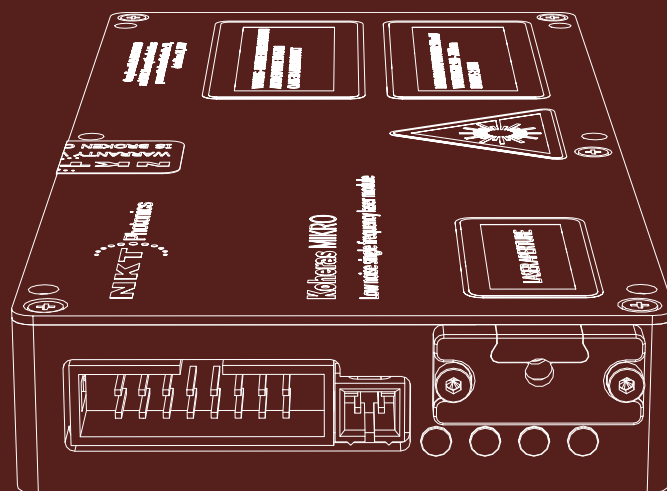


# Koheras MIKRO

Product Guide

Revision 1.5 10-2023



# PRODUCT GUIDE

This guide includes information for the following NKT Photonics products:

## **Koheras MIKRO**

Low Noise Single Frequency Laser Module



**CAUTION:** Do not open the laser module. The laser is equipped with warranty labels (see [Figure 32](#)) on the covers of the module. The warranty is void if the system is opened.

Manufactured by:

**NKT Photonics A/S**

Blokken 84, Birkerød-3460 Denmark

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Specifications are listed as metric units. Imperial units listed are conversions.

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# Guide Overview

This product guide is intended to provide functional, operational and installation information for the Koheras MIKRO laser modules. The guide is divided into three sections:

- **Koheras MIKRO Description** - introduces the laser, its functionality, interfaces and chassis variants.
- **Operating the laser** – provides information and procedures on how to connect and configure communications with the laser and manage its operation.
- **Installing the laser** – includes the details on how to install the laser chassis variants and connect optional interfaces.



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

*Koheras MIKRO Safety, Handling and Regulatory Information*



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

<https://www.nktpotonics.com/lasers-fibers/support/product-manuals/>

**Terminology** The guide may refer to the Koheras MIKRO modules as “the laser”. In specific cases where a distinction is required, the guide will use the actual laser model names or simply as “the module”.

**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.

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**Chapters inside** This guide includes the following chapters:

- Chapter 1 “[Laser description](#)” — Describes the laser including its general operational principles, management and interfaces.
- Chapter 2 “[Communicating with the Laser](#)” — Provides information and procedures on how to setup a PC with the laser’s management software and connect it to the laser.
- Chapter 3 “[Turning ON the Laser](#)” — Contains procedures on how to safely turn the laser emissions on and off using the management software.
- Chapter 4 “[Using CONTROL](#)” — Includes descriptions and procedures of all other GUI menu and panel items.
- Chapter 5 “[Software Development Kit](#)” — Includes descriptions and procedures for certain key settings that can be configured using the SDK.
- Chapter 6 “[Mechanical Installation](#)” — Includes information and procedures on how to correctly install the laser chassis. Procedures within this chapter focus on providing adequate temperature regulation.
- Chapter 7 “[Connecting the laser](#)” — This chapter provides the information on how to physically connect the safety interlock, power, the optical collimator, and the optional interfaces.
- [APPENDICES](#) — The guide includes multiple appendices including laser specifications, support contact details, accessory descriptions, a configuration ID cross-reference and miscellaneous procedures supporting the laser operation and installation.

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



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



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



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



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**Revision** This section records the document revision details.

Date	Revision	Changes
2019-09	1.0	First release - documents rewritten and overhauled from earlier releases.
2020-01	1.1	Added Appendix F - Configuration IDs. Configuration ID description and cross-reference for standard configuration IDs.
2020-01	1.2	Updated information regarding implementing the interlock with a safety door switch. The following sections are affected: <ul style="list-style-type: none"><li>• “Main electrical interface” on page 26</li><li>• “Connecting CONTROL to the laser” on page 32</li><li>• “Connecting the SDK GUI to the laser” on page 33</li><li>• “Connecting the safety interlock” on page 61</li><li>• “Main electrical interface” on page 73</li><li>• “Interlock” on page 81</li></ul>
2021-01	1.3	Updated support contact information in Appendix B.
2021-03	1.4	Errors in text edited or removed.
2021-03	1.0	Revision rolled back to 1.0 due to internal system requirements.
2022-01	1.1	Null change
2022-02	1.2	<ul style="list-style-type: none"><li>• Product name changed to Koheras MIKRO from Koheras BASIK MIKRO.</li><li>• Added scales drop down selection description in <a href="#">Procedure 3 on page 36</a>.</li><li>• Added power scale drop down selection of wavelength or offset to section “Power mode” on page 50.</li><li>• Added <a href="#">Figure 33 on page 73</a> showing the pinout of the main electrical interface.</li><li>• Updated <a href="#">Procedure 9 on page 75</a> to Windows 10.</li><li>• Minor grammar corrections and improvements in language clarity.</li><li>• Some figures have also been modified for clarity.</li></ul>
2022-03	1.3	Updated with the following: <ul style="list-style-type: none"><li>• Removed the misapplied serial monitor description and replaced it “<a href="#">Device Monitor</a>” on page 51.</li></ul>
2023-03	1.4	Updated the following: <ul style="list-style-type: none"><li>• Acronym NKTP removed and replaced with NKT Photonics throughout</li><li>• Updated NKT Photonics website addresses throughout.</li><li>• Updated the Setup bits register value in <a href="#">Figure 25 on page 54</a>.</li><li>• Updated the example register values given in ““<a href="#">Setting the operating mode</a>” on page 54.</li><li>• Updated the example register values given in “<a href="#">Auto start</a>” on page 54.</li><li>• Updated the Setup bits register value in <a href="#">Figure 26 on page 54</a>.</li><li>• Removed the redundant warning in “<a href="#">Auto start</a>” on page 54.</li><li>• Updated <a href="#">Table 11 on page 67</a> as follows:<ul style="list-style-type: none"><li>• All units indicated in (unit) changed to [unit].</li><li>• Unit in row Max. Phase Noise changed to [dB((Rad/√Hz)/m)].</li><li>• Added footnote to the table title.</li><li>• Added a footnote for E15 Optical S/N specification when equipped with non-PM fiber</li></ul></li></ul>
2023-10	1.5	Updated the style of the guide.

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# SECTION 1

## MIKRO DESCRIPTION

This section provides a description of the laser and its chassis types. It includes the following topics:

- “Laser description” on page 19
- “Module variants” on page 20
- “Laser features” on page 20
- “Miscellaneous” on page 23
- “Optical interface” on page 24
- “Electrical Interfaces” on page 25
- “Laser Control” on page 26
- “Status LEDs” on page 27
- “Module labels” on page 28



The Koheras MIKRO is an industrial single frequency fiber laser housed within a micro-casing. Further, the laser and its micro-casing (referred to as a module) is designed for integration with industrial applications where its built-in laser control circuits can continuously monitor the laser's performance. Using these monitoring circuits, the laser supports applications that demand ultra-low noise, high wavelength stability and ultra-stable single frequency operation unaffected by mode hops.

**Figure 1 Working panel of the MIKRO**



The laser is designed with distributed feedback fiber laser technology and center wavelengths that can be specified from 1535 to 1580 nm. The laser also supports a wide tuning range of approximately 1 nm from the specified center wavelength. Tuning is accomplished either manually through thermal tuning or using an external signal applied at the laser's fast wavelength modulation input port. A varying external signal applied to the port, modulates the output wavelength. Modulating the output wavelength can obtain improved stabilization when compared with the free-running wavelength specification.

The standard output of the laser utilizes either standard single mode fiber or optional polarization-maintaining fiber to improve the linear characteristics. Improved polarization linearity is usually required when the laser output is either externally modulated or frequency converted.

**Theory of operation** The Koheras MIKRO is a fiber laser that uses a fiber Bragg grating cavity to produce an output beam operating in single mode. The center wavelength of the laser is configurable using either thermal substrate control or optional Piezo components. Due to the special Bragg grating, the single mode operation is constantly maintained and is stable over the entire operating frequency band of the laser.

## Module variants

Koheras MIKRO modules are available in two variants: the E15 and C15 modules. The modules are classified by their phase noise, intensity and power level. [Table 1](#) lists the technical differences between the two variants.

**Table 1 MIKRO output specifications**

Module Type	Maximum Output Power	Phase Noise	RIN
C15	10 mW	Low	Ultra-low
E15	40 mW	Ultra-low	Low

**Configuration ID** MIKRO modules are defined by their configuration ID which includes the options. Refer to [Appendix F](#) for a list of Koheras MIKRO configuration IDs.

**Center wavelength** The center wavelength of a standard MIKRO laser is set to 1550.12 nm<sup>1</sup>. On ordering, the lasers can also be modified at the factory to other center wavelengths from 1535 to 1580 nm.

**Tuning types** Both module variants can be further specified with different tuning options. The options include narrow and wide thermal tuning for coarse adjustment and Piezo tuning for finer adjustment. Tuning options are specified when the laser is ordered from the factory.

### Piezo tuning

The standard Piezo tuning option allows the laser to implement fine fast wavelength modulation. For further information see [“Fast wavelength modulation” on page 21](#)).

### Thermal tuning options

Thermal tuning options available are:

- **Narrow thermal tuning** – provides narrow thermal tuning suitable for systems where a wide tuning range is not required but vibration immunity is vital.
- **Wide thermal tuning** – provides a wider thermal tuning range at the expense of reduced immunity to vibration and acoustic pickup.

## Laser features

**Thermal tuning** The wavelength of the lasers can be controlled using a thermal tuning technique that changes the temperature of the laser's fiber. The fiber laser is mounted under tension on a substrate. When the temperature of the substrate changes,

1. ITU DWDM C-BAND Channel 34



the laser cavity length also changes due to thermal contraction or expansion. Further, the temperature of the laser cavity itself also changes such that the laser wavelength changes in response to both thermo-optic and physical changes in the optical path length. See “[Tuning the wavelength](#)” on page 53.

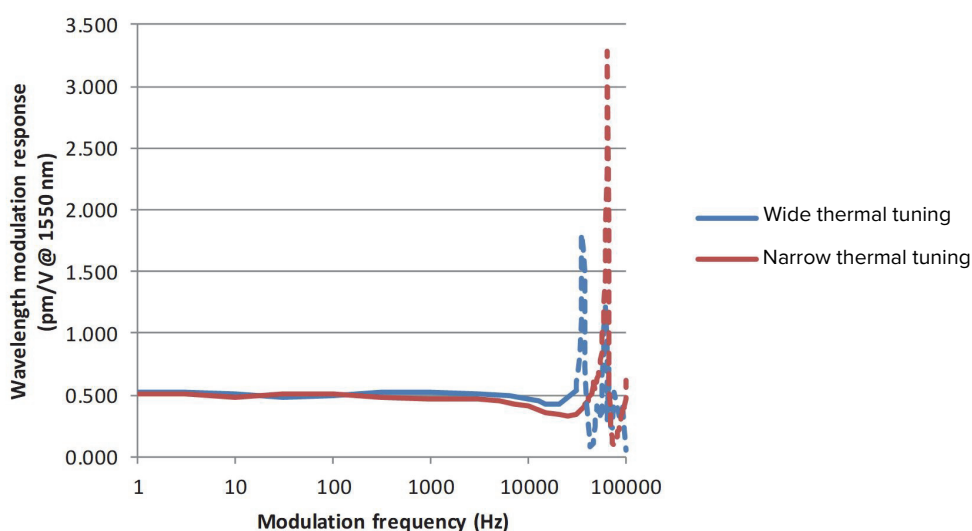
### Fast wavelength modulation

As an option, the lasers include the capability to use an external signal to modulate the emission wavelength using a Piezo. Laser modules with this option are modulated using an external electrical signal.

#### Wavelength+/- Signal

The Wavelength+/- signal is the external signal connected to the laser which modulates the wavelength. As this signal varies and increases its positive potential, the wavelength increases. [Figure 2](#) shows the frequency response when the fast wavelength modulation feature is utilized. The graph shows the response for both standard and wide thermal tuning substrates.

**Figure 2 Frequency response using wavelength modulation**



The response shown in [Figure 2](#) is for a laser with a wavelength at 1550 nm. The response is scaled linearly with the wavelength of the laser.

Also in [Figure 2](#), the Narrow Thermal Tuning module which has less vibration sensitivity, shows resonances that are higher in frequency. These modules are therefore more suitable for applications where modulations between 30 and 45 kHz are required.



**NOTE:** The frequency response is relatively flat up to 20 kHz, but resonances are seen at frequencies at and above the first resonance occurring at approximately 30 kHz. Wavelength modulation can be used for frequencies above 20 kHz, but it is recommended to avoid modulating the laser at the resonance frequencies.

**Operating mode** A MIKRO can operate using either current or power mode. Each mode describes how the emission level of the laser is regulated:

- **Current mode** – the current in the pump feeding the fiber laser is held stable.
- **Power mode** – the power out of the fiber laser is held at a fixed level.

The mode set depends on both the model and the application, refer to [Table 2](#) for the recommended mode to use. See “[Setting the operating mode](#)” on [page 54](#).

**Table 2 Recommended Power Modes**

MIKRO Model	Power Mode	Current Mode
C15	Better Power Stability	Better Frequency Stability
E15	Better Performance	Not Recommended



**NOTE:** Modules are configured from the factory to operate in Power mode.

**Auto-start** The lasers include an Auto-start control bit, when the bit is set, laser emission is enabled immediately after power is connected. This mode can be useful for applications where no communication with the module is possible. See “[Auto start](#)” on [page 54](#).

**Emission delay** The lasers have an Emission Delay register which is set to 1.5 seconds by default. When emission is enabled, the emission LED on the front of the module and the emission output pin of the electrical interface will immediately indicate emission. However with this feature, the emission of actual laser light is delayed by the time set with the register. See “[Setting the emission delay](#)” on [page 55](#).

**Shutdown delay** This feature delays disabling laser emission by 100 ms after the interlock/enable pins (See “[Main electrical interface](#)” on [page 26](#)) are set to low or a disable command is sent. When the laser is integrated with an amplified system, the shutdown delay ensures the laser’s seed signal does not disappear before an interfacing amplifier is turned off.

**High temperature shutdown** To prevent thermal run-away when the laser module temperature exceeds 65 °C, the emission is automatically turned off. The high temperature shutdown feature uses the thermal control function inside the laser to turn off the emission.



**NOTE:** The laser remains ON and has communications enabled, only the emission is turned off by the feature.

**Auto-start**

With the Auto-start feature, when the high temperature shutdown feature turns off emission and subsequently the module temperature drops below 60 °C, laser emission is automatically re-initiated. This only occurs if laser emission was on before a high temperature shutdown and auto-start is enabled.

**Power verification** This feature monitors the output power level from the fiber stage. If power drops below a predefined level in relation to the measured pump current, laser emission is automatically shut off.



**NOTE:** The slope is different for each individual laser as their emission efficiency varies.

The feature prevents for example, the output power reaching its maximum value if feedback unexpectedly disappears to the internal output power control function.

---

## Miscellaneous

**Power supply** An external 12 VDC power source (not included) is required. Power is connected to the main electrical interface connector, see “[Main electrical interface](#)” on [page 26](#).



