

Koheras ADJUSTIK (HP)

Low Noise Single Frequency Laser System

PRODUCT GUIDE



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PRODUCT GUIDE

This guide includes the following NKT Photonics lasers:

Koheras ADJUSTIK

Low Noise Single Frequency Laser System

Koheras ADJUSTIK HP

High Power Low Noise Single Frequency Laser System

GUIDE OVERVIEW

This product guide is intended to provide functional, operational and installation information for the Koheras ADJUSTIK and ADJUSTIK HP lasers. The guide is divided into three sections:

- **Koheras ADJUSTIK (HP) Description** - introduces the laser, its functionality, interfaces and chassis variants.
- **Operating the Laser** – – provides information and procedures on how to connect, configure and manage the laser.
- **Installing the Laser** – includes the details on how to install the laser and connect optional interfaces

Safety



Warning: Do not operate the laser before first reading and understanding all warnings, cautions and handling information stated within the documents:

Koheras ADJUSTIK Safety, Handling and Regulatory Information

– or –

Koheras ADJUSTIK HP Safety, Handling and Regulatory Information



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

<https://www.nktphotonics.com/product-manuals-and-documentation/>

Terminology This guide may refer to the Koheras ADJUSTIK and ADJUSTIK HP as “the laser”. In many cases, ADJUSTIK is used to describe both the ADJUSTIK and ADJUSTIK HP. In other cases where a distinction is required, this guide will make a clear referral to the actual laser model names.

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

Chapters inside This guide includes the following chapters:

- Chapter 1 “**Laser Description**” — Describes the laser including its general operational principles, management and interfaces.
- Chapter 2 “**Modulation**” — Implementation information for wavelength and amplitude modulation.

- Chapter 3 “[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 4 “[Turning ON the Laser](#)” — Contains procedures on how to safely turn the laser emission on and off using the management software.
- Chapter 5 “[Using CONTROL](#)” — Includes descriptions of all NKT CONTROL menu, settings, and panel items.
- 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 connections, and trigger output signals.
- [Appendices](#) — The guide includes multiple appendices including laser specifications, support contact details, accessory descriptions, laser part numbers, 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 uses the following symbols to either highlight important safety information or provide further information in relation to a specific topic.



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



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



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

Revision This section records the document revision details.

Date	Revision	Changes
2020-09	1.0	First release - documents rewritten and overhauled from earlier releases.
2021-03	1.1	Release 1.1 added the Koheras ADJUSTIK HP.
2021-04	1.0	Release 1.0 revision rolled back to 1.0 due to internal system requirements.

Date	Revision	Changes
2022-03	1.1	<p>Updates include minor grammar corrections and improvements in language clarity. Some figures have also been modified for clarity.</p> <ul style="list-style-type: none">• Added scales drop down selection description in Procedure 3 on page 64.• Added power scale drop down selection of wavelength or offset to section “Power mode” on page 87.• Removed the misapplied serial monitor description and replaced it “Device monitor” on page 88.• Updated description in section “Main adapter” on page 121.• Updated Procedure 9 on page 113 to Windows 10.
2022-04	1.2	<p>Updated the following:</p> <ul style="list-style-type: none">• Updated text and figures in section “Connecting the safety interlock” on page 97 and its subsections.

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SECTION 1

KOHERAS ADJUSTIK (HP) DESCRIPTION

This section provides a description of the following topics:

- “Laser Description” on page 23
- “Module variants” on page 26
- “Laser features” on page 30
- “Optical interface” on page 33
- “Laser Control” on page 34
- “Status LEDs” on page 35
- “Chassis labels” on page 36

The section also includes a chapter on modulating the optical output:

- “Modulation” on page 39

Laser Description

The Koheras ADJUSTIK and ADJUSTIK HP are single frequency distributed feedback (DFB) fiber lasers with passive vibration reduction. Both system types are housed within a rack mount control chassis which includes a front panel operations interface. Their optical output is defined by an ultra-narrow line width in the Hertz range and exceptionally low frequency and intensity noise. These characteristics make the lasers suitable for laser interferometry, coherent communication, microwave generation, spectroscopic, and multiple other scientific applications.

Figure 1 ADJUSTIK front panel



Figure 2 ADJUSTIK HP front panel¹



The ADJUSTIK and the ADJUSTIK HP are characterized by their output power as either standard or high output power respectively. Operationally the two models are identical and each is available in four variants with additional options that can be specified.

All variants are designed with distributed feedback fiber laser technology and for the ADJUSTIK², center wavelengths can be specified from either 1535 to 1580 nanometers or 1030 to 1120 nanometers – see [Table 1 on page 26](#). All laser variants support a wide tuning range of approximately 1 nm from the specified center wavelength.

