disabled.
**Warning:** The Koheras BOOSTIK HP system has built-in safety relay and interlock features to help ensure laser radiation is emitted only when desired and only when predetermined conditions are met.

The Koheras BOOSTIK HP system has built-in safety relay and interlock features to help ensure laser radiation is emitted only when desired and only when predetermined conditions are met.

The remote interlock and remote stop features render the system inoperable when a predefined condition occurs, such as the opening of a door. The internal safety relay is analogous to a beam shutter. It interrupts drive current to the diode pump lasers, and it is open each time the system is turned on. This means it will be impossible to apply current to the diode pump lasers until you close the circuit and reset the front panel key switch.
Optical output

Optical output can be one of five types. The type used is dependent on the amplifier power level, wavelength and on some models the output number. Refer to Table 2 below for details.

Note: For dimensions of the Optical output types, refer to Figure 18 on page 38.

Table 2 Optical output types

<table>
<thead>
<tr>
<th>Wavelength (nm)&amp; fiber type</th>
<th>Output power (W)</th>
<th>Fiber length (m)</th>
<th>Collimated FC/APC</th>
<th>Collimator only</th>
<th>Collimator with isolator type 1</th>
<th>Collimator with isolator type 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>10xx PM</td>
<td>2</td>
<td>2</td>
<td>◆</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1030 PM</td>
<td>5</td>
<td>2</td>
<td>◆</td>
<td></td>
<td></td>
<td>◆</td>
</tr>
<tr>
<td>1050 PM</td>
<td>5</td>
<td>2</td>
<td>◆</td>
<td></td>
<td></td>
<td>◆</td>
</tr>
<tr>
<td>1064 PM</td>
<td>5</td>
<td>2</td>
<td>◆</td>
<td></td>
<td></td>
<td>◆</td>
</tr>
<tr>
<td>10xx PM</td>
<td>10</td>
<td>1.5</td>
<td></td>
<td></td>
<td>◆</td>
<td></td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>1</td>
<td></td>
<td></td>
<td>◆</td>
<td>◆</td>
</tr>
<tr>
<td>1550-1570 PM</td>
<td>2</td>
<td>2</td>
<td>◆</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>2</td>
<td>◆</td>
<td></td>
<td></td>
<td>◆</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>1.5</td>
<td></td>
<td></td>
<td>◆</td>
<td>◆</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>1</td>
<td></td>
<td></td>
<td>◆</td>
<td>◆</td>
</tr>
<tr>
<td>1550-1570 SM</td>
<td>2</td>
<td>2</td>
<td>◆</td>
<td></td>
<td></td>
<td>◆</td>
</tr>
<tr>
<td>Multiport</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>◆</td>
<td>◆</td>
</tr>
</tbody>
</table>

i. Standard FC/APC connector (non-collimated)

Miscellaneous

Safety

Warning: The lasers output from the chassis is rated as class 4 laser and is therefore hazardous. Before turning on the BOOSTIK HP and connected seed laser, ensure to read and understand all safety statements of the document:

Koheras ACOUSTIK Safety, Handling and Regulatory Information

A paper copy of this document is included with your laser. If you do not have access it, you can download a copy from:

Managing the amplifier

**Operations interface**  
The amplifier is operated either from the front panel or through a Command Line Interface accessible through the USB RS-232 connection on the front panel.

“Operating the BOOSTIK HP Amplifier” on page 21 includes information on how to operate the amplifier with both interfaces.

### Emission LEDs

The Emission Enable/Disable button on the front panel houses an Emission LED LED as described in Table 3. The LED is located in the center of the button as shown in Figure 2.

<table>
<thead>
<tr>
<th>LED Name</th>
<th>Condition</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emission</td>
<td>ON Blue</td>
<td>Laser emission is ON.</td>
</tr>
<tr>
<td></td>
<td>OFF</td>
<td>Laser emission is OFF.</td>
</tr>
</tbody>
</table>

**Note:** DO NOT OPERATE the BOOSTIK HP until you are familiar with the controls and have taken all precautions necessary as described in the document: Koheras BOOSTIK HP Safety, Handling and Regulatory Information.
A Koheras BOOSTIK HP chassis has a number of labels on it that indicate hazards, regulatory, or manufacturing information. The labels are located on the panels described in Table 4.