**NOTE:** The NKT Photonics RS-485 adapter kit includes a suitable power supply for the laser. See “[Accessories](#)” – “[USB-RS485 adapter kit](#)”.

**Safety**

**WARNING:** The lasers are rated as class 3B lasers and are therefore hazardous. Before turning on the laser, ensure to read and understand all safety statements of the guide:

*Koheras MIKRO Safety, Handling and Regulatory Information*

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

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

**Accessories USB-RS485 adapter kit**

If you are not integrating the laser into an existing RS-485 capable system, an RS-485 adapter kit is available to connect a PC to the laser. With the adapter, a PC or other micro-controller can be connected to the laser using a standard USB serial port. The kit includes a suitable 12 VDC power supply, a 16 pin IDC to DB-15

connectorized ribbon cable, a type A to type B USB cable, and an interlock jumper. See [Appendix E](#) for more information about the adapter.

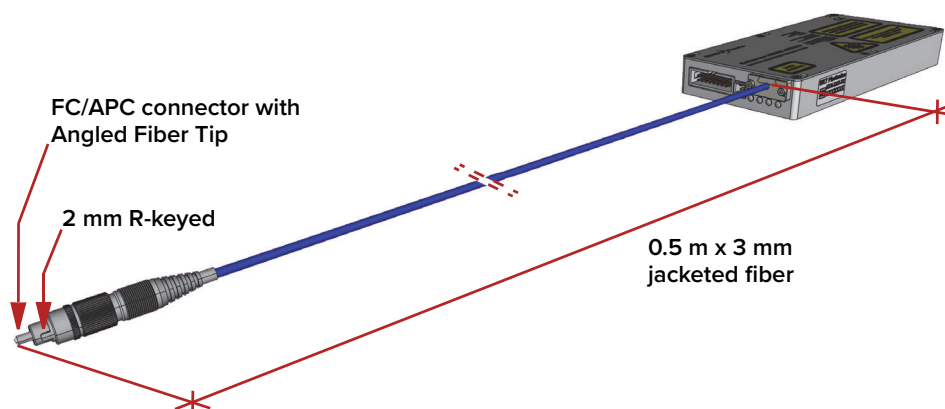
**Figure 3 USB-RS485 adapter**



## Optical interface

The lasers are equipped with a 0.5 m long 3 mm jacketed fiber patch cord (SMF28). The cord is connected to a standard FC/APC optical connector as shown in [Figure 4](#) below.

**Figure 4 MIKRO equipped with fiber cord and FC/APC connector**



### Polarization maintaining output (Panda PM 1550)

If the module includes an optional Panda polarization maintaining fiber pigtail, the slow axis is by default aligned to the connector key. Because of this, the laser polarization (E-field) is parallel to the key.

**Table 3 Optical interface specifications**

Parameter	SMF28	PM 1550
Fiber mode field diameter <sup>i</sup>	~10 microns	~10 microns
Numerical aperture	0.14	0.125

- i. Mode field diameter is approximate - contact NKT Photonics Support for more information ([Support contact details on page 72](#)).

## Electrical Interfaces

The laser is equipped with two standard electrical connectors. The connectors provide the laser with the following electrical interfaces:

- 12 VDC power
- RS-485 serial communications
- a safety interlock circuit
- emission control (5V logic)
- frequency stability status output
- fast wavelength modulation option

Table 4 lists the connector specifications and Figure 5. shows the location of the connectors on the laser.

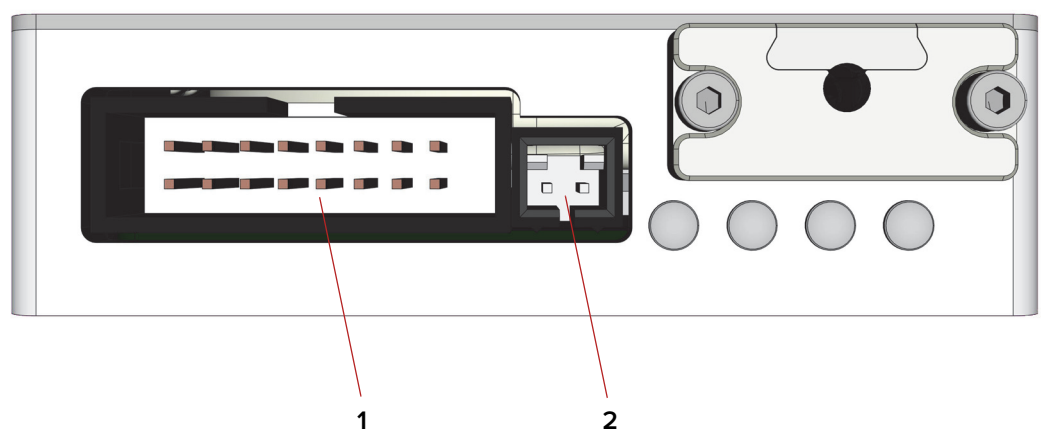
**Table 4 Connectors**

Interface name	Laser connector type	Cable connector
Main electrical interface	Male 16 pin IDC type	Female 16 pin IDC type connector
Fast wavelength modulation input	Male 2 pin SL type	Molex 50-57-9402 or similar female 2 pin SL connector



**NOTE:** For pin assignments, see [Appendix C](#).

**Figure 5 Front panel electrical connections**



- 1 Main electrical interface - male 16-Pin IDC    2 Fast wavelength modulation Input - male 2-Pin IDC

**Main electrical interface** The 16 pin main electrical interface connector includes the following connections to the laser:

- 12 VDC input power and ground – the laser requires a 12 VDC power supply (not included)
- Interlock loop connection – includes an interlock pin that connects to a door switch circuit to comply with safety regulations. See [“Connecting the safety interlock” on page 61](#).
- Serial RS-485 connections - two pins for serial communication with either the CONTROL laser management GUI or a custom application using the NKT Photonics SDK.
- Frequency stability status indicator – a single pin that outputs a high logic level when the laser achieves frequency stability.
- Emission indicator – a single pin intended to drive an external LED indicator. When laser emission is enabled, the pin output is set high.



**NOTE:** For pin assignments, see [Table 16 on page 73](#).

**Fast wavelength modulation input** If the laser module includes the fast wavelength modulation (Piezo) option, you can connect an external sinusoidal signal to this input. Fast wavelength modulation is achieved by applying an external varying voltage that is either positive only or both positive and negative. Only one of the pins needs to be connected:

- Pin 1 connects to a positive 10 to 100 volt external source relative to the negative pin 2 voltage.
- Pin 2 connects to a negative (-) 10 to positive (+) 10 volt external source

For more information on connecting an external signal to modulate the wavelength refer to [“Fast wavelength modulation input” on page 63](#).

---

## Laser Control

**User interface** The laser modules and any associated accessories are controlled using either NKT Photonics CONTROL management software installed on a PC or the NKT Photonics Software Development kit (SDK).

If you are using the GUI, it can control the laser’s emissions and adjust its power and pulse rate settings. Multiple laser statuses, warnings, errors and parameters can also be viewed. The SDK kit can similarly control the laser; however, using it requires integrating a custom control application or connecting the included SDK GUI software.

The PC or custom microprocessor must connect over the laser's RS-485 serial interface (see [“Main electrical interface” on page 26](#)).

[Section 2](#) includes multiple chapters describing the GUI and procedures related to controlling the laser with it.

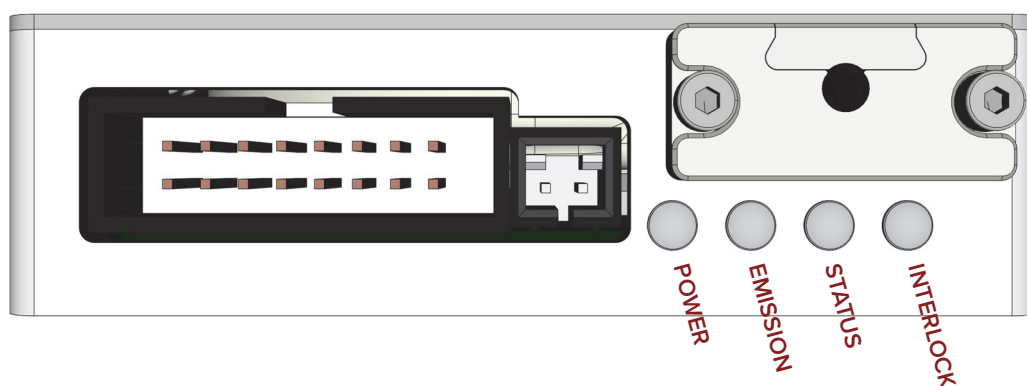


**NOTE:** An optional USB to RS-485 adapter is available to connect a standard PC to the laser.

## Status LEDs

The front panel houses four status LEDs as described in [Table 5](#). The LEDs are located on the front panel as shown in [Figure 6](#).

**Figure 6 Status LEDs**



**Table 5 Status LEDs**

LED Name	Condition	Description
Power	ON Green	DC Voltage at the DC power input pins is OK
	ON Red	DC voltage at the DC power input pins is too low.
	Flashing Amber	The module is transmitting data
	Off	No DC power at the module power input pins.
Emission	ON Red	Laser emission is ON,
	Off	Laser emission is OFF
Status	ON Green	The module laser frequency is stable.
	ON Amber	Module enable low OR module not stable (frequency tuning)
Interlock	ON Green	The interlock status is OK – the door circuit is closed and energized.
	On Red	The interlock status is Not OK – the door circuit is open or not energized.

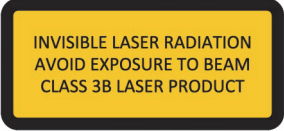

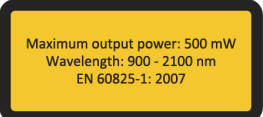




**NOTE:** DO NOT OPERATE the laser until you are familiar with the controls and have taken all precautions necessary as described in the *Koheras MIKRO Safety, Handling and Regulatory Information*.

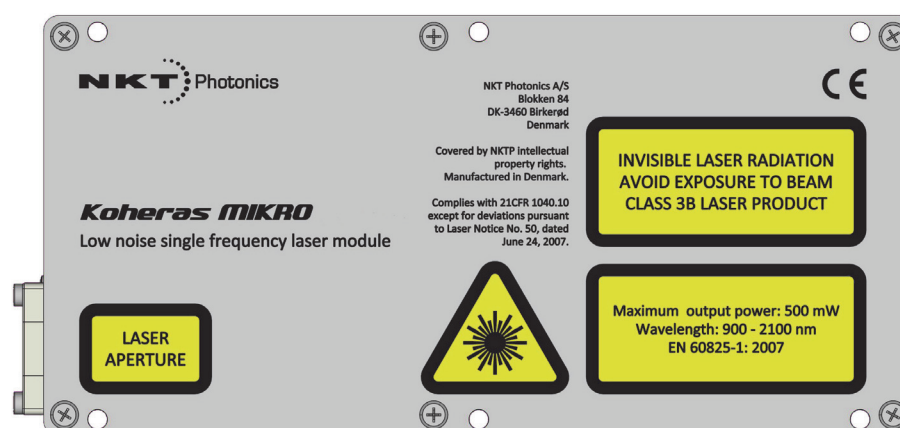
## Module labels

The Koheras MIKRO modules include multiple labels that indicate hazards, regulatory, or manufacturing information. The labels are located on several panels as described in Table 6 with the top panel shown in Figure 7.

**Table 6 Module labels**

Label	Panel	Description	
Classification - Emission Hazards	Top	Safety information stating the laser emission hazards and the laser's class rating.	
Manufacturing	Side	Manufacturing information including address, part and serial number, date manufactured and regulatory compliance.	
Product Information	Top	Safety label showing the emission specifications the laser is capable of.	
Laser Radiation Warning	Top	Safety information alert indicating this area of the laser is near a source of dangerous laser emissions.	
Laser Aperture	Top	Safety information alert indicating the location of the aperture where laser radiation is emitted from the laser.	

**Figure 7 Top Panel Label Locations**





## SECTION 2

# OPERATING THE LASER

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

- “Communicating with the Laser” on page 31
- “Turning ON the Laser” on page 35
- “Using CONTROL” on page 39
- “Software Development Kit” on page 53



You can manage the laser using either:

- NKT Photonics CONTROL management software installed on a PC
- or –
- the NKT Photonics Software Development Kit (SDK) integrated with a custom control system.

This chapter focuses on how to obtain and install both CONTROL or the SDK and then setup communications between a PC and the laser using the optional USB to RS-485 adapter. Using the adapter you can test the laser module when integrating it into a final application.

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### CONTROL software

The laser is shipped with the NKT Photonics CONTROL software installer on a USB key. You can also download the most recent CONTROL software from the following link:

<https://www.nktphotonics.com/support>

The CONTROL software is capable of controlling, configuring and monitoring the laser.

**Installing the software** After downloading the CONTROL installer to your PC, double click the installer and follow the built-in wizard. Further details on installing the software is available in [Appendix E](#).

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### Software Development Kit

NKT Photonics provides an SDK to integrate the laser with your custom control system. You can download the SDK from the same URL where CONTROL installer is found:

<https://www.nktphotonics.com/support>

To install the SDK, run the installer and follow the instructions in the install wizard.

**Generic User Interface** The installer also installs a test control interface known as the Generic User Interface (GUI) software as part of the SDK. This guide gives brief instructions on using the GUI to view, read, and modify registers that contain the operation parameters of the laser. The GUI is useful when integrating the module with a custom control system.



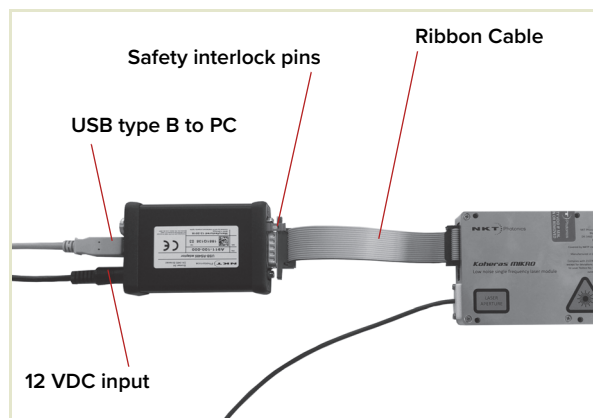
**NOTE:** For a full description of the SDK, registers and the Generic User Interface, refer to the NKT Photonics document: *SDK Instruction Manual*. The manual is installed along with the SDK components when the SDK installer is run.

## Connecting CONTROL to the laser

You can manage the laser over its RS-485 serial connection connected to a PC with CONTROL software. For test purposes, use the included NKT Photonics RS-485 adapter to connect the laser to the PC's USB port and also to a 12 VDC power source. Follow the steps in [Procedure 1](#) to connect CONTROL to the laser.

