

# ***FIBER AMPLIFIER***

## ***CW SLM PM AMPLIFIER***



***KOHERAS BOOSTIK HPA***

| REVISION HISTORY |            |                              |
|------------------|------------|------------------------------|
| Rev. 01          | 22/06/2011 | Inheritance of YFA amplifier |
| Rev. 02          | 25/01/2012 |                              |
| Rev. 03          | 20/03/2012 |                              |
| Rev. 04          | 19/08/2013 |                              |
| Rev. 05          | 27/05/2014 | JEP                          |
| Rev. 06          | 12/09/2016 | new design                   |

Continuous wave ErYb / Yb doped Fiber Amplifier User's Manual

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Part Number:

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# ***PREFACE***

Thank you for purchasing NKT PHOTONICS's Continuous Wave Fiber Amplifier (CW) system. This amplifier system produces ultra-bright, near-diffraction-limited, infrared laser light, delivered via a flexible output fiber and collimating optics.

The KOHERAS BOOSTIK HPA contains reliable, high-brightness diode lasers that pump a double-clad, ErYb- or Yb-doped optical fiber. The drive electronics power the diode lasers and control the fiber amplifier operation. A heat sink and fan provide necessary cooling.

The KOHERAS BOOSTIK HPA has an RS-232 Interface that allows you to control the amplifier system through your own electronics.

## About This Manual

This document describes user's recommendations and the functionalities of the KOHERAS BOOSTIK HPA for laboratory applications.

The KOHERAS BOOSTIK HPA includes an optical core, the pump laser diodes, the electronic boards and the required air cooling system. It also integrates a RS232 interface and a TTL modulation input for the control of the Amplifier.


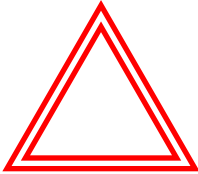
The KOHERAS BOOSTIK HPA emits a TEM<sub>00</sub> continuous wave radiation in the 1064nm or 1550nm range with a maximum continuous optical power of 1-15 W (depending on model) at nominal current.

This manual was written to help ensure your safety and to explain operation of the CW amplifier. Please read Sections 1 through 6 before you power up the amplifier.

If you have questions or comments about any part of this manual, please call NKT PHOTONICS at +45 4348 3900.

## Conventions Used in This Manual

This manual contains messages requiring particular kinds of attention, as follows:

| Symbol  | Description   |
|---|---|
|  | <b>DANGER</b><br>Conveys a personal safety hazard. Failure to observe such a warning may result in serious injury or loss of life. Ensure all conditions necessary for safe handling and operation are met before proceeding.             |
|  | <b>CAUTION</b><br>Conveys an equipment hazard. Failure to observe such a warning may result in serious damage to or destruction of the system. Ensure all conditions necessary for safe handling and operation are met before proceeding. |
| <i>NOTE Conveys useful information regarding your system's features.</i>            |   |

The following acronyms are used in this manual:

OEM    original equipment manufacturer

The following abbreviations and symbols are used in this manual:

A        ampere (amp)

mA      milliamper

ms      millisecond

nm      nanometer

s        second

V        volt

VAC    volts AC

W        watt

ns       nanosecond

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# ***1***

## ***SAFETY***

## 1.1 General Safety Guidelines

Below is basic information about the amplifier that should be understood and paid attention to.



### **DANGER**

**AVOID EYE OR SKIN EXPOSURE TO DIRECT OR SCATTERED RADIATION.  
NEVER LOOK INTO THE BEAM PATH. KEEP ALL BODY PARTS AND REFLECTIVE MATERIALS OUT OF THE BEAM PATH.**

The KOHERAS BOOSTIK HPA is a Class 4 infrared laser source that emits a collimated beam of invisible radiation at powers up to 15W in the 1.0 - 1.5 micron range. The beam has sufficient optical power to constitute a hazard, whether due to direct or scattered exposure. Some, but not all, potential human hazards include permanent loss of vision and/or subsurface skin damage. Additionally, the beam is collimated such that these hazards apply over large distances, as well as close up.



### **DANGER**

The KOHERAS BOOSTIK HPA amplifier system should not be operated unless all appropriate safety precautions are taken. These include, but are not limited to:

1. wearing protective safety glasses by all people in the vicinity of the amplifier system,
2. installing warning lights, signs, safety screens and/or curtains,
3. implementing a safety interlock so the amplifier shuts down if someone unexpectedly enters an area containing the amplifier, and
4. containing the beam to eliminate or minimize the possibility of exposure to the beam.

Use of the KOHERAS BOOSTIK HPA other than as specified herein may result in hazardous radiation exposure.



### **DANGER**

Use of optical instruments with the KOHERAS BOOSTIK HPA may increase eye hazard.