### Table 4 Module labels

<table>
<thead>
<tr>
<th>Label</th>
<th>Panel</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classification - Emission Hazards</td>
<td>Top</td>
<td>Safety information stating the laser emission hazards and the laser’s class rating.</td>
</tr>
<tr>
<td>Product Information</td>
<td>Top</td>
<td>Safety label showing the emission specifications of the laser.</td>
</tr>
<tr>
<td>Laser Radiation Warning</td>
<td>Front</td>
<td>Safety information alert indicating this area of the laser is near a source of dangerous laser emissions.</td>
</tr>
</tbody>
</table>
2 Operating the BOOSTIK HP Amplifier

A BOOSTIK HP amplifier is controlled and operated using either the:

- Front panel interface – described in “Front Panel Operation” on page 21
  – or –

- Command Line Interface (CLI) from a connected PC – described in “Command Line Operation” on page 27

Front Panel Operation

The front panel features an LED display panel and controls that can be used to configure and operate the laser amplifier, as shown in Figure 4. They include:

- an **LED text display** – displays amplifier current level, optical input power and alarms.

- a **selection dial** – selects between current and status menu items; adjusts the current level.

- **enter and exit buttons** – to enter and exit into and from menu items.

- an **emission button** with blue LED emission indicator – to enable and disable emission

*Figure 4* Front panel display and controls

> **Caution:** DO NOT ENABLE EMISSION UNLESS THE SEED LASER IS CONNECTED and ENABLED. Enabling the amplifier emission without suitable seed laser input may DAMAGE the amplifier.
Switching AC power ON

1. To apply AC power to the amplifier, press the rear AC mains button to the (I) position.

2. The cooling fans should immediately start and the front panel screen will display an initialization screen as shown in Figure 5.

*Figure 5* BOOSTIK HP initializing

![Initialization Screen](image)

Connect and switch ON the seed laser

When the amplifier has initialized, the display shown in Figure 1 indicates there is NO INPUT POWER and the front key switch is (KEY) OFF.

1. Connect the seed laser’s optical output to the optical input of the BOOSTIK HP amplifier (see - “Connecting the optical input from a seed laser” on page 33).

*Figure 6* Initialized

![Initialized Display](image)

2. Enable emission on the seed laser. The Pin (Power input) field in the front panel display shows the received emission power level as shown in Figure 7.

*Figure 7* Seed laser on

![Seed laser on Display](image)

Turn the key ON

1. To reset the interlock and turn on the preamplifier, turn the front panel key to the ON position. The display changes the STATUS field to KEY ON as shown in Figure 7.

**Warning:** With the connected seed laser ON, the Koheras BOOSTIK HP outputs an optical power of approximately 300mW. Avoid eye exposure to the beam.
Front Panel Operation

2. When the key is in the ON position and the input optical power is acceptable for the amplifier, the emission (Enable/Disable) button LED will flash BLUE for 30 seconds during stabilization.

3. After 30 seconds of stabilization, the amplifier is ready for operation.

   **Note:** The emission button LED flashes BLUE when emission is possible ONLY. This means the optical input received by the amplifier is acceptable and the interlock circuit is closed and reset (KEY ON) and no other alarms exist.

Set the Amplifier Current Control

1. Turn the selection dial until the prompt (>) points to the ACC (Amplifier Current Control) setting as shown in **Figure 9**.

2. Press the enter button to select the ACC setting.

3. Turn the selection dial to modify the ACC level. Range 0 to 8.5 amperes.

4. Press the exit button sets the ACC level.

   **Warning:** Use a low current setting when initially operating the laser amplifier in a new application. The current setting can be turned to a higher value once the beam path is determined to be safe.

---

**Figure 8** Key in ON position

**Figure 9** ACC selected

**Figure 10** ACC set to a low current setting
Enable Emission

1. To enable emission, press the emission (Enable/Disable) button on the front panel.

**Caution:** DO NOT ENABLE EMISSION UNLESS THE SEED LASER IS CONNECTED and ENABLED. Enabling the amplifier emission without suitable seed laser input may DAMAGE the amplifier.

**Warning:** Enabling emission from the BOOSTIK HP amplifier will emit hazardous laser Class 4 radiation from the optical output of the chassis. Ensure to observe and implement all safety regulations, warnings and cautions in this guide and the Koheras BOOSTIK HP Safety, Handling and Regulatory Information document before enabling emission.