Chassis and front panel style

Both the ADJUSTIK and ADJUSTIK HP are identified by their chassis color:

- ADJUSTIK – dual-color front panel and black top, bottom and side panels
- ADJUSTIK HP – single-color red chassis (Note that the livery for early ADJUSTIK HP production chassis is identical to a standard ADJUSTIK.)

Terminology

This guide generally refers to both main laser variants (ADJUSTIK and ADJUSTIK HP) as the laser. If necessary, where there is a distinction, each model or variant is clearly identified.

1. The chassis for early production ADJUSTIK HP lasers appears identical to ADJUSTIK models.
2. ADJUSTIK HP wavelengths are restricted, refer to [Table 1 on page 26](#).

Features and Options

The laser series includes the following features and options:

- Thermal Tuning – varies the wavelength using coarse thermal control of the laser substrate.
- Piezo Tuning – achieves fast wavelength modulation with finer control.
- Polarization-maintaining (PM) fiber – To maintain polarization, the optical output is transmitted over PM fiber. For other output fiber types, contact NKT Photonics.
- Wavelength modulation – the wavelength can be modulated using either an external or internal signal.
- Power or Current modes – the lasers can operate in either constant power or constant current mode.
- Adjustable output power (X15 variant only) – if this option is specified, the laser output can be amplitude modulated from either an internal generator or an external signal.
- Emission features – multiple features that control emission availability from the laser.

Tuning

Tuning is accomplished by either manual thermal tuning or using an external signal applied at the laser's fast wavelength modulation input pins. A varying external signal applied to the pins, modulates the output wavelength. Modulating the output wavelength can obtain improved stabilization as compared to the free-running wavelength specification.

Output fiber

The standard output of the laser utilizes polarization-maintaining (PM) fiber, improving the linear characteristics of the laser. Polarization linearity is vital when the laser output is either externally modulated or frequency converted. See [“Optical fibers, connectors and adapters” on page 33](#).

Manual restart

The laser includes a keyswitch to prevent unauthorized emission. The keyswitch also works in conjunction with the laser's safety functionality. For example, when emission is automatically disabled due to a safety interlock fault, the laser cannot be started again after the fault is rectified. An operator must first acknowledge the alarm raised by manually cycling the keyswitch from the ON to OFF to ON positions to permit a restart (enable) of the laser's emission.

High power variants

High power ADJUSTIK HP variants extend the output power of the laser up to 2W. Refer to [Table 1](#) to compare output powers across variants. Note that these values are the design intent and are both subject to change and modification by request.

Theory of operation The Koheras ADJUSTIK and ADJUSTIK HP are fiber lasers that use a fiber Bragg grating cavity to produce a single mode laser output. 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.

Safety



Warning: The lasers are rated as Class 3B and Class 4 lasers and are therefore hazardous. Before turning on the laser, ensure to read and understand all safety statements of the NKT Photonics document:

Koheras ADJUSTIK Safety, Handling and Regulatory Information

– or –

Koheras ADJUSTIK HP Safety, Handling and Regulatory Information

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

<https://www.nktphotonics.com/product-manuals-and-documentation/>

Module variants

Both the Koheras ADJUSTIK and ADJUSTIK HP are available in four variants. The variants are in general, classified by their wavelength, and output power. [Table 1](#) describes the primary technical differences between the variants showing the typical parameter values.

Table 1 ADJUSTIK and ADJUSTIK HP variant specifications

Variant	Standard λ	Other λ s	Output Power	Polarization Maintaining	Fast Modulation
X15	1550.12	1535 - 1580 nm	22.5 mW	Yes	Yes
E15	1550.12	1535 - 1580 nm	40 mW ¹	Yes	Yes
C15	1550.12	1535 - 1580 nm	> 10 mW (fixed)	Yes	Yes
Y10	1064.00	1030 - 1120 nm	> 10 mW (fixed)	Yes	Yes
HP X15	1550.12	1545 - 1565 nm	200 or 2000 mW	Yes	Yes
HP E15	1550.12	1545 - 1565 nm	200 or 2000 mW	Yes	Yes
HP C15	1550.12	1545 - 1565 nm	200 or 2000 mW	Yes	Yes
HP Y10	1064.00	1060 - 1075 nm	200 mW	Yes	Yes

1. Minimum output ~30% of the maximum

Part numbers [Table 21](#) in [Appendix E](#) lists available Koheras ADJUSTIK and ADJUSTIK HP lasers by their part numbers.