### **DANGER**

Never operate the system if the cover of the module has been removed. Doing so may expose you and/or others in the vicinity to invisible laser radiation that can cause serious eye damage and possible vision loss.

Do not remove your system's cover, make adjustments to, or attempt to repair the KOHERAS BOOSTIK HPA system. Only NKT PHOTONICS-authorized service personnel should perform repairs and adjustments.



## 1.2 Labels and Label Locations

Figure 1.1 provides information regarding warning and informational labels that are attached to the KOHERAS BOOSTIK HPA.



**Figure 1.1:** Labels and Locations

## 1.3 Safety Interlock

The KOHERAS BOOSTIK HPA 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 issue a command for the safety relay to close.

## 1.4 Compliance

For more information on laser safety, the following sources are available:

*Safe Use of Lasers* (Z136.1), published by:  
The American National Standards Institute (ANSI)  
11 West 42nd Street  
New York, NY 10036  
Tel: (212) 642-4900

*Laser Safety Guide*, published by:  
The Laser Institute of America  
13501 Ingenuity Drive, Suite 28  
Orlando, FL 32826  
Tel: (407) 380-1553.

*A Guide for Control of Laser Hazards*, published by:  
The American Conference of Governmental and Industrial  
Hygienists (ACGIH)  
1330 Kemper Meadow Drive  
Cincinnati, OH 45240  
Tel: (513) 742-2020

CEN Central Secretariat  
36, rue de Stassart  
B-1050 Brussels  
Fax : +32 2 550 08 19  
Email : [infodesk@cenorm.be](mailto:infodesk@cenorm.be)

Union Technique de l'Electricité (UTE)  
33, avenue du Général Leclerc – BP23  
F-92262 Fontenay-Aux-Roses Cedex  
Web : [www.ute-fr.com](http://www.ute-fr.com)

Deutsche Elektrotechnische Kommission im DIN und VDE (DKE)  
Stresemannallee 15  
D-60 596 Frankfurt am Main  
Web : [www.dke.de](http://www.dke.de)

# 2

## ***ELECTRICAL CHARACTERISTICS***

## 2-1 Electrical characteristics

| Characteristic | Test condition  | Min | Typ | Max | Unit |
|----------------|-----------------|-----|-----|-----|------|
| Supply voltage |                 | 88  | -   | 264 | VAC  |
| Frequency      | T=20°C<br>P=10W | 47  | -   | 63  | Hz   |

**Table 1:** Electrical characteristics

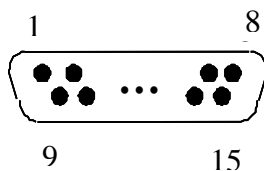
## 2-2 Electrical connectors

The front panel of the amplifier is equipped with a USB-B connector enabling remote control of the Amplifier via RS232 communication:

| Pin | Description      |
|-----|------------------|
| 1   | VCC USB (+5V DC) |
| 2   | DATA -           |
| 3   | DATA +           |
| 4   | Ground           |

**Table 2:** pinning for *USB-B* connector *on front panel*

The rear panel is equipped with a SubD 15 for the interlock connector:



| Pin | Description   |
|-----|---------------|
| 1   | GND interlock |
| 9   | Interlock     |

**Table 3:** Sub-D15 connector pinning

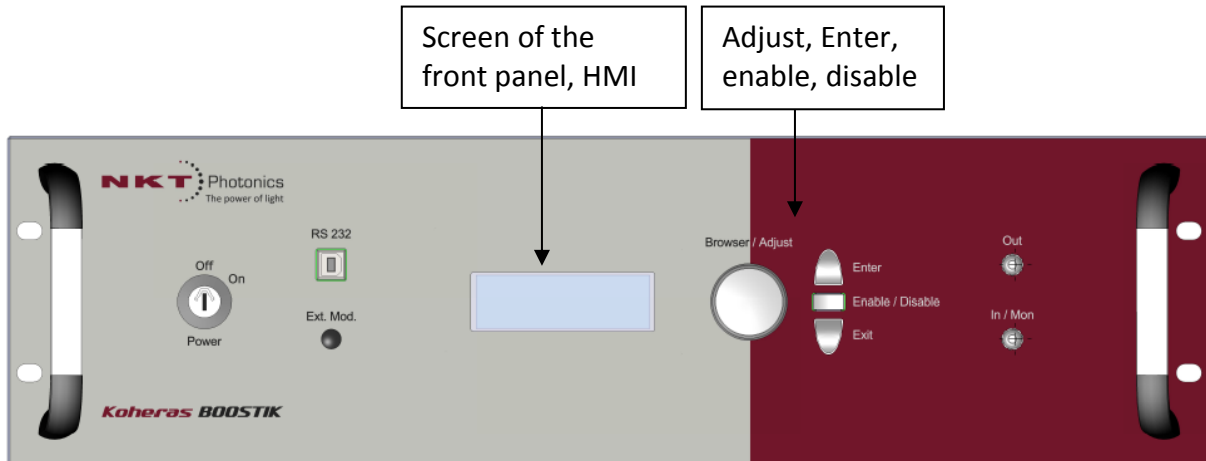
# 3

## *OPERATING INSTRUCTIONS*

### 3-1 Interface

Before initializing and operating the unit:

- Inspect it for any signs of damage, and read the user's manual thoroughly.
- Install it as specified below.
- Ensure that the unit is properly connected to the ground.