**Warning:** Even at very low current settings near 0 A, the fiber amplifier may emit an optical beam up to 1.6 W. The level is strongly determined by the amplifier configuration, current level setting and wavelength used.

2. When emission is enabled, the emission button LED flashes BLUE for 10 seconds during warm-up. When warm-up is completed the LED turns ON BLUE, see Figure 11.

**Figure 11** ON BLUE LED emission indicator –

Disable emission

1. To disable emission, press the emission button. The BLUE LED extinguishes and the emission is disabled.

**Warning:** Hazardous emission is still present when the key switch is in the ON position and emission is disabled.

Status and Alarms

The lower field in the front panel display will show either STATUS or ALARM. If STATUS is displayed no ALARMS are existing. If ALARM is displayed an ALARM exists.

**Status display**

1. Use the selection dial and move the prompt (>) to the STATUS field as shown in Figure 12.
Figure 12 Selecting STATUS

2. Press enter to display the idle amplifier current and internal temperature as shown in Figure 13.

Figure 13 Status display – no alarms

Alarm display

1. When an alarm exists, ALARMS is shown on the top menu in the front panel display. Use the selection dial and move the prompt (>) to the ALARM field as shown in Figure 14.

Figure 14 Selecting ALARMS

2. Press enter to display the existing alarms. Figure 15 shows there is an existing interlock alarm.

Figure 15 ALARMS display – Interlock alarm

Alarms Some alarms are permanently checked by the amplifier: INTERLOCK, TEMPERATURES LIMIT and CURRENT LIMIT.

The amplifier signal is automatically stopped when:

- Interlock is not present.
- Ambient temperature is too high.
- Lasers diode temperature (TL) > (TL)max
- Optical core module temperature (TC) > (TC)max
- Laser current > Max CURRENT LIMIT (typical value: 8A)

*Note:* The alarm threshold values are set during the manufacturing process and can only be changed by NKT Photonics. Max CURRENT LIMIT varies with each amplifier, but it is always adjusted to protect the pump diode.
Command Line Operation

The BOOSTIK HP amplifier can be operated remotely using a command line interface (CLI) from a PC connected to the front panel USB serial port.

DO NOT ENABLE EMISSION UNLESS THE SEED LASER IS CONNECTED and ENABLED. Enabling the amplifier emission without suitable seed input may DAMAGE the amplifier.

Connecting the PC

1. Turn the BOOSTIK HP on following the instructions in “Switching AC power ON” on page 22.

2. Using a Type A to Type B connector, connect the PC to the BOOSTIK HP.

3. If you are using Windows, wait for it to install an appropriate driver for the RS-232 Serial USB port. Once the driver is installed, the USB COM port will be available for use.

4. If your PC cannot automatically install an appropriate RS-232 USB driver, install a driver such as CDM2.04.06.exe or similar.

5. When the PC connects over USB, the front panel display on the amplifier will show “Remote Control”.

Launch and connect a terminal window

Your PC requires a terminal emulator to connect to the BOOSTIK HP and issue CLI commands.

1. Launch the terminal emulator and use the settings in Table 5 to connect it to the BOOSTIK HP amplifier.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baud rate</td>
<td>9600</td>
</tr>
<tr>
<td>Data bits</td>
<td>8</td>
</tr>
<tr>
<td>Parity</td>
<td>N</td>
</tr>
<tr>
<td>Stop bits</td>
<td>1</td>
</tr>
<tr>
<td>Flow control</td>
<td>N</td>
</tr>
<tr>
<td>End of line characters</td>
<td>CR + LF</td>
</tr>
<tr>
<td>Local echo</td>
<td>ON</td>
</tr>
</tbody>
</table>

2. In the terminal emulator window, press ENTER, a question mark (?) prompt should appear as below indicating you are connected to the BOOSTIK HP:

?
Check the amplifier information

1. Issue the command: “CDI”. The amplifier should respond with the NKTP serial number of the unit.

```
? 
CDI
NKT1900008 
?
```

Connect and switch ON the seed laser

1. Connect the seed laser’s optical output to the optical input of the BOOSTIK HP amplifier (see - “Connecting the BOOSTIK HP” on page 31).

2. To display the input power, issue the command: “CMP 1”, to the amplifier:

```
CMP 1
192 
?
```

3. “192” shown above is the input power, which is in units of $10^{-4}$ amperes.