### Procedure 1 Connecting CONTROL to the laser

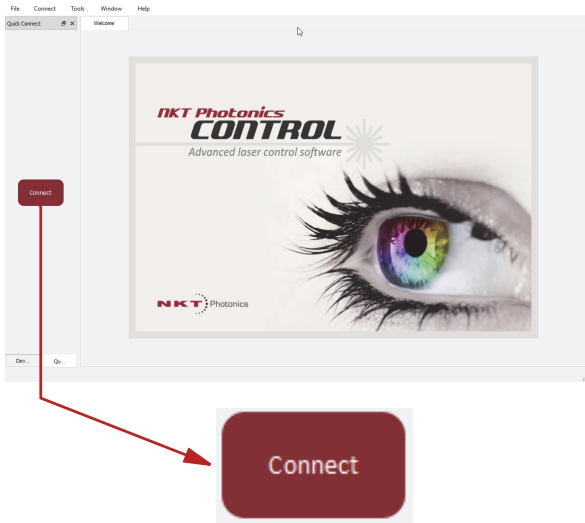
Action	
1	<ol style="list-style-type: none"> <li>Using the IDC 16 pin to DB-15 ribbon cable, connect the NKT Photonics RS-485 adapter to the 16 pin main interface connector on the front panel of the laser.</li> <li>Connect the RS-485 adapter to your PC using the USB-A to USB-B cable.</li> <li>Connect the safety interlock circuit following the information in the section: <a href="#">Connecting the safety interlock on page 61</a>.</li> <li>To power on the laser, connect the power supply to the RS-485 adapter power jack and then plug it into an AC mains outlet.</li> </ol>
2	<p>Launch CONTROL by either:</p> <ul style="list-style-type: none"> <li>clicking on Windows – Start – Programs – NKT Photonics – CONTROL</li> <li>– or –</li> <li>double clicking the CONTROL shortcut on the desktop.</li> </ul>



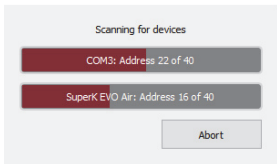
### Action

- 3 The CONTROL window opens.

Click on the *Connect* button in the upper left region of the window.



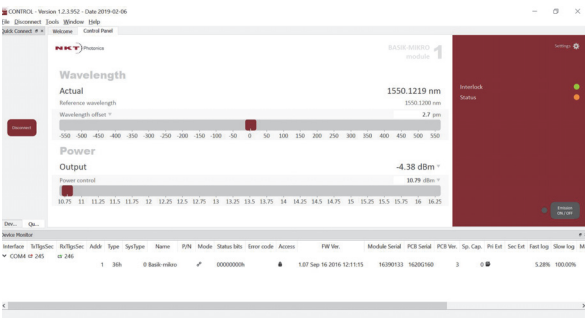
- 4 CONTROL automatically scans for any connect lasers and accessories available on both PC COM ports and configured Ethernet ports.



- 5 CONTROL connects with the laser.

In the status panel of CONTROL, the *Status* indicator is lit ON amber until the laser thermalization set point is reached. At that point the indicator is lit ON green.

END CONTROL connection Procedure



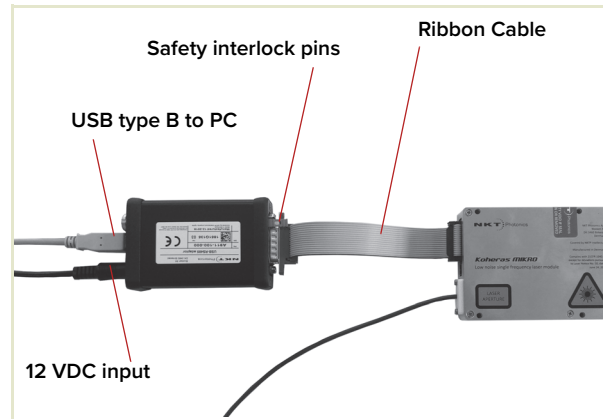
## Connecting the SDK GUI to the laser

You can manage the laser using its RS-485 serial connection connected to a PC with the SDK installed. The SDK provides a Generic User Interface (GUI) that can view, read and write registers in the laser module as a test tool when integrating the laser. Also for test purposes, use the included NKT Photonics RS-485 adapter to connect the laser to the PC's USB port and also to a 12 VDC power source. Follow the steps in [Procedure 2](#) to connect the SDK GUI to the laser.

## Procedure 2 Connecting the Generic User Interface to the laser

### Action

- 1
  - a. Using the IDC 16 pin to DB-15 ribbon cable, connect the NKT Photonics RS-485 adapter to the 16 pin Main Interface connector on the front panel of the laser.
  - b. Connect the RS-485 adapter to your PC using the USB-A to USB-B cable.
  - c. Connect the safety interlock circuit following the information in the section: [Connecting the safety interlock on page 61](#).
  - d. To power on the laser, connect the power supply to the RS-485 adapter power jack and then plug it into an AC mains outlet.



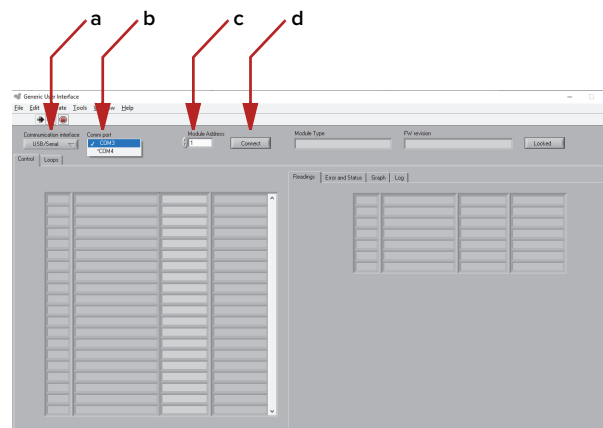
- 2 Launch the GUI by clicking on:

Windows – Start – Programs – Generic User Interface

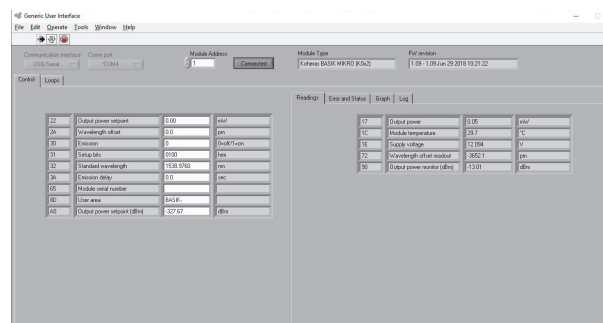


- 3 The GUI window opens:

- a. Under *Communication Interface* - select *USB/Serial*
- b. Click on the *Comm* button in the upper left region of the window. Select the USB port connected to your PC.
- c. In the *Module Address* field, enter: 1
- d. Click the *Connect* button.



- 4 The GUI connects to the laser and displays the current register values.



## 3

# Turning ON the Laser

### Safety

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

*Koheras MIKRO Safety, Handling and Regulatory Information*

You must follow all safety regulations required at the location where the laser is operated.

### Preparation

Enable emission, when the following steps are completed.

1. The laser is securely installed and connected according to the procedures in [“Mechanical Installation” on page 59](#) and [“Connecting the laser” on page 61](#). This means the laser is installed in the recommended environment with power applied and at the very minimum the door switch interlock and the CONTROL PC or a custom integrated control system is connected.
2. For test purposes, the laser is connected to a PC using the RS-485 interface and the PC has CONTROL management software installed and executing according to the procedures in [“Communicating with the Laser” on page 31](#).
3. The FC/APC connector is placed so that any emissions are contained within the working application such as for example, a beam dump that can safely absorb the emitted beam power.



**WARNING:** Enabling emissions emits hazardous laser Class 3B radiation. Ensure to observe and implement all safety regulations, warnings and cautions in this guide and the *Koheras MIKRO Safety, Handling and Regulatory Information* document before continuing.



**WARNING:** Ensure the fiber connector face (tip) is clean. Optical power transmitted through the connector may burn particles on the connector face damaging it.



**NOTE:** When connecting the output fiber patch cord, ensure to match it with an appropriate fiber type.



**CAUTION:** Do not enable emission if the laser has been exposed to temperature and humidity beyond the operating specifications. The laser is designed to operate in a non-condensing environment from +15°C to +60°C. Before enabling emission, allow the laser at least 30 minutes to stabilize at the operating room temperature. Enabling emission when the laser is too cold or hot may lead to the module being damaged.

## Controlling laser emission

**Turning On the laser** To enable emission using CONTROL, follow the steps in [Procedure 3](#). To enable it using the SDK Generic User Interface (GUI), use [Procedure 4](#).



**NOTE:** The laser is equipped with internal temperature sensors that monitor the temperature of sensitive components. If these components are outside their specified temperature range, the laser source halts emission.

### Procedure 3 Enable emission using CONTROL

#### Action

1 Connect to the laser as described in [Procedure 1](#).

2 Check in the CONTROL status panel that the *Interlock* indicator shows ON Green and the *Status* indicator displays ON Amber.

Click the *Emission ON/OFF* button to enable emission. The emission indicator turns ON red.

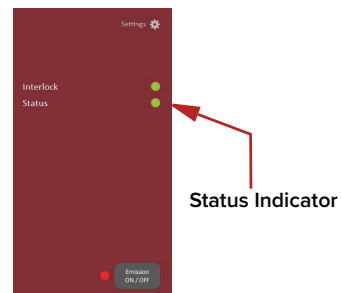
**NOTE:** On the laser's front panel, the LEDs should indicate as follows:

- *Power* ON Green
- *Status* ON Amber
- *Interlock* ON Green
- *Emission* ON Red



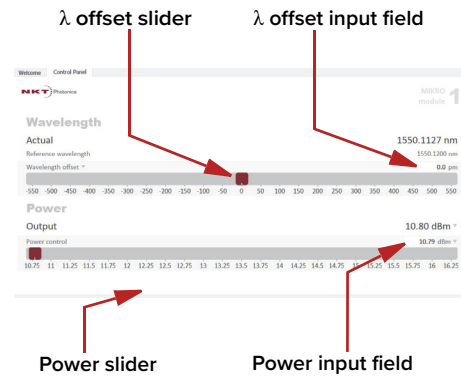
3 When the *Status* indicator turns ON Green, the laser thermalization set point is reached and stabilized.

**NOTE:** The laser's status LED (see - [Status LEDs on page 27](#)) should also show ON Green at this point.





Action	
4	<p>a. In the Control panel, set the reference wavelength (<math>\lambda</math>) or its offset using the <i>Wavelength or offset</i> slider control. To set it, click hold and move the red slider to adjust the setting.</p> <p>b. Alternatively, you can directly enter the wavelength (nm) or offset (pm) by typing the value into the wavelength input text field at the upper right side of the control.</p> <p>c. Set the laser's emitted power using the <i>Power</i> slider. To change the power, click hold the red slider to adjust its position along the bar.</p> <p>d. Alternatively, you can directly enter the output power in dBm or mW by typing the value into the power input text field at the upper right side of the control</p>



$\lambda$  offset slider


$\lambda$  offset input field

Power slider

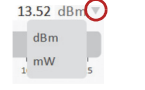
Power input field

**NOTE:** To set the scale units, click on the downward pointing arrows for both the wavelength and power settings.

$\lambda$  scale setting

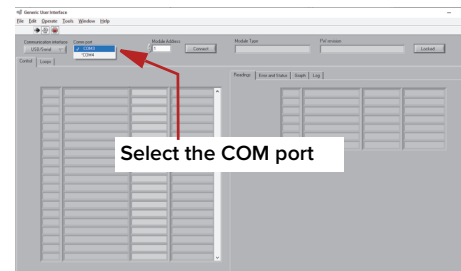


Power scale setting

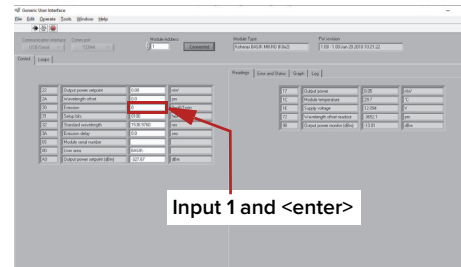


#### Procedure 4 Enable emission using the SDK Generic User Interface

Action	
1	Connect to the laser as described in <a href="#">Procedure 2</a> .
2	<p>Select the correct USB port from the <i>Comm port</i> drop down menu.</p> <p>Ensure the <i>Module Address</i> is set to 1 and click <i>Connect</i>.</p> <p>The SDK GUI connects to the laser.</p>
3	<p>In the parameter input field of Register 30 – <i>Emission</i>, input 1 to enable laser emission.</p>



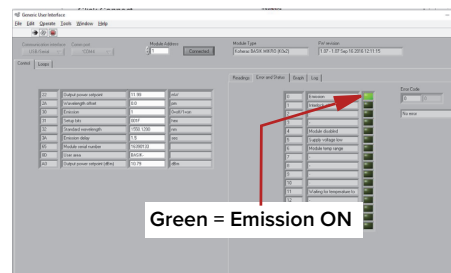
Select the COM port



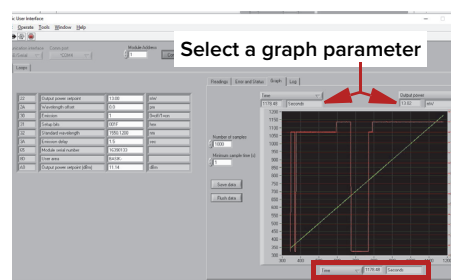
Input 1 and <enter>

## Action

- 4 Click on the *Error and Status* tab in the right side of the window; verify the *Emission* status is lit green. (You can also check the laser's emission LED.)



- 5 Click on the graph tab and then select the parameters to be plotted from the left and right Y-axis and the X-axis drop down menus.



**NOTE:** For a full description of the SDK, registers and its Generic User Interface, refer to the NKT Photonics document: *SDK Instruction Manual*. The manual is installed when the SDK installer is run.

## 4 Using CONTROL

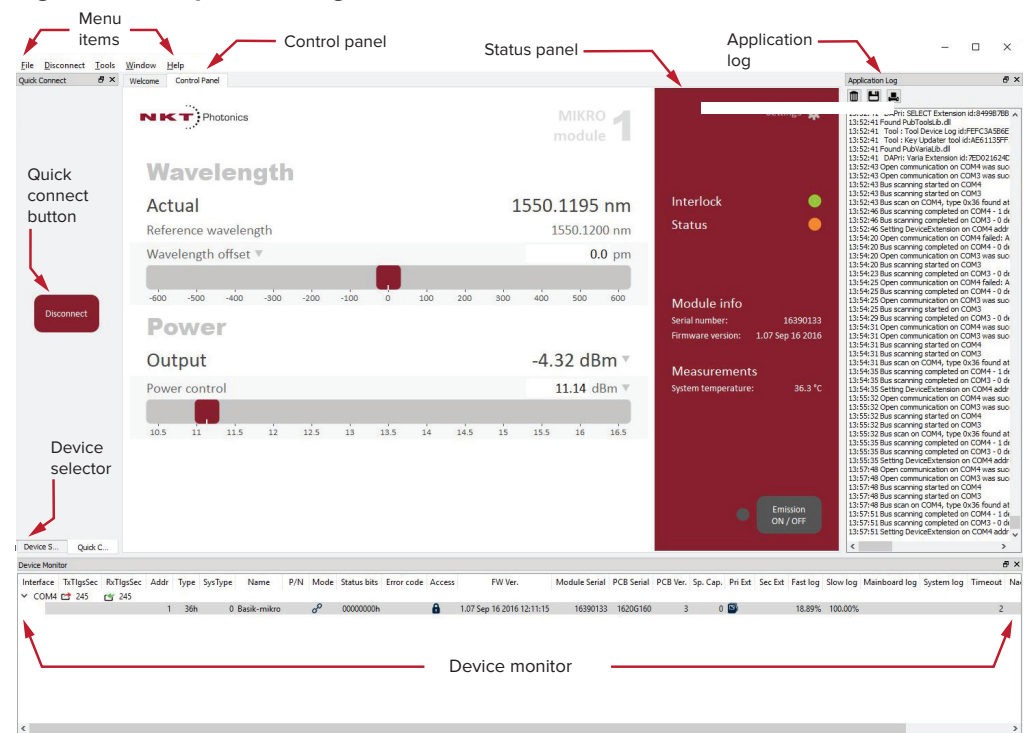
### CONTROL overview

The CONTROL interface includes multiple panels and a selection of menu drop down items in the upper left corner. Using the *Window* drop down menu, you can add or remove the displayed panels and panels can be dragged within the main window or into separate windows. The panels and menu shown in [Figure 8](#) are briefly described [Table 7](#) with links to more details descriptions.