### 3-2 Starting procedure

- 1- When installing the amplifier, make sure that there is enough clearance space for air circulation around the product, in particular at the front and the back of the fiber amplifier.
- 2- Check that the output beam delivery is clean without dust on optical surfaces.
- 3- Check the input connector is clean without dust on optical surfaces and connect the input of amplifier.
- 4- Plug the power supply cables and connect the Interlock pin as described before.

**NOTE** The fiber amplifier cannot be operated without interlock properly connected.

- 5- Turn on the power supply : the fans turn ON, **the initialization starts.**



**Figure 3.1:** initialization's screen

- 6- When the initialization is finished, the KOHERAS BOOSTIK HPA displays a measurement of the input power (Pin), a current set point (Idl) and a measurement of diode temperature.

Example:



- 7- Connect the seed laser to the input of the amplifier using an FC adapter and turn your seed laser ON.
- 8- Turn the Key ON: if the input power is lower than the pre-determined lower threshold power (typically 10-20 mW), there is an Alarm LIP (low Input Power), otherwise the preamplifier turns ON.

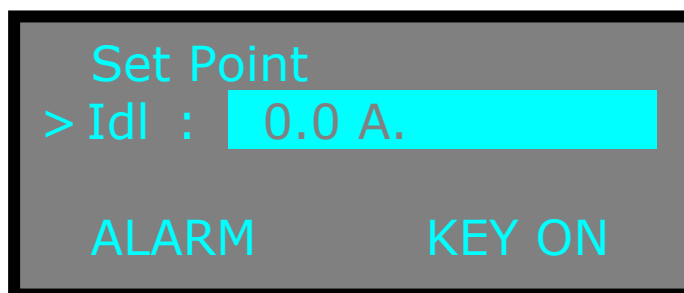


**DANGER**

At this step the KOHERAS BOOSTIK HPA produces an optical power (approx. 300mW). Avoid eye exposure to the beam.

**NOTE** During the 30s of stabilization, the button enable/disable flashes.

- 9- **After 30s of stabilisation**, the booster is now ready to be operated. After the stabilization, you can adjust the power amplifier pump current:
- - Turn the "Browser/Adjust" knob and select with the cursor ">" the setpoint current **Idl** as indicated on the screen copy hereunder.
  - Validate by pressing the ENTER button:



- Turn the “Browser/Adjust” knob and to set the current to the desired value.
- validate by ENTER
- To enable the power amplifier emission, press “Enable/Disable” on the front panel.



**DANGER**

Warning, for  $I_{dl} = 0.0A$  and the “enable/disable” push button ON, the fiber amplifier produces 1.6W.

**NOTE**

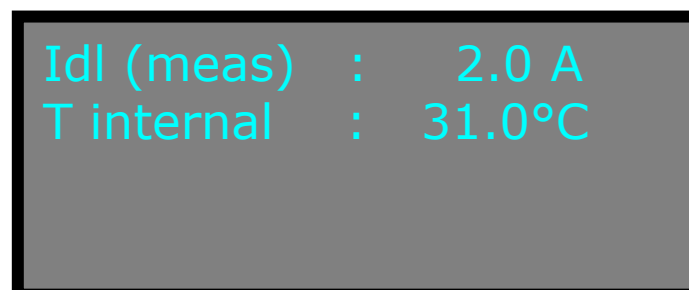
1. *There is a warm up time for optimum performances after powering ON the fiber amplifier signal: during 10s the “enable/disable” push button flashes.*
2. *To turn OFF the KOHERAS BOOSTIK HPA press the “Enable/Disable button (the blue led turns OFF), turn the key switch to the OFF position.*

### 3-3 Status window

- Turn the “Browser/Adjust” button and select with the cursor “>” the STATUS
- 



- Validate by ENTER, the STATUS window displays:



The STATUS windows displays the current measure ( $I_{dl}(meas)$ ), the internal temperature of the module ( $T_{internal}$ ).