Turn the key ON

1. To reset the interlock and turn on the preamplifier, turn the front panel key to the ON position.

   **Warning:** With the connected seed laser ON, the Koheras BOOSTIK HP outputs an optical power of approximately 300mW. Avoid eye exposure to the beam.

2. After 30 seconds of stabilization (flashing BLUE emission LED), the amplifier is ready for operation

   **Note:** The emission button LED flashes BLUE when emission is possible ONLY. This means the optical input received by the amplifier is acceptable and the interlock circuit is closed and reset (KEY ON) and no other alarms exist.

Set the Amplifier Current Control

1. Enter the ACC command to set the current level set point in the BOOSTIK HP. The command is issued with a current value as a parameter:

```
ACC .1
0.10 
?
```

   **Note:** When entering ampere values below 1 omit the leading zero before the decimal point.

2. Check the ACC set point value after modifying it by issuing the ACC command without a parameter:

```
ACC 
```
Command Line Operation

0.10
?

**Warning:** Use a low current set point when initially operating the laser amplifier in a new application. The current set point can be turned to a higher value once the beam path is determined to be safe.

### Enable Emission

1. To enable emission, issue the “CDO” command with the enable parameter “1”:

   CDO 1

   1

   ?

   **Caution:** DO NOT ENABLE EMISSION UNLESS THE SEED LASER IS CONNECTED and ENABLED. Enabling the amplifier emission without suitable seed laser input may DAMAGE the amplifier.

### Warning:

Enabling emission from the BOOSTIK HP amplifier will emit hazardous laser **Class 4** radiation from the optical output of the chassis. Ensure to observe and implement all safety regulations, warnings and cautions in this guide and the *Koheras BOOSTIK HP Safety, Handling and Regulatory Information* document before enabling emission.

### Warning:

Even at very low current settings near 0 A, the fiber amplifier may emit an optical beam up to 1.6 W. The level is strongly determined by the amplifier configuration, current set point and wavelength used.

2. When emission is enabled, the emission button LED flashes BLUE for 10 seconds during warm-up. When warm-up is completed the LED turns ON BLUE, see Figure 11.

### Disable emission

1. To disable emission, issue the “CDO” command with the disable parameter “0”:

   CDO 0

   0

   ?

2. The BLUE emission LED extinguishes and the emission is disabled.

3. Check that the BOOSTIK HP is disabled using the command “CDO” without any parameter:

   CDO

   0

   ?
If the BOOSTIK HP is disabled the CLI will return a “0”.

**Warning:** Residual emission is still present.

---

**CLI Command list**

Along with the commands previously used, status information can also be retrieved. **Table 6** lists all commands available with the CLI.

**Table 6  CLI command list**

<table>
<thead>
<tr>
<th>Command</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACC</td>
<td>(0.0 to 8.5)</td>
<td>No parameter – displays the set point current level. With parameter – modifies the set point in Amperes. (ACC mode)</td>
</tr>
<tr>
<td>AMC</td>
<td>–</td>
<td>Displays the actual current level while enabled.</td>
</tr>
<tr>
<td>AMT</td>
<td>1</td>
<td>Displays the temperature of the diode/booster.</td>
</tr>
<tr>
<td>CMA</td>
<td>–</td>
<td>Displays the ambient temperature.</td>
</tr>
<tr>
<td>CMP</td>
<td>1</td>
<td>Displays the input optical power level.</td>
</tr>
<tr>
<td>CDO</td>
<td>(0,1)</td>
<td>No parameter returns the amplifier enable status. 1 enables the amplifier i.e. ON, and 0 disables it i.e. OFF.</td>
</tr>
<tr>
<td>CDI</td>
<td>–</td>
<td>Returns the amplifier information.</td>
</tr>
</tbody>
</table>

i. Parameters in parenthesis are optional

**Command syntax**

Commands are entered at the CLI “?” prompt and issued to the BOOSTIK HP by pressing the ENTER.

If a parameter is required, a space must separate the parameter from the command.
Connecting the BOOSTIK HP

This chapter focuses on the relevant details of electrical and optical connections to the amplifier.

For information on connecting:

- the Safety Interlock – see “Connecting the safety interlock” on page 31.
- power – see “Connecting power” on page 32.
- PC to BOOSTIK HP communications – see “USB PC connection” on page 33.
- Seed laser input – see “Connecting the optical input from a seed laser” on page 33.