Center wavelength The center wavelength of ADJUSTIK lasers are typically set to 1550.12 nm (ITU DWDM C-BAND Channel 34) or 1064.00 nm. However, the lasers can also be specially ordered from the factory with other center wavelengths ranging from 1535 to 1580 nm or 1030 to 1120 nm¹.



Note: For ADJUSTIK HP lasers, wavelength ranges available are limited from either 1545 to 1565 nm or 1060 to 1075 nm².

Output power Depending on the module type, the output power varies between greater than 10 mW and up to and including 2 W. The output power is generally fixed for ADJUSTIK lasers; however, an [Amplitude modulation](#) option can be specified with some variants to adjust the output power over a large dynamic range. For ADJUSTIK HP lasers, the output power is variable from 10-100% of its maximum power output.

1. Contact NKT Photonics support for more information - see [Support contact details on page 110](#).

Tuning types The laser's variants can be further specified with different tuning options. The options include narrow and wide thermal tuning for coarse adjustment, Piezo tuning for finer adjustment and output power tuning. The tuning options must be specified when the laser is ordered from the factory.

Thermal tuning

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.



Note: Wide thermal tuning is the default option for the lasers.

Piezo tuning

The internal laser modules support fine fast wavelength modulation using Piezo tuning. For further information see [“Fast wavelength modulation” on page 30](#).



Note: The lasers are fitted with Piezo tuning by default. If Piezo tuning is not required, it must be specified when ordering the laser.

Output power tuning¹

Output power tuning is determined by the ADJUSTIK variant type:

- C15 and Y10 variants – No power tuning, output power is fixed at the factory.
- E15 variant – Limited power tuning from approximately 30 to 100% of the maximum output power.
- X15 variant – Full range power tuning from 0 to 100% of its maximum output power. (If the amplitude modulation option is included.)

¹ Output power tuning is only available for ADJUSTIK lasers.

Front and rear panels

Front panel **Figure 3** shows the front panel of the laser. On the front panel are two optical outputs, main and monitor. The front panel also includes controls to turn on and operate the laser autonomously without using CONTROL software. The controls include:

- *LCD display panel* – displays operational parameters and a menu system where the laser’s parameters are configured.
- *Menu and return buttons* – use to enter into menu levels, select parameter digits, confirm the setting and return to a higher menu level.
- *Selection dial* – use the dial to move the selection pointer among the menu items and modify parameter values.
- *Emission button* – enables and disables emission. (Enables emission only if the system meets safety and operational parameters.)
- *Key switch* – the key switch must be ON to enable emission. Remove the key to prevent unauthorized laser operation.



Note: Use the key switch to clear an interlock alarm when an open in the laser’s interlock circuit has been rectified. First turn the key to OFF, and then ON again to clear the alarm. See “[Connecting the safety interlock](#)” for more information.

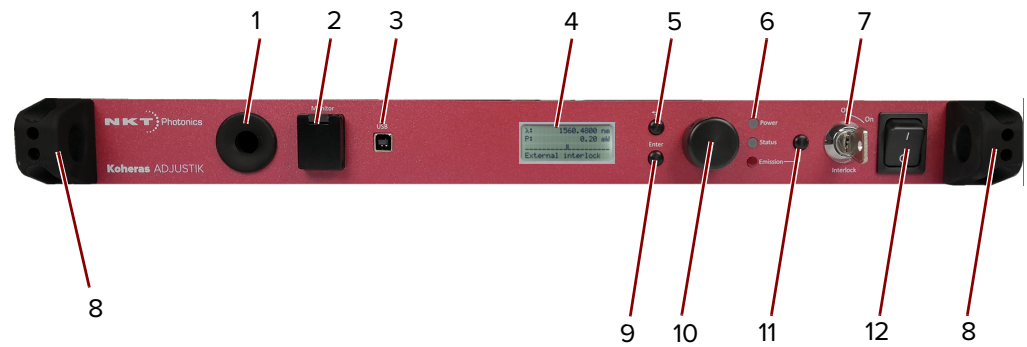
- AC mains switch – powers the laser ON or OFF.

See “[Optical specifications](#)” on page 30 for more information on the optical outputs and their connector configuration.

Status LEDs on the front panel indicate the following states:

- *Power* – the supply voltage status
- *Interlock* – interlock circuit open/closed (not OK/OK)
- *Emission* – the laser emission status
- *Status* – the module stability status

For more information see “[Status LEDs](#)” on page 35.