The “STATUS” screen displays the Alarms too. *(see the chapter 5 Trouble shooting).*

### 3-4 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  $(T_L) > (T_L)_{\max}$
  - Optical core module temperature  $(T_C) > (T_C)_{\max}$
  - Laser current  $>$  Max CURRENT LIMIT (typical value : 8A)

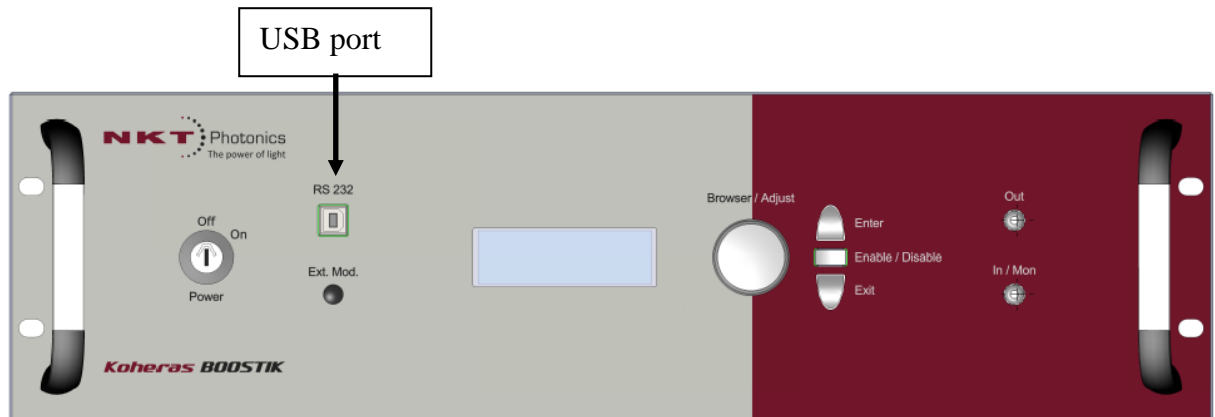
|             |  |
|-------------|--|
| <b>NOTE</b> | <i>The alarm threshold values are set by NKT Photonics during the assembly process and cannot be changed by the customer. Max CURRENT LIMIT can change from one amplifierr to another one, but it is always adjusted in order to protect pump diode.</i> |
|-------------|--|

# 4

## ***CONTROL VIA RS232***

#### 4-1 RS232 mode

The front panel of amplifier is remotely controlled by PC via a RS232 interface.



**NOTE** The type of RS232 connector is a USB-B connector.

In order to remotely control the amplifier via the RS232 interface, connect the fiber amplifier to one of the serial port of a computer (COM1 or COM2), or a USB port with CDM 2.04.06.exe.



: CDM2.04.06.exe makes a new serial port of your computer with a USB port.

When the amplifier is connected at the PC, the HMI displays:



## 4-2 Remote / local mode

The amplifier is remotely controlled by PC via a RS232 interface.

**NOTE**      *There are two types of RS232 cables: the straight configuration (TX->TX, RX->RX) and the crossed configuration (TX->RX, RX->TX). If you use your own RS232 cable, make sure that it is compatible with MLT cable configuration (crossed).*

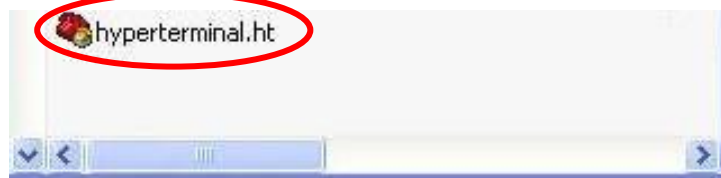
In order to remotely control the amplifier via the RS232 interface, connect the amplifier to one of the serial port of your computer (COM1 or COM2).