Connecting the safety interlock

To comply with safety regulations and help provide a safe operating environment, the safety interlock of the BOOSTIK HP chassis must be connected to a switch activated by an access door to its operating area. The interlock circuit detects when the door switch opens and immediately disables emission.

**Interlock connection**

The door interlock circuit is connected to the female DB-15 connector on the rear panel (see Figure 3). Connect the circuit to the pins shown in table x.

<table>
<thead>
<tr>
<th>Table 7</th>
<th>Pin assignments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin #</td>
<td>Description</td>
</tr>
<tr>
<td>1</td>
<td>Interlock ground</td>
</tr>
<tr>
<td>9</td>
<td>Interlock</td>
</tr>
</tbody>
</table>

i. Pins positions shown in the figure below.

**Figure 16** DB-15 pin numbering

![DB-15 pin numbering](image)

**Caution:** Do not short-circuit the Interlock input. Short-circuiting the interlock circumvents safety regulations and NKT Photonics does not take liability for any injuries or damage caused by doing so.
Caution: The switch connected to the interlock must be of an approved type. Further, the switch must be installed in a manner so that its operation cannot be fixed in the open state using a tool.

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

Connecting an interlock switch

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

**Procedure 1** Connecting the door interlock circuit

<table>
<thead>
<tr>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Install a switch that opens when the door accessing the BOOSTIK HP enclosure is opened. The switch must comply with safety regulations.</td>
</tr>
<tr>
<td>2 Use a cable with a maximum wire length of five meters and at a minimum 26 AWG, connect the switch to the rear DB-15 interlock connector. For cable lengths longer than five meters, it is recommended to use shielded cable.</td>
</tr>
</tbody>
</table>
| 3 Perform a continuity test using a multimeter:  
  - First connect the multimeter leads to the interlock plug terminals.  
  - Confirm when the enclosure door is closed, the meter shows the circuit as closed.  
  - Confirm when the enclosure door opens, the meter shows the circuit as open. |

Connecting power

Power is supplied to the laser through the rear AC input connector. The connector is a standard C-14 type designed for use with an AC power cord that is fitted with a C-13 connector. Electrical and cable specifications are listed in Table 8.

**Table 8** Power specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC Mains Input</td>
<td>88-264 VAC @ 47-63 Hz</td>
</tr>
</tbody>
</table>
| Power cord            | The power cord must be capable to safely transmit the laser’s specified AC ratings whilst maintaining a safe connection with the local AC mains outlets.  
                         | The power cord used must follow local or national regulations.                             |
| AC connector (inlet)  | IEC 60320 – C14                                                                               |
| Power cord connector  | The power cord must have an IEC 60320 C-13 connector for proper connection with the BOOSTIK HP AC inlet. |

i. T= 20°C, P=10W
USB PC connection

Using a USB-A to USB-B cable, connect a PC to the USB-B port on the front panel of the BOOSTIK HP. The port supports RS-232 communications requiring the PC to implement a USB to RS-232 driver.

Table 9 lists the pin assignments for USB-B connector on front panel

<table>
<thead>
<tr>
<th>Pin #</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VCC USB (+5 VDC)</td>
</tr>
<tr>
<td>2</td>
<td>DATA -</td>
</tr>
<tr>
<td>3</td>
<td>DATA +</td>
</tr>
<tr>
<td>4</td>
<td>Ground</td>
</tr>
</tbody>
</table>

Connecting the optical input from a seed laser

**Seed input connection**

The Koheras BOOSTIK HP optical input is equipped with a 1 m pig-tail connectorized fiber. The default connector at the end of the pig-tail is an FC/APC connector.

Using an appropriate optical fiber coupler, connect the seed laser optical output connector to the input connector of the BOOSTIK HP amplifier.

**Caution:** Before connecting the input optical connectors, ensure to check the connector tips using a fiber microscope. Using a microscope, check for any deformities, damage, residue or other contaminants at the optical tip of each connector. Either clean the connectors or contact NKT Photonics support if replacement is necessary.

**Caution:** DO NOT ENABLE EMISSION UNLESS THE SEED LASER IS CONNECTED and ENABLED. Enabling the amplifier emission without suitable seed laser input may DAMAGE the amplifier.