**Table 7 CONTROL panels and menu items**

Panel	Function	See
Status Panel	This panel displays the selected device status, emission control and a CONTROL settings menu.	<a href="#">Status panel on page 43</a>
Menu Items	Four drop down menus with multiple functions.	<a href="#">CONTROL menu items on page 46</a>
Quick Connect	Contains a button when clicked, scans all available PC ports for connected NKT Photonics products.	<a href="#">Connecting to the laser on page 41</a>
Device Selector	Icons representing currently connected devices, click to access the device.	
Control Panel	The <i>Control</i> panel contains controls for the laser. For example, It contains configuration controls to set wavelength and output power.	<a href="#">CONTROL – Control panel on page 50</a>
Serial Monitor	To also help debugging issues, this panel displays multiple port and device parameters.	<a href="#">Device Monitor on page 51</a>
Application Log	This panel displays a debugging log that can be saved to a file.	<a href="#">Application log on page 52</a>

**Figure 8 GUI panel navigation**



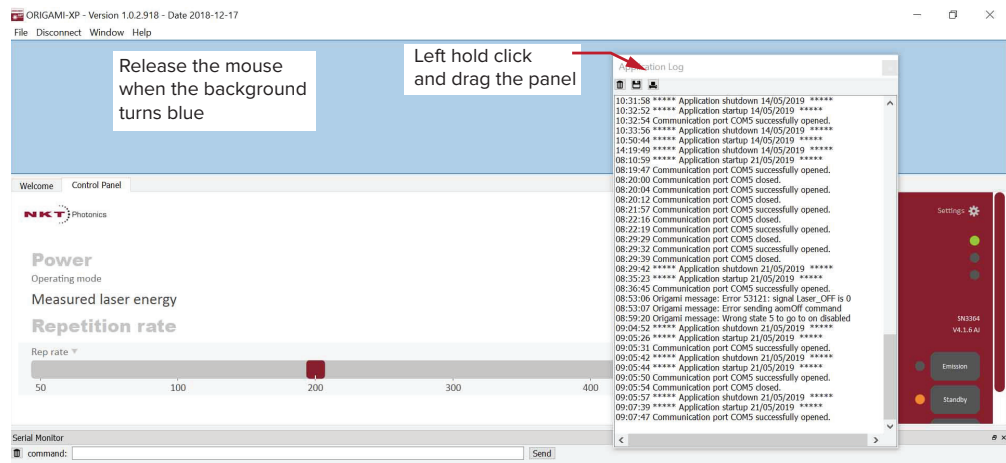
**Relocating panels** You can drag the different panels of CONTROL to any location within the main interface or into a separate floating panel. [Procedure 5](#) describes how to relocate a panel within the main window.

### Procedure 5 Relocating panels

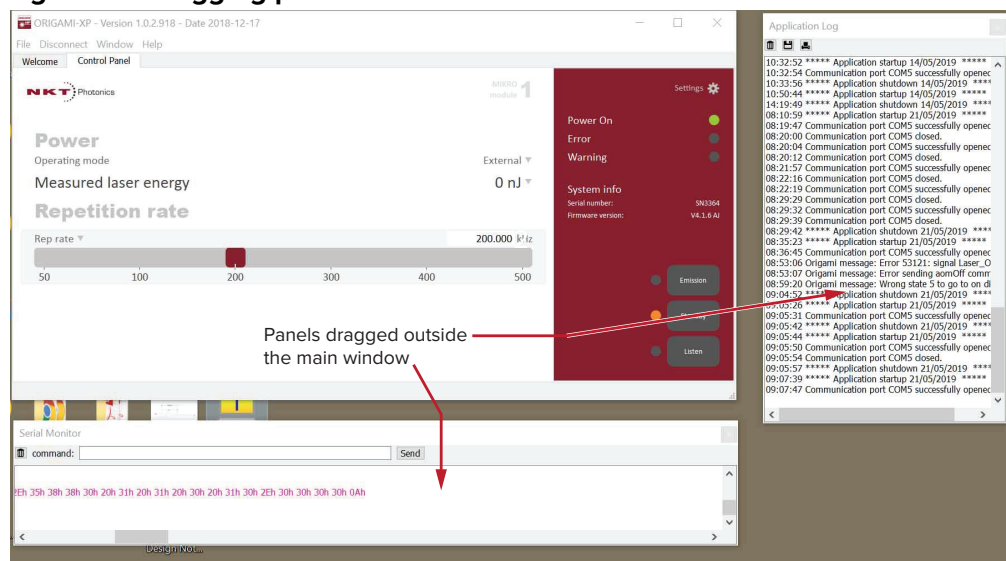
#### Action

- 1 Left click and hold the top title bar of the panel.
- 2 While holding the left mouse button down, drag the panel to another location in the main window.
- 3 In the new location, when the background turns blue, release the mouse button – see [Figure 9](#).
- 4 Alternatively, drag the panel out from the main window and release the mouse button. A separate window for the panel is created. (see [Figure 10](#))

**Figure 9 Relocating panels within CONTROL**

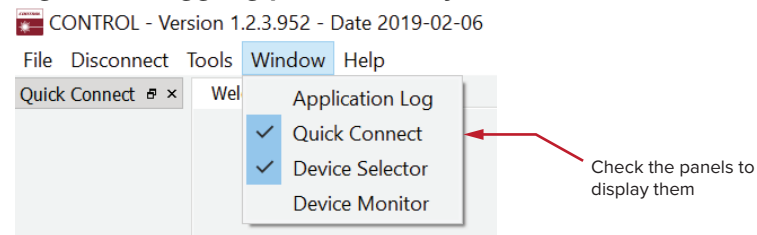


**Figure 10 Dragging panels outside the main window**



**Toggling panels visible** Use the *Menu > Window* drop down menu to check and uncheck panels to be displayed. A blue check mark indicates the panel is displayed.

**Figure 11 Toggling panel visibility**



**NOTE:** To close a panel, click the X at the upper right corner of the panel.

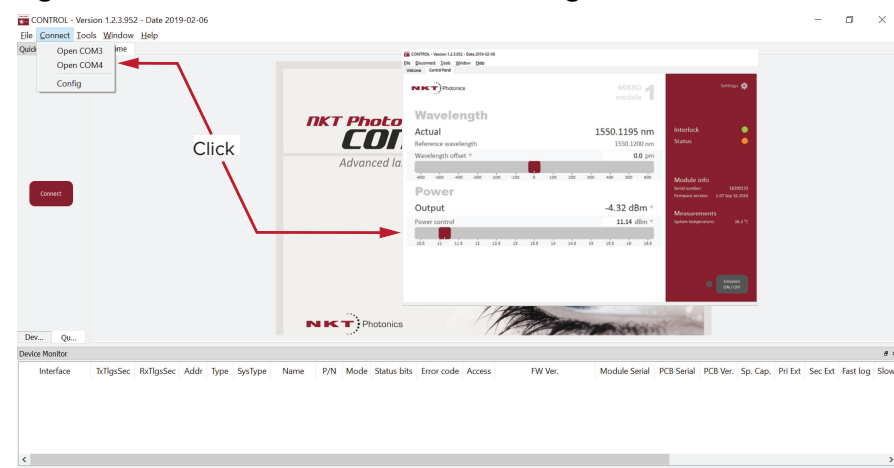
**Connecting to the laser** When CONTROL is launched, the *Welcome* screen is displayed as in [Figure 12](#). In the menu bar, click the *Connect* drop down menu and then click on the COM port your laser is connected to. *Control* and *Status* panels are displayed when the laser connects to the GUI.



**NOTE:** Clicking the *Connect* button, scans and connects to all ports connected to NKT Photonics lasers.

See [“Connecting CONTROL to the laser” on page 32](#)

**Figure 12 Welcome screen and connecting**



### Quick connect

Click the *Connect* button and CONTROL scans all available ports for NKT Photonics devices that it can connect to. Once CONTROL finishes the scan, a list of the devices is presented.

**Figure 13 Connect button**



## Status panel

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

**Figure 14 Status panel**



**Status indicators** The panel displays the following indicators:

### **Interlock**

Indicates if power is connected to the laser.

- ON Green – interlock circuit closed
- ON Red – interlock circuit open

### **Status**

Indicates the laser thermalization:

- ON Green – the laser has reached the set point temperature and has stabilized.
- ON Amber – the laser is in the process of warming up.

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


- Laser serial number
- Laser firmware revision

**Emission button** The *Emission ON/OFF* button turns the laser emission ON, i.e. emission enabled – see “[Controlling laser emission](#)” on page 36.

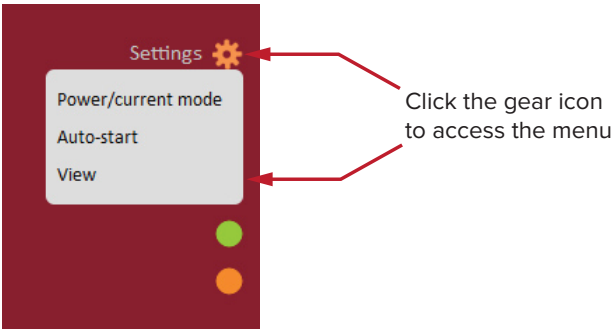
The indicator to the left of the button turns ON Red when laser emission is enabled. When laser emission is disabled, the indicator is OFF Grey.



**WARNING:** Class 3B laser emission is present when the emission button indicator is ON Red.

**Settings** *Settings* are accessible by clicking the gear icon  in the upper right corner of the status panel. Clicking the gear icon displays a drop down menu of setting items as shown in [Figure 15](#).

**Figure 15 Settings**



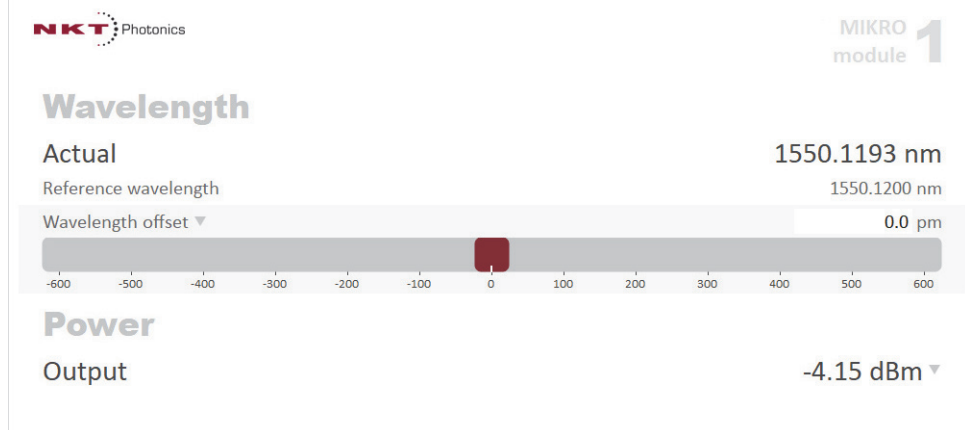
Setting item	Function	See
Power/Current mode	Toggles the mode of the laser between power and current mode.	<a href="#">Power/Current mode on page 44</a>
Auto-start	Check box to toggle Auto-start on or off.	<a href="#">Auto-start on page 45</a>
View	Menu with a check box to enable displaying the system information on the status panel.	<a href="#">View on page 45</a>

**Power/Current mode**

You can set the laser to operate in either power or current mode as described in “[Operating mode](#)” on page 22. Click the menu item to toggle the mode. The *Control* panel automatically displays the controls for the new mode. [Figure 16](#) shows the controls displayed when the operating mode is set to *Current* – see also – “[CONTROL – Control panel](#)” on page 50.



Figure 16 Controls displayed in current mode

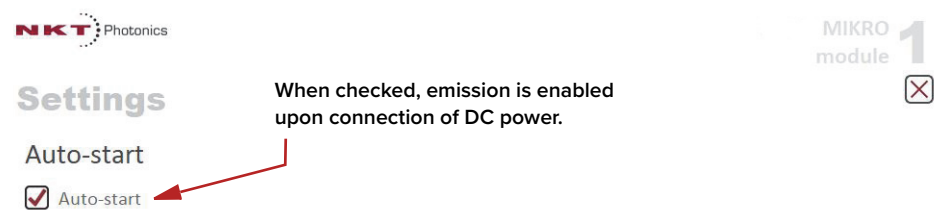
**Auto-start**

The auto-start function is enabled by checking the *Auto-start* box in this panel. See also



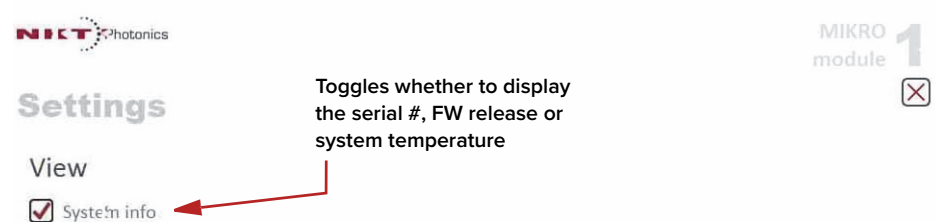
**WARNING:** Emission is automatically enabled upon power-up when the auto-start function is selected.

Figure 17 Enabling the auto-start function

**View**

Check the *System info* box to toggle on the display of the laser serial number and firmware release number within the status panel.

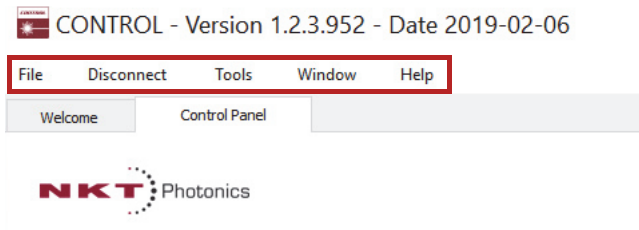
Figure 18 View setting



CONTROL menu items

There are four drop down menus in the main control window as highlighted in [Figure 19](#). Click on the items in the menu to reveal the drop down menus.

Figure 19 Menu Items



Menu Item	Function
File	Exits CONTROL.
Connect / Disconnect	Connects or disconnects lasers.
Tools	Select from one of three special tools to use with your laser. Tools available are: <ul style="list-style-type: none"><li>• <a href="#">Key Updater tool on page 46</a></li><li>• <a href="#">Log Downloader on page 47</a></li><li>• <a href="#">Extensions Overview on page 48</a></li></ul>
Window	Toggles the display of panels - see <a href="#">Toggling panels visible on page 41</a>
Help	Displays the current version of GUI and provides access to the included CONTROL manual.

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

To use the Key Updater tool follow [Procedure 6](#).