## 4-3 RS232 interface

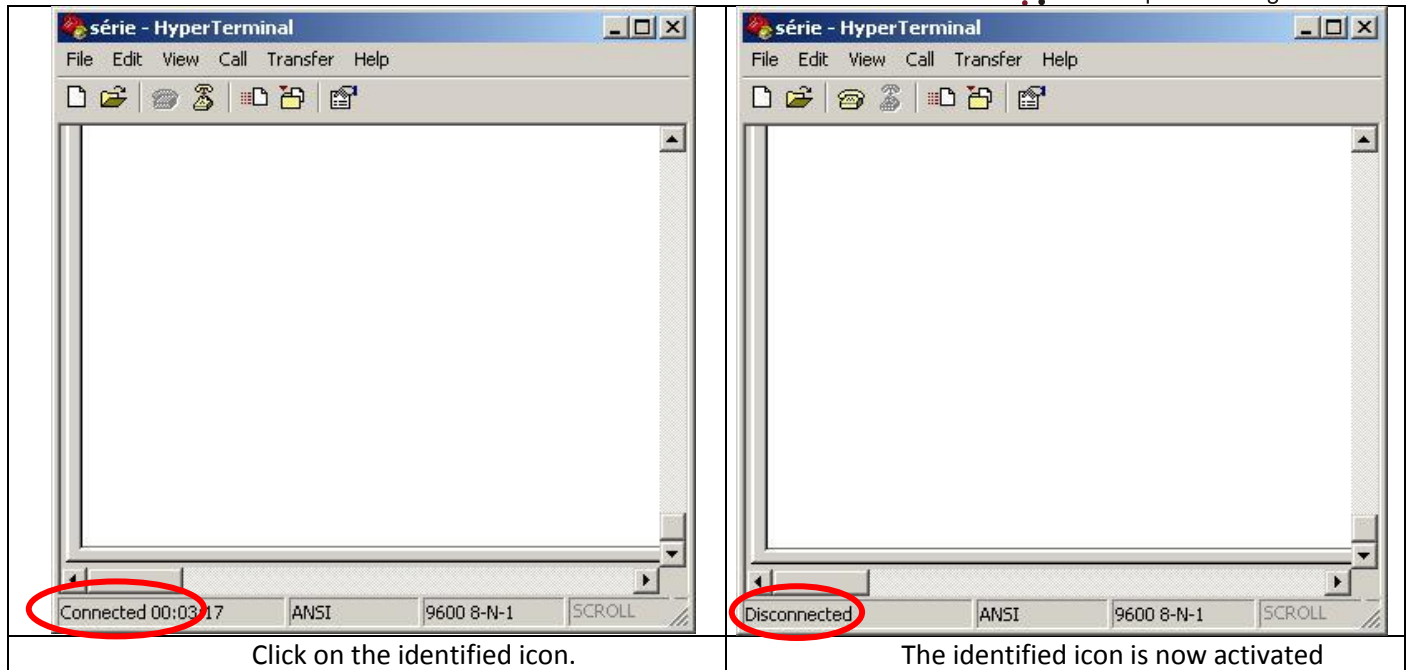
### 4-3-1 Hyper-terminal session

To enable remote control of the amplifier connect the RS232 cable to a COM port of a Windows compatible computer. It is recommended to use the communication cables supplied with the amplifier or to make your own wires following the pin out given in § 2-2. Then, follow these steps and use the following parameters while connecting to the amplifier:

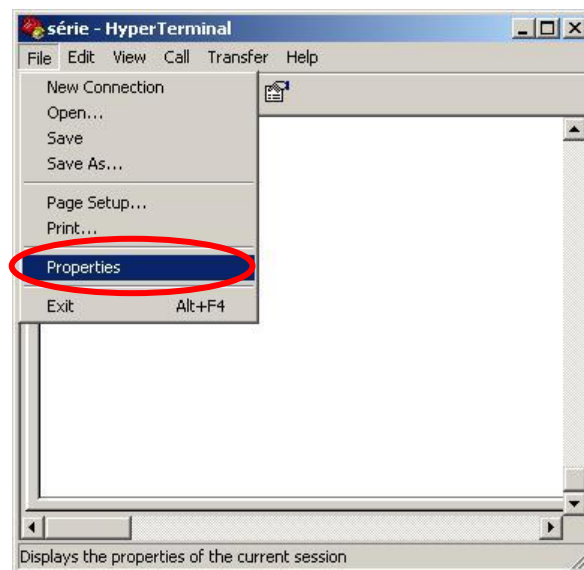
- 1- Plug the USB key provided with the amplifier on the computer
- 2- Click on the USB key icon.
- 3- Double-click on "hyperterminal.ht"



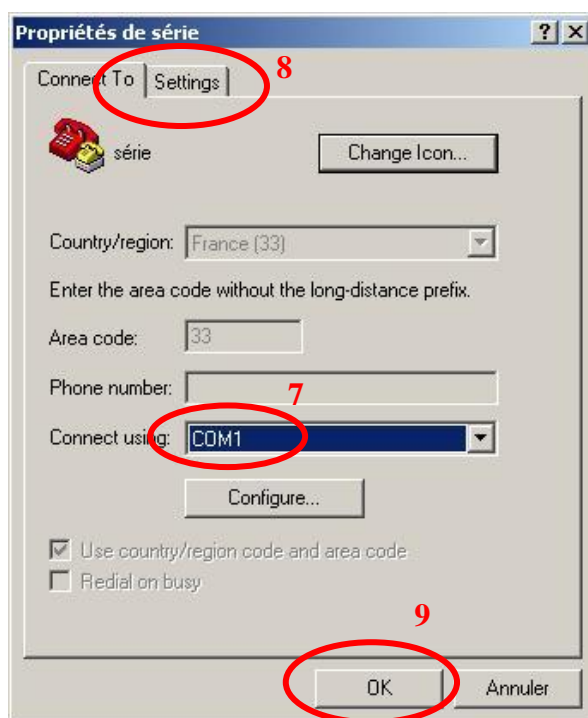
- 4- The following window appears on the computer's screen:



- 5- Check if you're connected or disconnected
- 6- If you're disconnected, in menu bar select "File" then "Properties"