**Warning:** ENSURE the seed laser is DISABLED when connecting its output to the input of the amplifier.
Connecting the optical input from a seed laser
### Table 10  Optical specifications

<table>
<thead>
<tr>
<th></th>
<th>E15</th>
<th>Y10</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Center Wavelength</strong>¹</td>
<td>1550-1570</td>
<td>1050 - 1090</td>
</tr>
<tr>
<td><strong>Laser Emission</strong></td>
<td>CW - inherently single frequency</td>
<td>CW - inherently single frequency</td>
</tr>
<tr>
<td><strong>Beam Quality (M2)</strong></td>
<td>M2 &lt; 11 @ 2 W output</td>
<td>M2 &lt; 11 @ 2 W output</td>
</tr>
<tr>
<td></td>
<td>M2 &lt; 11 @ ≥ 5 W output</td>
<td>M2 &lt; 13 @ ≥ 5 W output</td>
</tr>
<tr>
<td>**Output power [W]**ii</td>
<td>2, 5 or 10</td>
<td>2, 5, 10 or 15</td>
</tr>
<tr>
<td>**Output power regulation [%]**³ii</td>
<td>30 - 100</td>
<td>30 - 100</td>
</tr>
<tr>
<td><strong>Linewidth (kHz)</strong></td>
<td>&lt; 1</td>
<td>&lt; 20 optionally lower</td>
</tr>
<tr>
<td><strong>Linewidth (kHz)⁴</strong></td>
<td>&lt; 0.1</td>
<td>-</td>
</tr>
<tr>
<td><strong>Phase Noise (μrad/√Hz/m)</strong></td>
<td>&lt; 2 @ 100 Hz</td>
<td>Not applicable</td>
</tr>
<tr>
<td></td>
<td>0.8 @ 1 kHz</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>0.4 @ 10 kHz</td>
<td>-</td>
</tr>
<tr>
<td><strong>Peak RIN (MHz)</strong></td>
<td>~ 0.7</td>
<td>~ 1.5</td>
</tr>
<tr>
<td>**RIN level @ Peak / 10 MHz (dBc/Hz)**v</td>
<td>&lt; -100 @ peak</td>
<td>&lt; -105 @ peak</td>
</tr>
<tr>
<td></td>
<td>&lt; -135 @ 10 MHz</td>
<td>&lt; -140 @ 10 MHz</td>
</tr>
<tr>
<td><strong>Long term stability (RMS, 1h @ 25°C [%])</strong></td>
<td>&lt; ± 2 %</td>
<td>&lt; ± 2 %</td>
</tr>
<tr>
<td><strong>Optical S/N (50 pm res.) (dB)</strong></td>
<td>&gt; 50 (typically &gt; 55)</td>
<td>&gt; 65 (typically &gt; 70)</td>
</tr>
<tr>
<td><strong>Polarization</strong></td>
<td>Linear (PM)</td>
<td>Linear (PM)</td>
</tr>
<tr>
<td><strong>Min. Thermal Tuning Wavelength Tuning Range (pm)</strong></td>
<td>+/- 350</td>
<td>+/- 240</td>
</tr>
<tr>
<td><strong>Total thermal wavelength tuning range [pm]</strong></td>
<td>1000</td>
<td>700</td>
</tr>
<tr>
<td><strong>Optical S/N (50 pm res.) (dB)</strong></td>
<td>&gt; 50 (typically &gt; 55)</td>
<td>&gt; 65 (typically &gt; 70)</td>
</tr>
<tr>
<td><strong>Fast Wavelength Modulation range (GHz)</strong></td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td><strong>Fast Wavelength Modulation (KHz)</strong></td>
<td>up to 20</td>
<td>up to 20</td>
</tr>
<tr>
<td><strong>Optical monitor output (from seed)</strong></td>
<td>FC/APC</td>
<td>FC/APC</td>
</tr>
<tr>
<td><strong>Output fiber termination</strong></td>
<td>FC/APC @ 2 W output</td>
<td>FC/APC / collimator @ 2 W output</td>
</tr>
<tr>
<td></td>
<td>Collimator @ ≥ 5 W output</td>
<td>Collimator @ ≥ 5 W output</td>
</tr>
<tr>
<td><strong>Typical beam diameter @ 1/e²</strong></td>
<td>FC/APC @ 2 W</td>
<td>FC/APC / &lt; 2.2 mm</td>
</tr>
<tr>
<td></td>
<td>=2 mm @ 5 and 10 W</td>
<td>&lt; 1 mm @ 5 and 10 W</td>
</tr>
<tr>
<td><strong>Output isolation [dB]</strong></td>
<td>&gt; 35</td>
<td>&gt; 30</td>
</tr>
</tbody>
</table>