Procedure 6 Using the Key Updater tool

**Action**

1

2

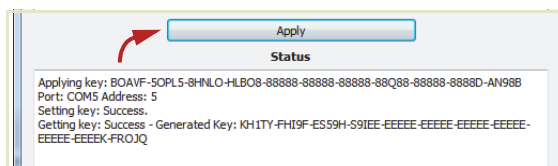
Enter a key code in the field “Enter key code”.

**NOTE:** Key codes are generated by NKT Photonics.

In the list of modules, check the box on the right of each applicable module.

**Action**

3



Click "Apply"



**NOTE:** Certain keys can generate a new locally generated key code. These locally generated keys are usually required during a support session and are sent to NKT Photonics support personnel.

**Log Downloader**

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

NKT Photonics CONTROL automatically downloads log files from modules of any connected devices. The log files are stored in a local database of the CONTROL PC. However, certain NKT Photonics modules, including the Koheras MIKRO mainboard, do not support automatic download of log files. For these modules, you can use the Log Downloader tool to put the device into dedicated log download mode by enabling a collect log function.

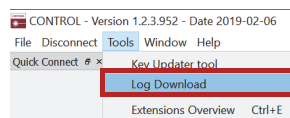


**NOTE:** When the collect log function is enabled, it temporarily disables automatic log collection from all other devices. The CONTROL interface turns gray, and communication with the laser and log collection with all other modules is disabled.

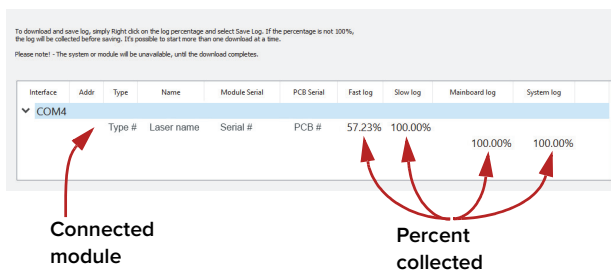
To download log files, use the Log Downloader as described in [Procedure 7](#).

**Procedure 7 Using the Log Downloader****Action**

- 1 Click the *Tools* menu and click on *Log Download* to start the Log Downloader tool.



- 2 The tool displays all connected modules with log capability. To decrease the download time of the module log files, CONTROL continuously collects module log data and stores this log data in a local database on the PC. Logs are collected from each module and each has a percentage indicator that shows the percentage (%) collected of the module's total log data.



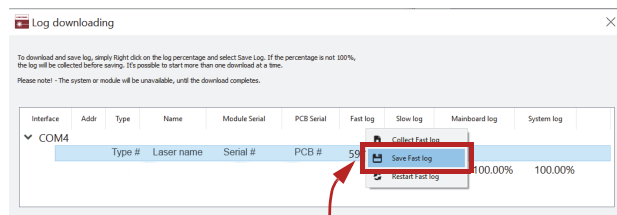
### Action

- To download and save a log file to the CONTROL PC, right click the percentage indicator and select either:

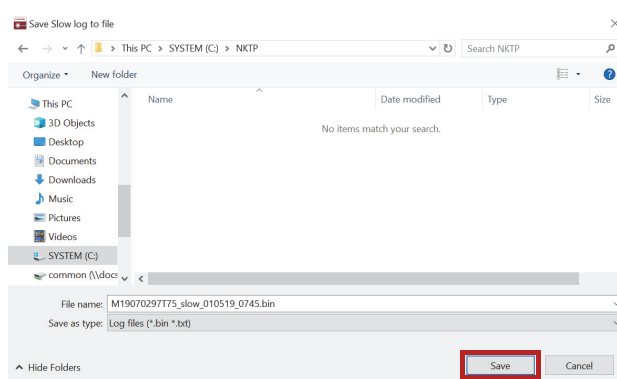
**Save log** – Immediately saves the file onto the CONTROL PC. If the percentage shows less than 100%, the log is first collected. See Collect log below.

**Collect log** – Starts a dedicated log collection mode that disables all other CONTROL activity.

- If you select Save log, a dialog box prompts for a filename and folder to store the log in.

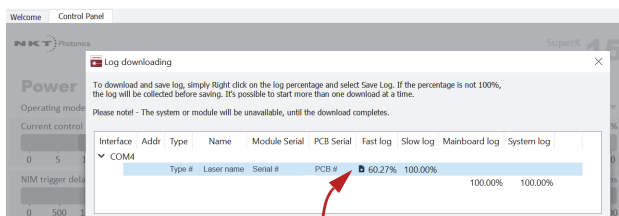


Right click  
the % indicator



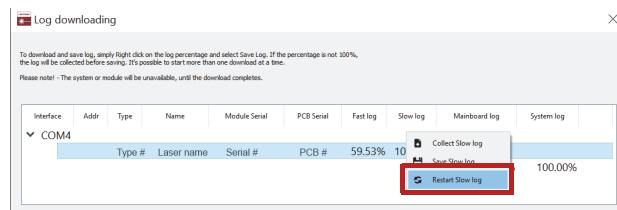
- If you select Collect log, the log is collected and saved in dedicated mode. The CONTROL panel turns grey and all other functions are disabled.

When the log collection is finished, all other CONTROL functions are accessible again.



Dedicated Collection Mode

- Select *Restart* to clear out all collected log data and restart log data collection.



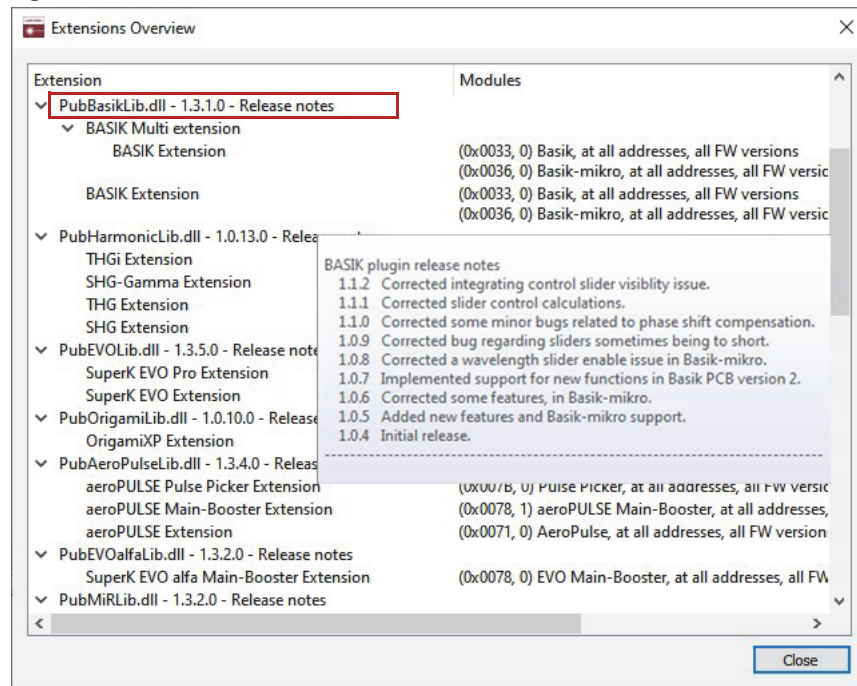
## Extensions Overview

Use this tool to view the installed extensions (similar to plugins) that are included with CONTROL. The extensions are found in the following folder:

C:\Program Files (x86)\NKT Photonics\NKTP CONTROL\Plugins

To view the extensions, open the Tools menu and click on Extensions Overview. The Extensions Overview window is launched as shown in Figure 20.

**Figure 20 Extensions Overview**



**NOTE:** To show a short description of the release notes as seen in Figure 20, hover the mouse pointer over the “Release notes” text

The PubBASIKLib.dll details highlighted in Figure 20 shows the version of the .dll file (1.3.1.0), the included extensions and which module types they support such as 0x0036 which is the MIKRO module.



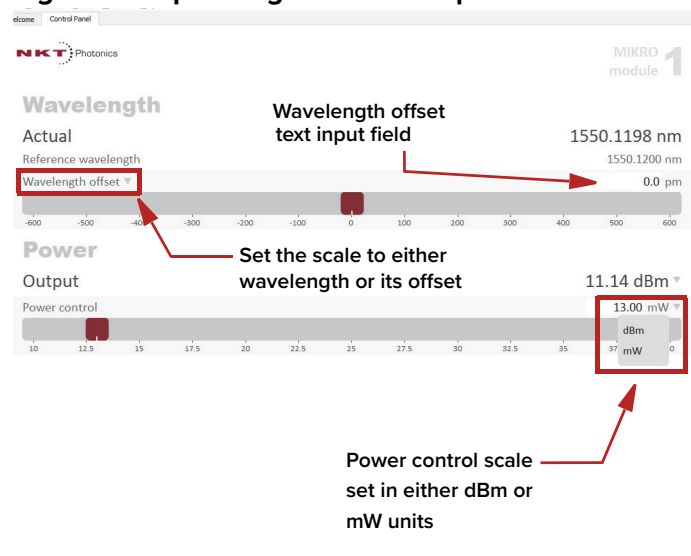
**NOTE:** Multiple extensions for a wide range of NKT Photonics lasers types are typically installed when using the default installation of CONTROL.

## CONTROL – Control panel

For a Koheras MIKRO, the *Control* panel presents different operating controls when set to either *Power* or *Current* mode. The modes are selected by clicking on the *Settings* drop-down menu (gear icon) in the status panel. See “[Settings](#)” on page 44.

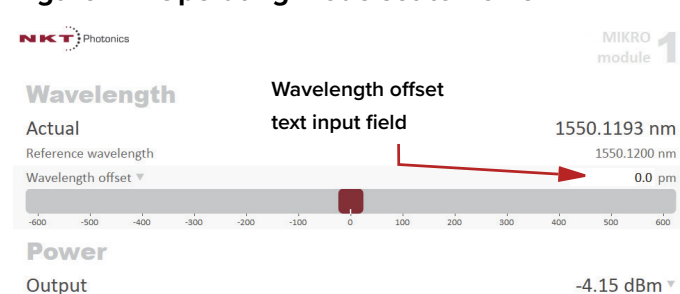
**Power mode** In the Power operating mode the optical output power level is used to control the laser’s output. The panel provides both a wavelength or its offset control in nanometers (or picometers for the offset) and an output power control that can be scaled in either mW or dBm.

**Figure 21 Operating mode set to power**



**Current mode** In *Current* operating mode, the current in the fiber pump is kept at a constant level. Only the wavelength offset control is available in the control panel menu.

**Figure 22 Operating Mode set to Power**



## Device Monitor

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

The display parameter values are continuously updated and can be used to help debug communication issues with connected devices. The parameters are described in [Table 8](#).

**Table 8 Device Monitor parameters**

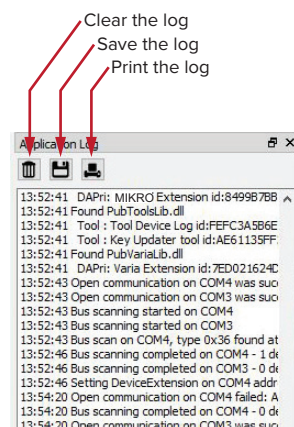
Parameter	Description
Interface	The PC port interface the device(s) is connected to. Click the “greater than” symbol to the left of the port to display the connected device(s) parameters.
TxTlgsSec	The number of telegrams per second being transmitted to the connected device.
RxTlgsSec	The number of telegrams received per second from the connected device.
Addr	The address of the connected module.
Type	The type of the connected module; read from the module.
SysType	The system type, default 0 – can be used to describe system variants and is read from the module.
Name	The name of the connected device module.
P/N	The device module part number.
Mode	The mode or status of the connected module: <i>connected</i> , <i>disconnected</i> , or <i>disabled</i> .
Status bits	The actual status bits read from the connected module.
Error code	The actual error code read from the connected module.
Access	Protected/Locked status of the module.
FW Ver.	The device module's firmware release date.
Module Serial	The serial number of the device module.
PCB Serial	The device module's printed circuit board serial number.
PCB Ver.	The version of the device module's printed circuit board.
Sp. Cap/	The module speed capability in bits per second as read from the module – values: 0=(default) 115200, 1=230400, 2=460800, 3=921600
Pri Ext	Primary extension/GUI loaded for this module. Hover over the icon to list more details – Note that there can only be 1 primary.
Fast Log	0%-100% collected. Note only if the module has a fast log and only internal modules have fast and slow logs.
Slow Log	0%-100% collected. Note only if the module has a slow log.
Mainboard Log	0%-100% collected. Note only if the module has a main log. Only main boards have main and system logs.
System Log	0%-100% collected. Note only if the module has a system log. Only main boards have main and system logs.
Timeout	Time in milliseconds since the last telegram was received from the device module.

Parameter	Description
Nack	Total number of negative acknowledgments received from the device module.
CRC	Total number of received telegrams with CRC failures.
COM	Total number of communication errors with framing or protocol errors. Hover over the icon to list more details.
Busy	Total number of busy responses from the module. Busy responses occur when a module receives a message but cannot process it due to its current work load.

## Application log

In addition to the Serial Monitor, the Application Log panel is used for debugging serial communications. The panel displays time stamps for both COM port open and close times and also general status information. You can clear, save and print the log data using the buttons in the upper left corner.

**Figure 23 Serial Monitor**



The panel is enabled by placing a check mark on the Window pull down menu next to the Application Log item.

To close the panel click on the upper right corner "X".



## 5 Software Development Kit

When integrating a custom platform using the Software Development Kit, you can test registers controlling the laser's operating parameters using its Generic User Interface. For general operation it is recommended to use CONTROL. This section describes four example settings to illustrate how to use the Generic User Interface to read and write the laser's operating registers. The example settings are:

- wavelength – see “[Tuning the wavelength](#)” on page 53
- operating mode – see “[Setting the operating mode](#)” on page 54
- auto-start setting – see “[Auto start](#)” on page 54
- emission delay setting – see “[Setting the emission delay](#)” on page 55  
“[Tuning the wavelength](#)” on page 53

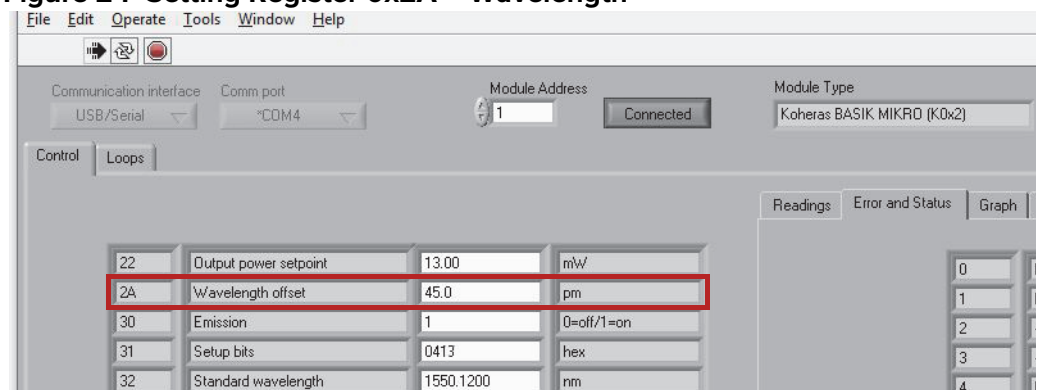
**NOTE:** For a full description of the SDK, registers and the SDK GUI, refer to the NKT Photonics document: *SDK Instruction Manual*. Both the manual and the GUI are installed when the SDK installer is run.