- 7- In properties window, select a communication port (for example "COM 2")

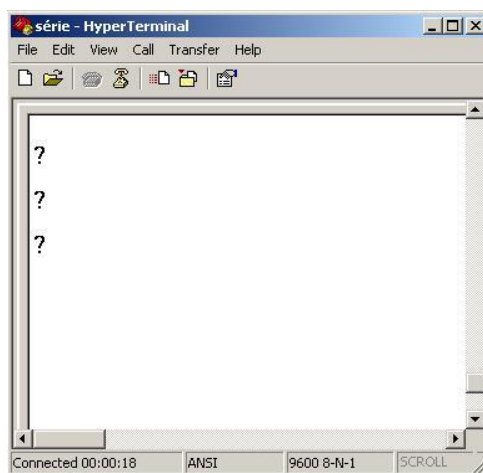


- 8- Now, click on the “Settings” icon and check that following parameters are selected or not. If not, please select them as indicated.

| Parameter    | Setting | Unit |
|--------------|---------|------|
| Baud Rate    | 9600    | Baud |
| Data Bits    | 8       | Bits |
| Parity       | None    |      |
| Stop bits    | 1       | Bit  |
| Flow control | None    |      |

**Table 3:** Communications Settings

- 9- Validate the configuration by a click on “OK”
- 10- To check if the communication is properly established between the computer and the device, please press « Enter » on keyboard. If the communication is properly established, the device echoes a “?”.



Once through these steps, the device can be controlled using the RS232 command set described below.

- If there is a communication issue, restart the amplifier.
- If the problem is still present, please contact NKT Photonics for any further assistance.

Once the hyper-terminal session is launched with the above parameters, you can start to send commands to the amplifier.

#### 4-3-2 RS232 instructions

##### *Passive commands*

| Arg 0 | Arg 1 | Function                                     |
|-------|-------|--|
| ACC   |       | Gives the set point on ACC mode              |
| AMC   |       | Gives the value current real                 |
| AMT 1 |       | Gives the value of temperature diode booster |
| CMA   |       | Gives the value of ambient temperature       |
| CMP 1 |       | Gives the value of input power               |
| CDO   |       | Gives the Enable Amplifier (ON/OFF) status   |
| CDI   |       | Gives the information about the amplifier    |

**Table 4:** RS232 passive commands

##### *Active commands*

| Arg 0 | Arg 1   | Function  |
|-------|---------|---|
| ACC   | <value> | Modifies the set point on ACC mode<br>Ex : value = 4 for set point at 4 A |
| CDO   | 1,0     | Modifies Enable Amplifier status<br>1 = ON ; 0 = OFF                      |

**Table 5 :** RS232 active commands

**NOTE** Each argument must be separated by a space space-bar sign.  
Example: CDO<space>1<enter> → Modifies the enable amplifier status.

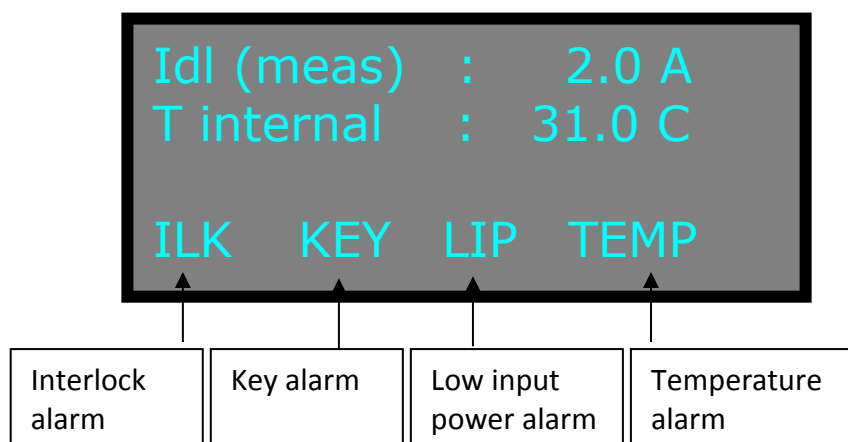
# 5

## *TROUBLE SHOOTING*



| Problem description   | Solution  |
|---|---|
| The amplifier cannot be turned ON when the request is transmitted to the amplifier. | <ul style="list-style-type: none"> <li>• Make sure that the communication between the PC and the amplifier is working.</li> <li>• Check that the Interlock connector is correctly plugged.</li> <li>• Check that no alarm is activated</li> </ul> |
| There is no communication between the amplifier and the PC                          | <ul style="list-style-type: none"> <li>• Make sure that the hyperterminal session parameters are correct (see section X-a).</li> <li>• Check if your RS232 cable is compatible with MNL configuration (crossed configuration).</li> </ul>         |
| Low output power  | <ul style="list-style-type: none"> <li>• Check if there is no overbending of the collimator flexible tube.</li> </ul>   |
| Output power instability  | <ul style="list-style-type: none"> <li>• Check that there is no potential optical signal reflection back into the collimator.</li> </ul>  |
| Alarm temperature   | <ul style="list-style-type: none"> <li>• Check that there is enough clearance space in the front and the back of the amplifier for air circulation.</li> </ul>  |