¹. The center wavelength is selectable within the specified range. Contact NKT Photonics for options outside the range.

ii. Depends on the center wavelength.

iii. The range can be larger depending on the center wavelength and output power.

iv. Lorentzian

v. Shot-noise limited > 5 MHz
### Table 11 Mechanical dimensions

<table>
<thead>
<tr>
<th>All chassis models</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Size (H x W x D)</strong></td>
<td>132 x 482 x 448.5 mm (5.20 x 18.98 x 19.23 in)</td>
</tr>
<tr>
<td><strong>Rack Dimension</strong></td>
<td>19” x 3U</td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>&lt;13 kg (&lt;28.66 lb)</td>
</tr>
</tbody>
</table>

### Table 12 Operating and storage environment

<table>
<thead>
<tr>
<th>All Chassis Models</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operating Temperature</strong></td>
<td>15°C to 35°C (59°F to 95°F)</td>
</tr>
<tr>
<td><strong>Storage Temperature</strong></td>
<td>-20°C to 65°C (-4°F to 149°F)</td>
</tr>
</tbody>
</table>

### Table 13 Electrical

<table>
<thead>
<tr>
<th>All Chassis Models</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AC Supply Voltage</strong></td>
<td>88-264 VAC 50-60Hz</td>
</tr>
<tr>
<td><strong>Maximum Power Consumption</strong></td>
<td>&gt;55 to &gt;180 W</td>
</tr>
</tbody>
</table>

i. Dependant on the amplifier ratings, contact NKT Photonics support.

### Table 14 Mechanical dimensions

<table>
<thead>
<tr>
<th>All chassis models</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Size (H x W x D)</strong></td>
<td>130 x 463 x 348 mm (5.12 x 18.23 x 13.70 in)</td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>~10 kg (~22 lb)</td>
</tr>
</tbody>
</table>
Figure 17 Mechanical dimensions
**Figure 18** Optical output type dimensions

- **Collimated FC/APC**

- **Collimator only**

- **Collimator with isolator type 1**

- **Collimator with isolator type 2**
B Service and support Information

Servicing the laser

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

Caution: Do not open the laser’s modules. The laser modules are equipped with warranty labels (see Figure 19) on the covers of the laser chassis. The warranty is void if the system is opened.

Figure 19 Warranty seal

Caution: The laser contains electro-static discharge (ESD) sensitive components. To avoid permanent ESD damage, use ESD protection precautions when handling the laser. Always connect the laser’s earth point to a ground earth within your facility.

Opening the laser chassis

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

WARRANTY VOID IF REMOVED Label

The unit is sealed with a label “WARRANTY VOID IF REMOVED”. It is strictly prohibited to remove the chassis cover.
Support contact details

For technical or general support, NKT Photonics can be contacted for help regarding issues and questions with your laser or its accessories.

**Support Email**  support@nktphotonics.com

**Online support**  http://www.nktphotonics.com (click on support)

**Shipping address**  NKT Photonics A/S
Blokken 84
DK-3460 Birkerød
Denmark
## Troubleshooting

**Table 16 Laser Troubleshooting**

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>The amplifier cannot be turned ON when the enable command is issued and sent to the amplifier.</td>
<td>1. Make sure that the communication link (USB serial) between the PC and the amplifier is working.</td>
</tr>
<tr>
<td></td>
<td>2. Check the Interlock connection, door switch and the circuit loop is closed.</td>
</tr>
<tr>
<td></td>
<td>3. Check for existing alarms on the front panel display.</td>
</tr>
<tr>
<td>There is no communication between the amplifier and the PC</td>
<td>1. Make sure that the terminal emulator parameters are correct (Table 5).</td>
</tr>
<tr>
<td></td>
<td>2. Check the USB RS232 cable.</td>
</tr>
<tr>
<td>Low output power</td>
<td>1. Check for any over bending of the collimator flexible tube.</td>
</tr>
<tr>
<td>Output power instability</td>
<td>1. Check for potential optical signal reflection back into the collimator.</td>
</tr>
<tr>
<td>Alarm temperature</td>
<td>1. Check that there is clearance space in the front and the back of the amplifier for adequate air circulation.</td>
</tr>
</tbody>
</table>