**NOTE:** This section assumes the GUI is already connected to the MIKRO. For information on connecting the GUI, refer to the chapter “[Communicating with the Laser](#)” on page 31.

### Tuning the wavelength

The relationship between temperature and the fiber laser's wavelength is stored in the laser's memory module. To tune the laser thermally, enter the desired wavelength offset in picometers (relative to the nominal wavelength) into register 0x2A of the memory module.

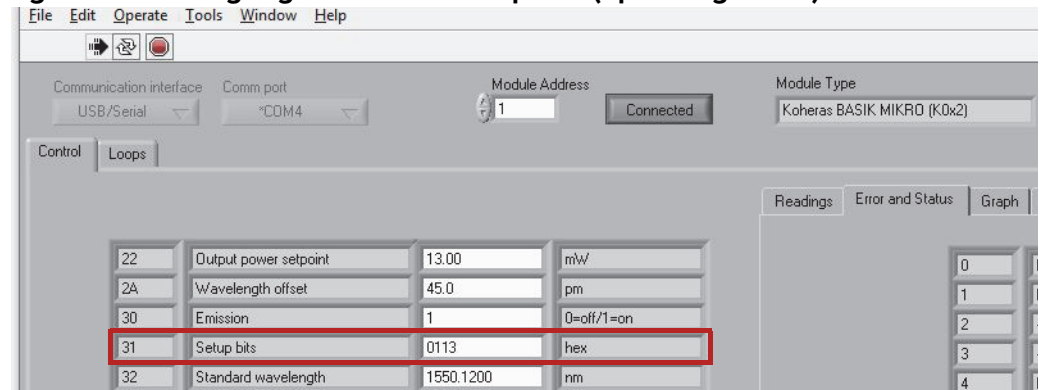
**Figure 24 Setting Register 0x2A – Wavelength**



## Setting the operating mode

To set the operating mode, set bit 8 of register 0x31. When the bit is set to '0', the MIKRO operates in *Power mode* and when set to '1', it operates in *Current mode*.

**Figure 25 Setting register 0x31 – setup bits (operating mode)**



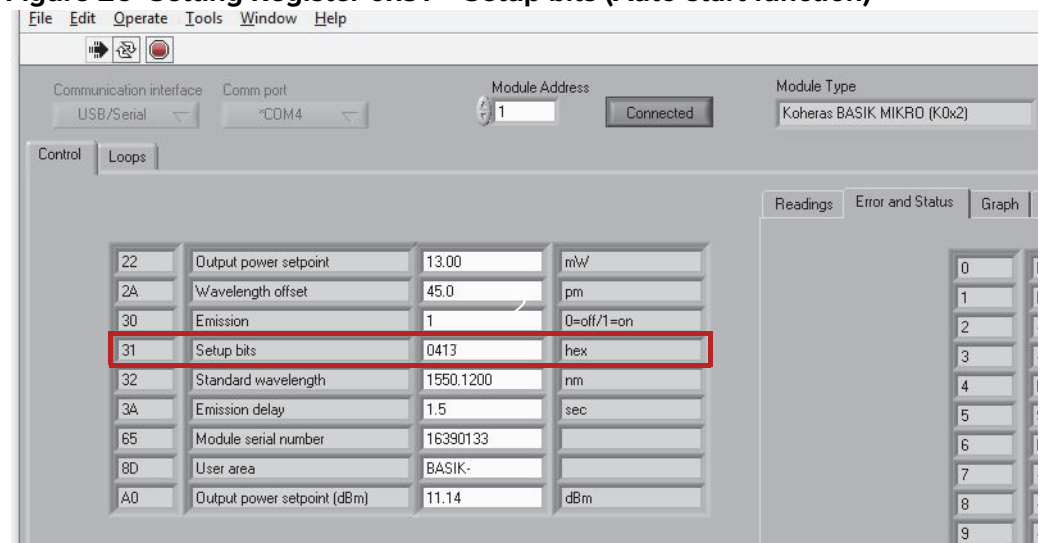
To set the mode, input the following examples into register 0x31:

- 0113 – *Current mode* is set
- 0013 – *Power mode* is set

## Auto start

The Auto-start function uses bit 10 of register 0x31 to enable or disable the Auto-start function. '0' sets the autostart to disabled and '1' sets it to enabled.

**Figure 26 Setting Register 0x31 – Setup bits (Auto-start function)**



The following are some examples of entries in the 0x31 register.

- 0513 – auto-start function is enabled with current mode set.
- 0413 – auto-start function is enabled with power mode set.

- 0113 – auto-start function is disabled with current mode set.
- 0013 – auto-start function is disabled with power mode set.



**NOTE:** For register 31, bits 0-7 and bits 9, 11-15 are unused.

## Setting the emission delay

To set the emission delay timer, enter a time, in seconds in register 0x3A.

**Figure 27 Setting Register 0x3A – Emission delay**

The screenshot shows a software window with a menu bar (File, Edit, Operate, Tools, Window, Help) and a toolbar. Below the toolbar, there are fields for 'Communication interface' (USB/Serial), 'Comm port' (\*COM4), 'Module Address' (1), and 'Module Type' (Koheras BASIK MIKRO (K0x2)). A 'Connected' button is also present. The main area has two tabs: 'Control' and 'Loops'. The 'Loops' tab is active, displaying a table of registers. The table has four columns: Register Address, Register Name, Value, and Unit. Register 3A, 'Emission delay', is highlighted with a red box, showing a value of 1.5 seconds. To the right of the table, there are tabs for 'Readings', 'Error and Status', and 'Graph', and a vertical stack of buttons numbered 0 through 9.

Register Address	Register Name	Value	Unit
22	Output power setpoint	13.00	mW/
2A	Wavelength offset	45.0	pm
30	Emission	1	0=off/1=on
31	Setup bits	0413	hex
32	Standard wavelength	1550.1200	nm
3A	Emission delay	1.5	sec
65	Module serial number	16390133	
80	User area	BASIK-	
A0	Output power setpoint (dBm)	11.14	dBm



## SECTION 3

# INSTALLING THE LASER

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

- [“Mechanical Installation” on page 59](#)
- [“Connecting the laser” on page 61](#)



## 6

# Mechanical Installation

The Koheras MIKRO is designed to be used as a stand-alone module installed on a flat surface. The laser generates a substantial amount of heat that must be dissipated. This section describes how to mount the laser module to ensure optimal function.

### General

All chassis types must be installed on a level surface that is free from vibrations. The ambient temperature surrounding the laser should be stable and free from anything that could cause temperature fluctuations. Temperature changes and vibrations may affect the laser's operation and result in abnormal operation.



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

### Heat dissipation

The heat generating parts within the module are thermally connected to the bottom of the module case. To dissipate heat, ensure there is a thermal path from the module's bottom panel to the surrounding environment. Ensure this by verifying the bottom panel makes full contact with a flat mounting surface. To act as an adequate heat sink, the surface should be metallic and preferably constructed of aluminum.

### Thermal resistance

Thermal resistance ( $R_{\theta}$ ) to the environment depends on the maximum environmental temperature, the maximum module temperature and maximum power consumption for the module.

$$R_{\theta} = (t_{\text{module}} - t_{\text{environment}}) / P_{\text{max}}$$

Where:

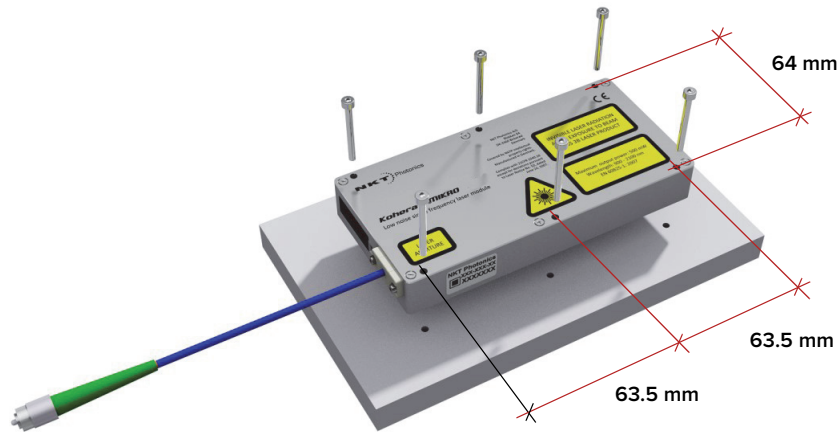
$$t_{\text{module}} = 60^{\circ}\text{C}$$

$$P_{\text{max}} = 10 \text{ watts.}$$

## Installation method

Figure 28 below shows the recommended way of mounting the module on a flat surface.

**Figure 28 Mounting the laser**



1. Prepare a flat mounting surface with pre-drilled 3.3 mm diameter holes or M3 tapped holes that match the dimensions in Figure 28. (Refer also to Figure 31 for other module dimensions.)
2. Using 6 – M3 x 25 (or longer depending on the surface) machine screws, fasten the laser module to the surface.
3. Inspect the installation to ensure the entire bottom panel of the module makes thermal contact with the mounting surface. (The mounting surface must be suitable to act as a heat sink.)

**Operating and storage environment** Appendix A states required ambient operating and storage environment specifications.



**WARNING:** The Koheras MIKRO is a Class 3B laser product and its operation facility and conditions must comply with the standards listed below or similar:

- CFR21 1040.10 & Laser Notice LN50
- IEC / EN 60825-1



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

For information on how to connect:

- The Safety Interlock – see “[Connecting the safety interlock](#)” on page 61
- Power – see “[Connecting power](#)” on page 63
- Fast Wavelength Modulation Input – see “[Fast wavelength modulation input](#)” on page 63
- The Optical Output – see “[Connecting the optical output](#)” on page 64

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## Connecting the safety interlock

To comply with safety regulations and help provide a safe operating environment, connect the safety interlock of the laser to a switch activated by an access door to the laser’s operating enclosure. When the switch connected to the access door opens, it opens the interlock circuit which immediately turns off and disables laser emission. The laser is disabled within approximately 100 ms from when the interlock circuit opens. To enable emissions again, the circuit must first be closed and the emission button clicked within the CONTROL GUI.

**Interlock operation** When temporarily operating the MIKRO as a stand-alone laser on a bench top, you can connect an interlock to the “[RS-485 adapter](#)”. The adapter has three pins that connect to the laser’s interlock functionality. The pins are located next to the RS485 connector. Referring to the diagram shown on the adapter label, jumping the outermost pin with the center pin disables laser emission. Conversely, moving the jumper over the innermost and center pin, permits emission and defeats the interlock (i.e. this sets 5V to pin 8 of the main electrical interface), see [Figure 34 on page 82](#).

### Connecting the interlock

Using a Molex 50-57-9003 connector housing or similar, connect a door switch circuit to the center and innermost interlock pins of the adapter as shown in [Figure 29](#) and described in [Procedure 8](#).

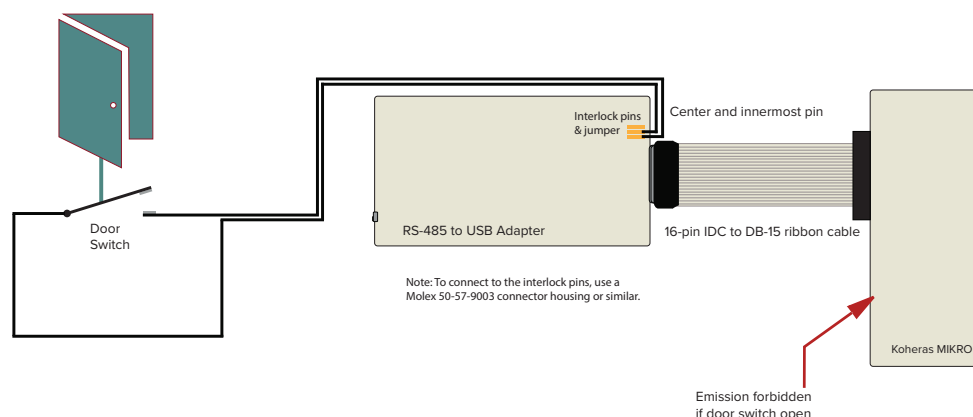


**WARNING:** To prevent injury, always follow the instructions in IEC TR 60825-14 on correct implementation of interlock systems. [Procedure 8](#) describes how to connect a safety door switch to the interlock circuit when testing the laser.



**NOTE:** The Interlock Loop connector (LEMO type) of the RS-485 adapter is not in use when the adapter is connected to a MIKRO module.

**Figure 29 RS-485 adapter connected to a door switch (open position)**



**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 the 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 8](#) to connect a safety door switch to the interlock circuit of the laser.

### Procedure 8 Connecting the door interlock circuit

Action
1 Install a switch that opens when the door accessing the laser enclosure is opened. The switch must comply with regulations.
2 Using a Molex 50-57-9003 or similar plug connector, connect the switch to the inner most and center interlock pins of the RS485 adapter.
3 Before powering on the laser, perform a continuity test using a multimeter: <ul style="list-style-type: none"> <li>Remove the plug connector from the adapter interlock pins and connect multimeter leads to it.</li> <li>Confirm when the enclosure door is closed, the meter shows the circuit as closed.</li> <li>Confirm when the enclosure door opens, the meter shows the circuit as open.</li> </ul>
4 Using the DB-15 to IDC 16 pin ribbon cable, connect the RS485 adapter to the laser.
5 Push the plug connector from the door switch onto the interlock pins of the adapter. Ensure to orientate it so the innermost and center pin are connected to the door switch.

# Connecting power

The RS-485 adapter kit includes an external power supply as shown in [Figure 30](#). The power supply provides 12 volts DC to the RS-485 adapter by means of a two pole barrel connector. Power is delivered to the laser through the ribbon cable from the adapter to the laser’s 16 pin main interface connector. Refer to [Table 16 on page 73](#) for the laser’s pin assignments.

Follow the instructions in [Procedure 1](#) to connect power to the laser.

**Figure 30 Power supply**



**Table 9 Power adapter specifications**

Item	Description
DC Output	12 V – 5 A
AC Input	100-240 VAC @ 50-60 Hz – 1.5 to 0.7 A
AC Connector (inlet)	IEC 60320 – C6
DC Connector	2.5 mm Barrel (2.5x5.5x12)

## Fast wavelength modulation input

When stability of the laser wavelength is the priority, you can connect an external sinusoidal signal to the fast wavelength modulation input. The signal modulates a Piezo element within the laser substrate which rapidly thermally tunes the laser.

Signal specifications are shown in [Table 10](#). Pin assignments are also listed under “Fast wavelength modulation input” on [page 74](#).

**Table 10 Fast wavelength modulation specifications**

Specification	Description
Connector Type	The input accepts a 2-pin SL type use Molex 50-57-9402 or similar
Piezo Capacitance	450 to 700 nF
50/V.ms	50 V/ms
Signal Bias	Positive @ the wavelength
Maximum Slew Rate	50 V/ms

**Capacitance** The wavelength modulation function is made with a piezo element inserted in the laser substrate where the fiber laser is mounted. The piezo element is from an electrical point of view seen as a capacitor with a capacitance at 450-700 nF.

**Slew rate** Table 10 shows that the slew rate of the electrical signal must not be larger than 50 V/ms. For a sinusoidal signal applied to the *Wavelength+/-* input, this corresponds to a maximum of 159 Hz at 100 Vpp.