**Table 6:** Trouble shooting



**Figure 3:** Trouble shooting on HMI in window STATUS

| Status Alarm definition ( Alarm : bit equal 0) |                             |
|--|-----------------------------|
| BIT 0  | Booster current alarm       |
| BIT 1  | PreAmp current alarm        |
| BIT 2  | Booster temperature alarm   |
| BIT 3  | PreAmp temperature alarm    |
| BIT 4  | Ambient temperature alarm   |
| BIT 5  | Low input power alarm       |
| BIT 6  | Key alarm                   |
| BIT 7  | Emergency alarm (interlock) |

**Note**                      *“STA” [CR] gives status byte indicator in the opposite as the bit number increases.  
Example :  
STA [CR]  
10111111 means that the « Global enable » is on at high level so the 0 occurs for bit 6 and is represented in 2<sup>nd</sup> position.*

# APPENDICES

## Appendix 1: Optical Specifications

See “Technical specifications” sheet attached to this User’s Manual for further details

## Appendix 2: Mechanical Drawings

All dimensions in mm

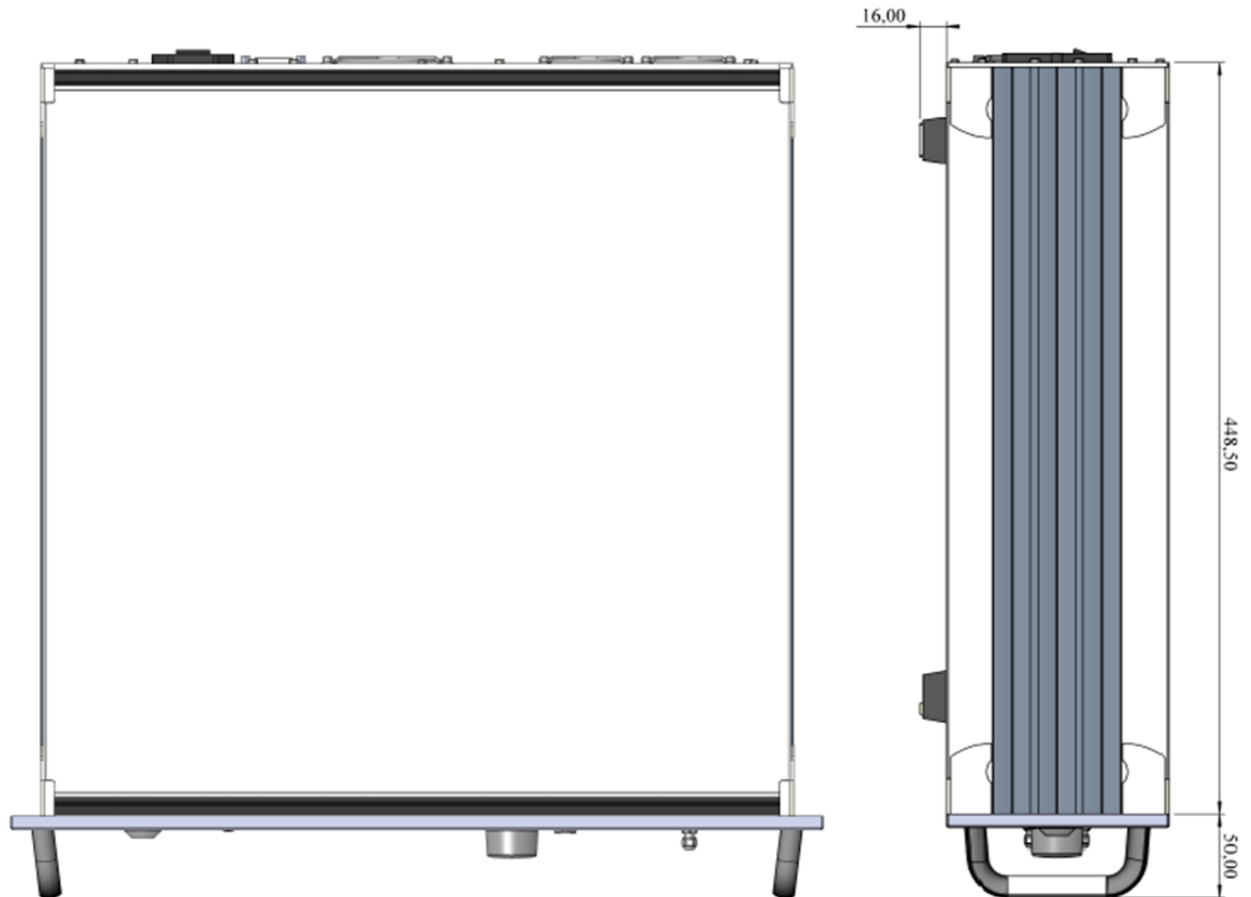


Figure A-3-1 : top and side view

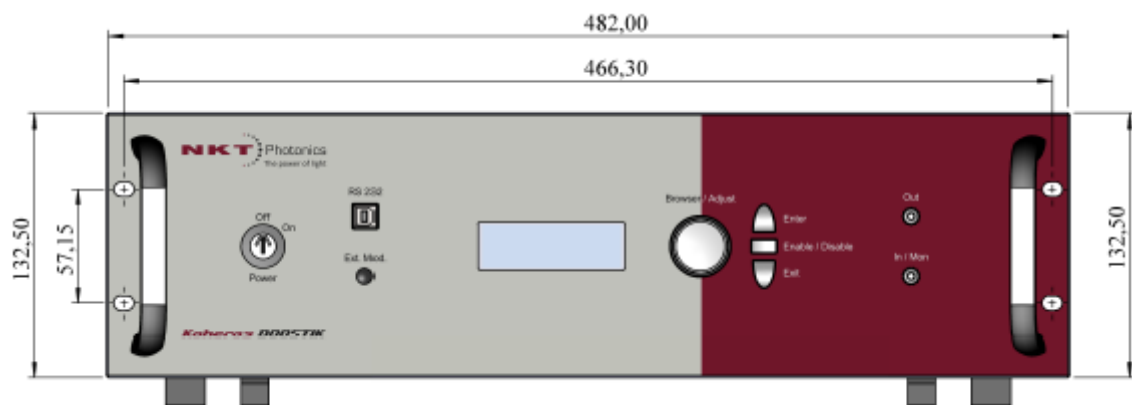


Figure A-3-2 : front panel view

### **Appendix 3 :Warranty**

NKT PHOTONICS warrants the CW Fiber Amplifier to be free from defects in workmanship and materials, hereinafter called "Nonconformity," for a period of twelve (12) months from the date of shipment. This warranty does not apply to systems which NKT PHOTONICS determines, upon inspection, have failed, become defective or unworkable due to abuse, mishandling, misuse, alteration (unless approved in writing by NKT PHOTONICS), negligence, improper installation, use which is not in accordance with the information and precautions described in the PL Operator's Manual, or other causes beyond NKT PHOTONICS's control.

Operating at above the maximum rated output power will void both the basic and extended warranty. This warranty does not apply to

- (i) any products or components not manufactured by NKT PHOTONICS or