**NOTE:** When fast wavelength modulation is not employed, connect the *Wavelength+/-* pins of the connector to each other using a jumper. Jumping the pins prevents noise from being picked up by the circuit which may cause undesired phase noise.

## Connecting the optical output

Before connecting the optical output connector (FC/APC), ensure to check the connector tip using a fiber microscope. Using the microscope, check for any deformities, damage, residue or other contaminants at the optical tip of the connector. Either clean the connector or contact NKT Photonics support if a replacement is necessary.

# APPENDICES

The appendices include:

- [Appendix A on page 67:](#) Specifications
- [Appendix B on page 71:](#) Service and support
- [Appendix C on page 73:](#) Interface pin assignments
- [Appendix D on page 75:](#) CONTROL Installation
- [Appendix E on page 81:](#) RS-485 Adapter
- [Appendix F on page 83:](#) Configuration ID



# A Specifications

**Table 11 Optical<sup>1</sup>**

	E15	C15
<b>Laser Emission</b>	CW - inherently single frequency	CW - inherently single frequency
<b>Beam Quality [M2]</b>	< 1.05	< 1.05
<b>Linewidth [kHz]<sup>i</sup></b>	< 0.1	< 15
<b>Max. Phase Noise [dB((Rad/√Hz)/m)]</b>	-90@10 Hz -110@100 Hz -130@20 kHz	-69@10 Hz -89@100 Hz -109@20 kHz
<b>Max phase-noise [μrad/√Hz/m]</b>	32@10 Hz 3.2@100 Hz 0.3@20 kHz	355@10 Hz 36@100 Hz 3.5@20 kHz
<b>Peak RIN [MHz]</b>	~ 0.7	~ 1
<b>RIN level @ Peak / 10 MHz [dBc/Hz]</b>	<-100 / <-135	<-120 / <-140
<b>Optical S/N (50 pm res.) [dB]</b>	> 50 (typ. > 55) <sup>ii</sup>	> 65 (typ > 70)
<b>Min. Thermal Tuning Wavelength</b>	± 350	± 350
<b>Tuning Range [pm]<sup>iii</sup></b>	Wide range <sup>iv</sup> Narrow range <sup>iii</sup> ± 150	± 150
<b>Total thermal tuning range [pm]</b>	Wide range <sup>iii</sup> Narrow range <sup>iii</sup> 1000 450	1000 450
<b>Option Specifications</b>		
<b>Fast Wavelength Modulation range [GHz]</b>	>8	>8
<b>Fast Wavelength Modulation [KHz]</b>	up to 20	up to 20
<b>PM Output - PER [dB]</b>	>23	>23

i. Lorenzian

ii. >47 dB (typically > 52 dB) for non-PM version.

iii. Relative to the center wavelength at room temperature. If the laser case temperature is outside the range of approximately 10-50 °C, the range of detuning from the center wavelength may be reduced.

iv. See “Thermal tuning options” on page 20.

**Table 12 Mechanical dimensions**

All chassis models	
<b>Size (H x W x D)</b>	20 x 70 x 150 mm 0.79 x 2.76 x 5.91 in)
<b>Weight</b>	0.35 kg (0.77 lb)

1. Always refer to the factory test sheet for the optical specifications of an individual laser and refer to the NKT Photonics sales datasheet for the most up-to-date optical specifications when selecting a laser.

---

**Table 13 Operating and storage environment**

All Chassis Models	
<b>Operating Temperature</b>	15°C to 60°C (59°F to 140°F)
<b>Storage Temperature</b>	-20°C to 60°C (-4°F to 140°F)
<b>Operating Humidity (non-condensing)</b>	0 to 70%

**Table 14 Electrical**

All Chassis Models	
<b>Supply Voltage</b>	11 to 13 VDC 5 A
<b>Maximum Power Consumption</b>	10 W

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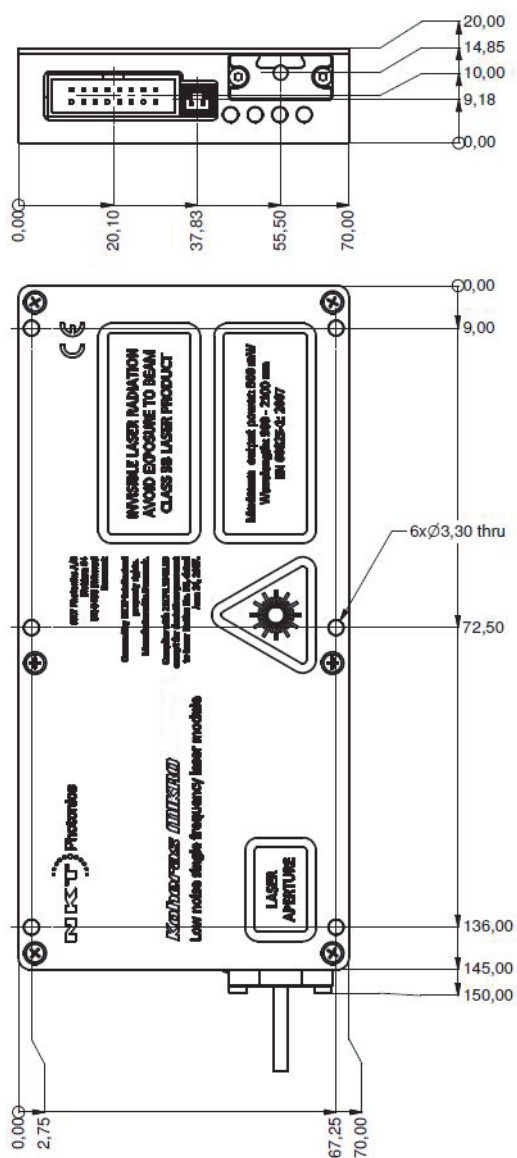
**Table 15 Safety and regulatory compliances**

Safety	Regulatory
EN 60825-1:2014: Safety of laser products Part 1: Equipment classification and requirements <b>[Laser Class 4]</b> EN 61010-1:2010: Safety requirements for electrical equipment for measurement, control, and laboratory use Part 1: General requirements	EN 61326-1:2013: Electrical equipment for measurement, control and laboratory use EMC requirements – Part 1: General requirements 2004/108/EC Electromagnetic Compatibility 2011/65/EC Restriction of the use of certain Hazardous Substances in electrical and electronic equipment (RoHS)

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Figure 31 Mechanical dimensions





## B

# Service and support Information

## Servicing the laser

The laser has 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 module. The laser modules are equipped with warranty labels (see [Figure 32](#)) on the module casing. The warranty is void if the module is opened.

**Figure 32 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 module casing

There are no user serviceable components inside the module casing. Should your laser malfunction, and it cannot be serviced on site, it must be shipped to the NKT Photonics office in Birkerød, Denmark - see “[Shipping address](#)” on [page 72](#).

### WARRANTY VOID IF REMOVED Label

The unit is sealed with a label “WARRANTY VOID IF SEAL IS BROKEN OR REMOVED”. It is strictly prohibited to disassemble the module casing.

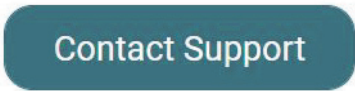
## Support contact details

If you need help or have questions regarding your Koheras MIKRO laser or its accessories, contact NKT Photonics through our support website below:

**Support website** 1. Go to:

<https://www.nktphotonics.com/support>

2. Scroll down and click or press:



Contact Support

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

**Online support web-  
page** <http://www.nktphotonics.com> (click on support)

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

## C Interface pin assignments

### Main electrical interface

Figure 33 Main electrical interface PIN layout

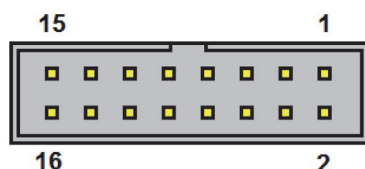


Table 16 Main electrical interface pin assignment

Pin #	Signal	Description
1	Module OK	Low: module enable low OR module not stable (frequency tuning) High: module stable (frequency)
2	Emission	Collector output with internal 240 $\Omega$ resistor in series. High when the Koheras MIKRO has laser emission ON. Anode from a LED can be connected directly to this pin and the Cathode to GND to indicate laser emission externally.
3	RS485-	The negative/inverted part of the RS485 communication signal.
4	RS485+	The positive/non-inverted part of the RS485 communication signal.
5	Not used	
6	EnableLogic Input	Must be set high (5V) in order to achieve laser emission. If emission has been obtained and the Enable pin goes low, emission is shut off.
7	Not used	
8	Interlock Logic Input	Must be set high (5V) in order to achieve laser emission. If emission is obtained and this Interlock pin goes low, emission is shut off. This control input is for personal safety, and handled with redundancy inside the module.
9-12	GND	0 volt / ground.
13-16	12V+	12 volt supply voltage for Koheras MIKRO module.

## Fast wavelength modulation input

**Table 17 Fast Wavelength Modulation input**

Pin #	Signal	Description
1	Wavelength+	Positive control signal for fast wavelength modulation. A higher positive signal on Wavelength+ relative to Wavelength- leads to a larger optical wavelength. The voltage level on this pin must be between -10 and +100 volt relative to Wavelength-.
2	Wavelength-	Negative control signal for fast wavelength modulation. The voltage level on this pin must be between -10 and +10 volt relative to GND.

## D CONTROL installation

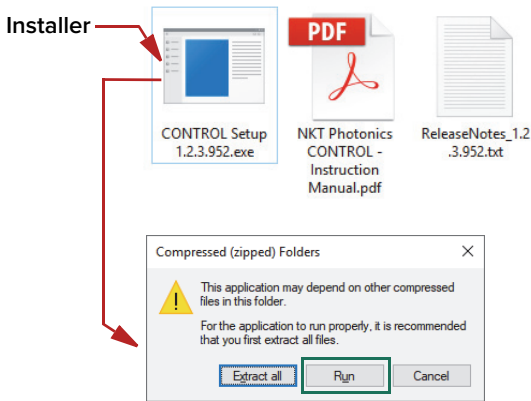
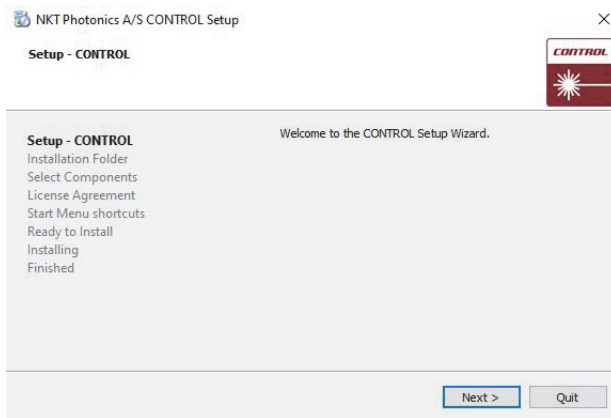
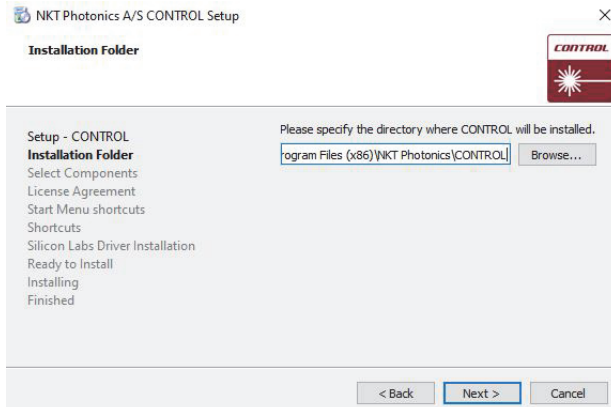
### Installing CONTROL

Download the software from:

<https://www.nktphotonics.com/support>

Follow the steps in [Procedure 9](#).

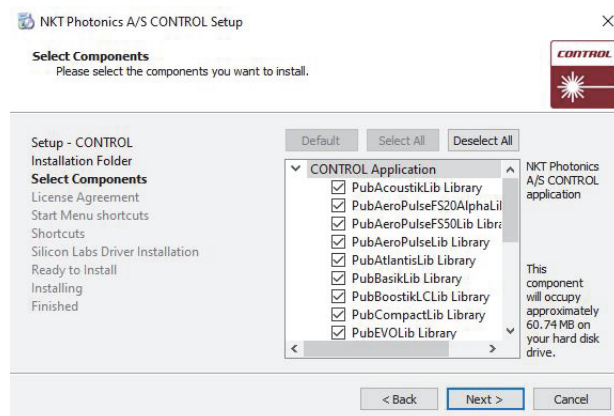
#### Procedure 9 Installing CONTROL

Action	
1	<div>On the PC, launch the installer package and then click the Run button.</div> <div></div>
2	<div>The installation wizard appears.</div> <div>Click Next to continue.</div> <div></div>
3	<div>Accept to use the default installation directory or select another directory by clicking the Browse button.</div> <div>Click Next to continue.</div> <div></div>

## Action

- 4 Uncheck the components you do not require. By default, all components are installed.

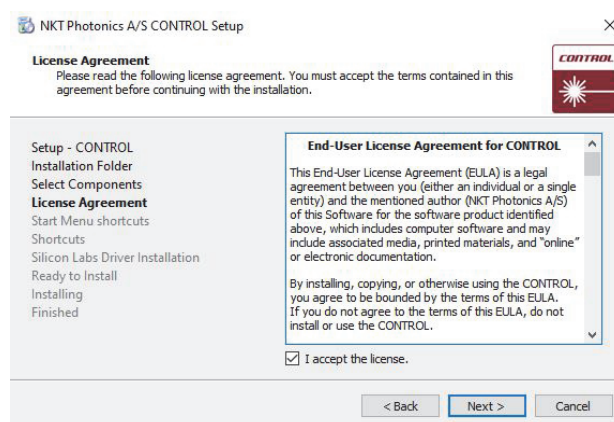
Click *Next* to continue.



- 5 Read the End-User License Agreement, and check "I accept the license." box.

Not checking the box ends the installation wizard.

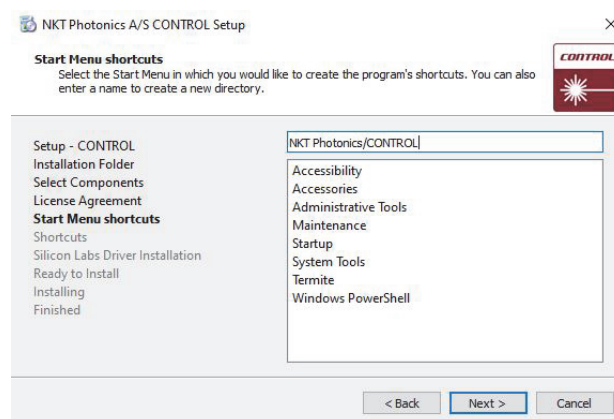
Click *Next* to continue.



- 6 The wizard creates a start menu folder with program short-cuts.

Use the default name or enter a new name for the folder.

Click *Next* to continue.

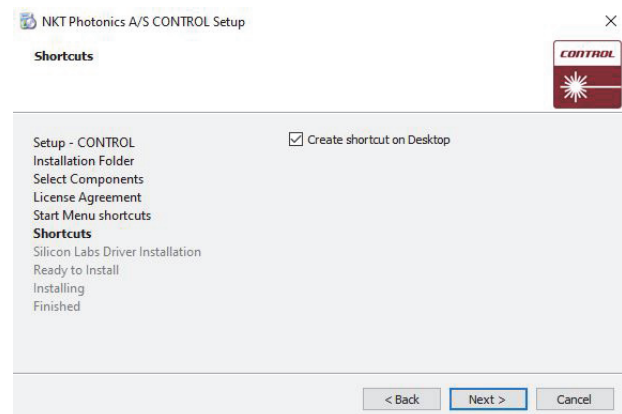




**Action**

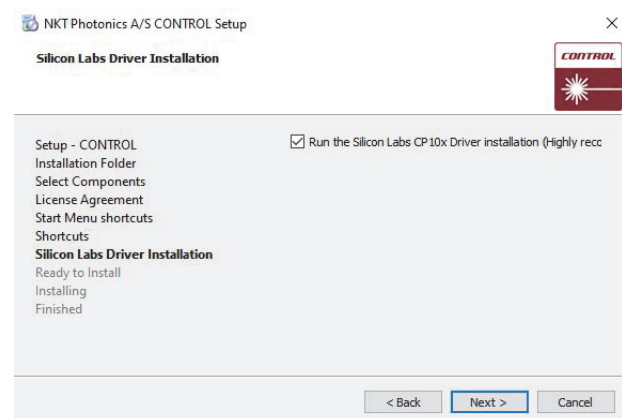
- 7 Check the box to create a desktop shortcut to access Control.

Click *Next* to continue



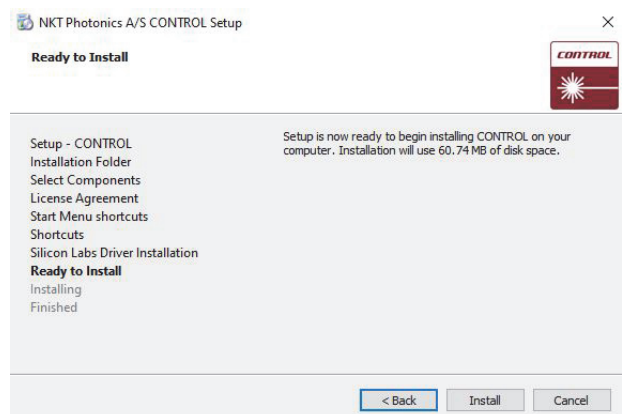
- 8 Check the 'Run the Silicon Labs CP10x driver installation' box and click *Next*.

**NOTE:** If you do not have the driver installed USB connectivity will fail.



- 9 Click *Install* to install NKT Photonics CONTROL software on your PC.

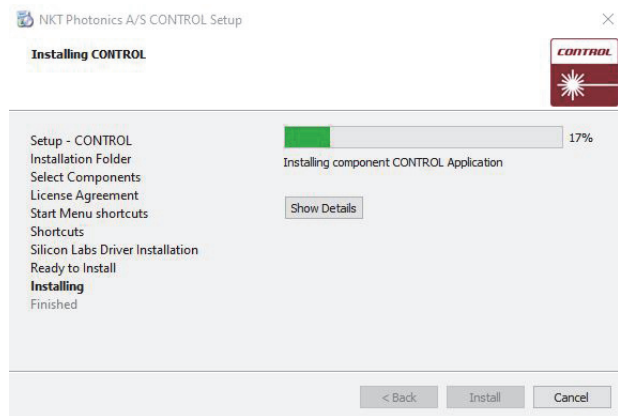
Click *Cancel* if you want to abort the installation..



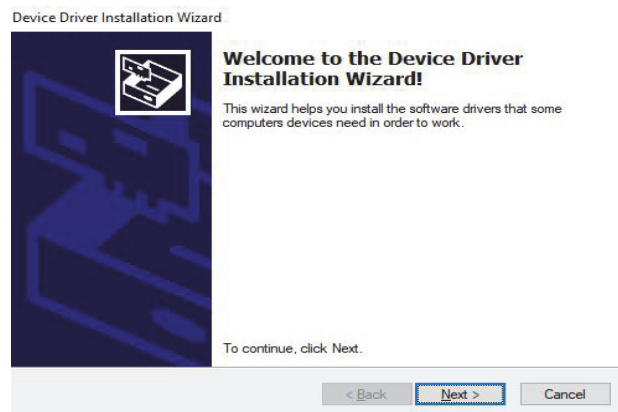
**Action**

- 10 The wizard displays a progress meter for the installation.

**NOTE:** A normal install should only take a few seconds.

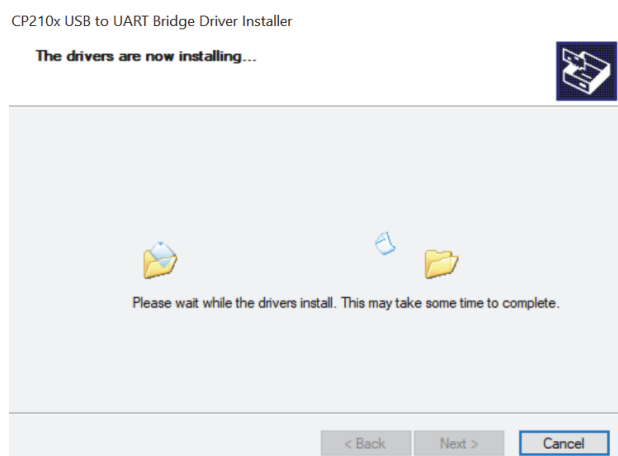


- 11 Click *Next* to install the UART drivers for the PC USB port.



- 12 The drivers are installed.

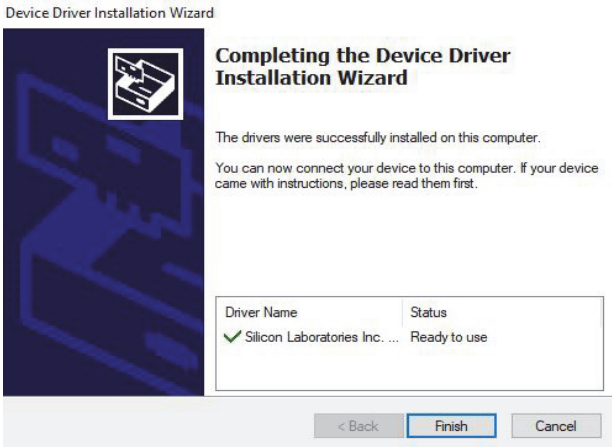
**NOTE:** Depending on your computer this occurs so fast you may not see this.



Action

13 The Silicon Labs drivers is installed successfully.

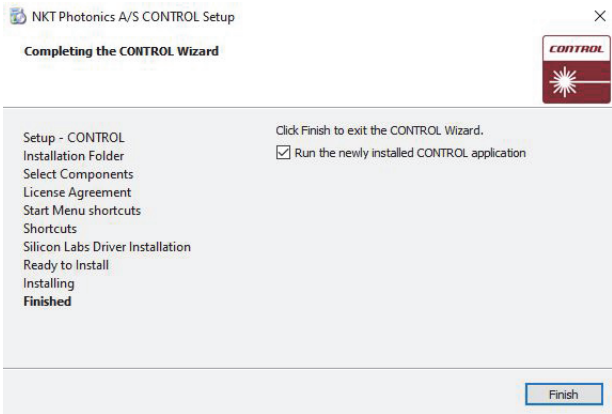
Click *Finish* to end the driver installation.



14 CONTROL is now installed.

Check the Run box to launch CONTROL when the *Finish* button is clicked.

Click *Finish* to end the installation wizard.



End of Procedure



## E RS-485 adapter

If required, an RS-485 adapter kit is available for use with the laser. The adapter provides multiple functions:

- Input for DC power
- USB to RS-485 communication ports
- Interlock connection and jumper
- Status LEDs

If you need an adapter and its associated components contact NKT Photonics support, see [“Support contact details” on page 72](#).

**Main adapter** [Figure 34](#) depicts the adapter port interfaces that connect to both the PC and laser. The adapter’s main function is to connect and convert the laser’s RS-485 communication signals to serial USB and vice versa. The USB port can then be connected to either a management PC executing CONTROL or the SDK. The laser connects to the adapter using a 16 pin ribbon cable with a male DB-15 connector. For USB connectivity the adapter is equipped with a B-type USB port that typically connects to a PC using a standard Type A to Type B USB cable.



**NOTE:** To connect a PC to the adapter, NKT Photonics USB serial adapter software must be installed on the PC.

### Power

The adapter also provides a two-pole power input socket to connect with an included external power supply. The connected DC supply powers the adapter and also provides power to the laser through the DB-15 connector and ribbon cable.

### Interlock

To connect the laser’s interlock pins to a door switch, the adapter is equipped with a 3 pin connector that includes a jumper. With the jumper set over the center and outermost pin, the interlock is open and no emission is possible. Setting the jumper over the innermost and center pins, the interlock is closed and emission is possible.



**NOTE:** Note the interlock circuit is closed when 5V is detected on pin 8 of the main electrical interface of the MIKRO.

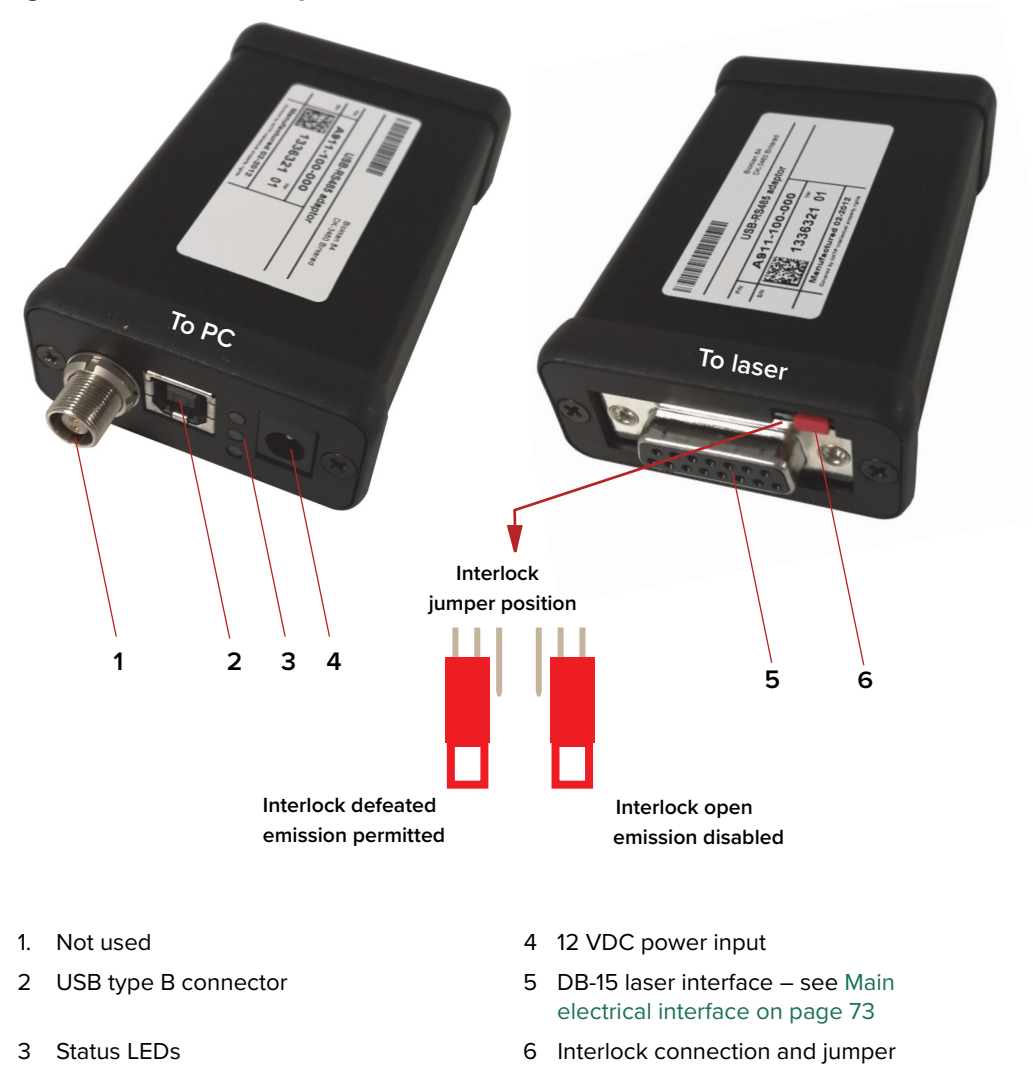
### LEDs

The adapter includes three status LEDs that are described in [Table 18](#).

Table 18 RS-485 adapter status LEDs

LED	Condition	Description
Power	OFF	No Power Connector
	ON Green	12 VDC Power Connected
TX/RX	Flash RED	Adapter receives USB data (from PC)
	Flash Green	Adapter receives RS-485 data (from laser)
Emission	Off	No laser emission
	ON Red	Laser emission enabled

Figure 34 RS-485 adapter

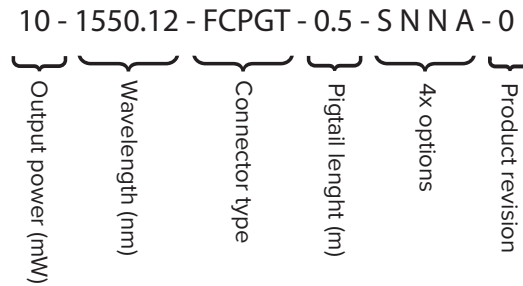


# F

## Configuration ID

MIKRO modules are available as either C15 or E15 variants (see [Table 1 on page 20](#)). The modules can be specified with various options that are indicated in the six fields of the module configuration ID shown in [Figure 35](#). You can find a list of the standard configuration IDs in [Table 19](#).

**Module Configuration ID** **Figure 35 How to read the configuration ID**



**Table 19 Standard MIKRO Configuration ID**

Variant	Output Power (mW)	Wavelength (nm, vacuum)	Output Connector type <sup>i</sup>	Pigtail Length (m)	Linewidth <sup>ii</sup>	Piezoi <sup>iii</sup>	Enhanced Vibration Immunity <sup>iv</sup>	Polarization Maintaining <sup>v</sup>	Product Revision
C15	10	####.##	- FCPGT	- 0.5	- S	N	N	A	- 0
C15	10	####.##	- FCPGT	- 0.5	- S	S	N	A	- 0
C15	10	####.##	- FCPGT	- 0.5	- S	N	P	A	- 0
C15	10	####.##	- FCPGT	- 0.5	- S	S	P	A	- 0
E15	40	####.##	- FCPGT	- 0.5	- S	N	N	A	- 0
E15	40	####.##	- FCPGT	- 0.5	- S	N	N	C	- 0
E15	40	####.##	- FCPGT	- 0.5	- S	S	N	A	- 0
E15	40	####.##	- FCPGT	- 0.5	- S	S	N	C	- 0
E15	40	####.##	- FCPGT	- 0.5	- S	N	P	A	- 0
E15	40	####.##	- FCPGT	- 0.5	- S	N	P	C	- 0
E15	40	####.##	- FCPGT	- 0.5	- S	S	P	A	- 0
E15	40	####.##	- FCPGT	- 0.5	- S	S	P	C	- 0

- FCPGT**=FC/APC pigtail (default), **FCBLK**=FC/APC bulkhead  
**SCPGT**=SC/APC pigtail, **SCBLK**=SC/APC bulkhead
- S**=Standard, **R**=Reduced
- S**=Standard (Piezo), **N**=Non-Piezo
- P**=Polarization Maintaining (PM), **N**=Non-PM - see
- A**=No, wide thermal tuning range, **C**=Yes, narrow thermal tuning range







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