- (ii) any aspect of the products based on Buyer's specification, unless Seller has reviewed and approved such specification in writing.

EXCEPT FOR THE FOREGOING WARRANTY, NKT PHOTONICS SPECIFICALLY DISCLAIMS AND EXCLUDES ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING IMPLIED WARRANTIES OF NONINFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

Buyer shall notify NKT PHOTONICS of any Nonconformity during the warranty period, obtain a return authorization for the nonconforming products, and return the nonconforming products, freight prepaid, to NKT PHOTONICS's designated facility along with a written statement describing the Nonconformity. NKT PHOTONICS's sole and exclusive obligation under this warranty is to use reasonable commercial efforts, at NKT PHOTONICS's option, to repair, replace or refund the purchase price for any products which are returned to NKT PHOTONICS as set forth above and which are, after examination by NKT PHOTONICS, determined in NKT PHOTONICS's reasonable discretion to be nonconforming. Products which are repaired or replaced within the warranty period are warranted only for the remaining unexpired portion of the original warranty period applicable to the repaired or replaced products or components. However, the warranty period does not include the time period between when NKT PHOTONICS receives the nonconforming products and when NKT PHOTONICS returns the repaired or replacement products to Buyer.

Buyer agrees that the foregoing provisions constitute the sole and exclusive remedies available to Buyer for breach of warranty by NKT PHOTONICS with respect to the products.

IN NO EVENT WILL NKT PHOTONICS BE LIABLE FOR ANY INDIRECT, INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO, LOSS OF ANTICIPATED PROFITS OR BENEFITS, EVEN IF NKT PHOTONICS HAS BEEN INFORMED OF THE POSSIBILITY THEREOF IN ADVANCE. IN NO CASE WILL NKT PHOTONICS'S AGGREGATE LIABILITY TO BUYER BE GREATER THAN THE PURCHASE PRICE PAID BY BUYER TO NKT PHOTONICS FOR THE PRODUCTS WHICH ARE THE SUBJECT OF BUYER'S CLAIM.

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