Figure 3 ADJUSTIK HP front panel layout¹

- | | | | |
|---|------------------------------------|----|--------------------------------------|
| 1 | Optical output (main fiber output) | 7 | Keyswitch |
| 2 | Monitor optical output | 8 | Rack mounting flange and finger-grip |
| 3 | USB serial connector | 9 | Menu button |
| 4 | LCD display panel | 10 | Selection dial |
| 5 | Menu return button | 11 | Emission button |
| 6 | Status LEDs | 12 | AC mains switch |

Rack mounting

There is a flange on each side of the front panel for mounting the laser in a standard 19-inch rack. The flanges include plastic finger-grips to facilitate installing and removing the laser from a rack. For more information on installing the laser, see [“Mechanical Installation” on page 93](#).

Rear panel [Figure 4](#) shows the rear panel which includes the following connectors:

- *AC mains inlet* - standard IEC C-14 mains inlet connector
- *LEMO connector* - 2 pin door interlock circuit
- *Modulation* – Male DB-9 pin connector providing pins for wavelength input/output, amplitude modulation input and trigger signals.
- *Ethernet* – 10/100 Mbps BASE-T Ethernet port for IP connectivity to the laser.
- *External Bus* Female DB-15 pin connector – connects the laser to other systems or accessories. The connector provides RS-485 bus control interface, 12V DC power and an extension of the interlock safety circuit for connected accessories. If no accessories are connected, the supplied bus defeater must always be placed on the External bus connector to loop back the interlock safety circuit – see [“Connecting the safety interlock” on page 97](#).

1. The ADJUSTIK controls and panel layout are identical

Figure 4 ADJUSTIK rear panel layout

- | | | | |
|---|-------------------------------|---|-----------------------------|
| 1 | AC mains inlet | 4 | 10/100 BASE-T Ethernet port |
| 2 | LEMO door interlock connector | 5 | External bus |
| 3 | Modulation (input and output) | 6 | Cooling fins |



Note: The pin assignments of the rear panel connectors are described in [Appendix C](#)

Optical specifications

Main optical output

ADJUSTIK lasers are classified as laser CLASS 3B and ADJUSTIK HP lasers as CLASS 4. The main optical output is identified by the laser aperture label placed next to it. See “[Chassis labels](#)” on page 36.

Monitor Output

The monitor output is classified as a laser CLASS 1 output and does not require a laser aperture label.

Laser features

Thermal tuning The wavelength of the laser 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, 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 82.

Fast wavelength modulation The laser includes the capability to modulate the emission wavelength using a Piezo which is termed *fast wavelength modulation*. The modulation signal applied to the Piezo is selectable from either the laser’s internal generator or an external electrical signal.

Input circuits

Section “[Fast wavelength modulation](#)” on page 39 provides examples of fast wavelength modulation circuits and performance.

Wavelength+/- Signal

To modulate the laser’s wavelength, you can apply an external differential signal to the modulation connector pins on the rear panel. As the input signal varies and increases its positive potential, the wavelength of the laser increases. The response at higher signal frequencies can vary and depends on whether the laser uses narrow or wide thermal tuning substrates. For example, lasers with narrow thermal tuning substrates, show piezo resonances that are higher in frequency. These modules are therefore more suitable for applications where modulations between 30 and 45 kHz are required.



Note: For both tuning types 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.

External cavity stabilization

The lasers support the use of the Pound-Hall-Drever technique to reduce low frequency phase noise to an ultra-low level. It requires that the output is stabilized using an external cavity circuit. Refer to “[External cavity stabilization](#)” on page 47 for details of the implementation.

Amplitude modulation

If the laser includes the amplitude modulation option, an external electrical signal or the laser’s built-in function generator can be used to modulate the laser output power. Modulation of the output power ranges from 0 to 100% of the output power.

Amplitude+/- Signal

To modulate the power, apply an external differential signal to the *Modulation* connector on the rear panel. A differential signal applied to these pins varies the amplitude directly. See “[Modulation input/output](#)” on page 111 for the connector’s pin assignment.

Setpoint

When amplitude modulation is used, the maximum power output can be limited to a configured preset value. This value is known as the “setpoint” and it limits the maximum output to less than the 100% power level.



Note: For more information on using Amplitude modulation with either an external signal or the built-in function generator, See “[Amplitude modulation](#)” on page 46.

Operating mode

All variants can operate in *Current* mode, where the current in the pump feeding the fiber laser is kept stable. Some variants can operate in *Power* mode as well, where the power out of the fiber laser is held at a fixed level.

- **Current mode** – the current in the pump feeding the fiber laser is kept stable.

- **Power mode** – the power out of the fiber laser is held at a fixed level.

Which mode to set depends on both the variant and the application. [Table 2](#) lists the characteristics of the modes for each of the laser variants.

Table 2 Characteristics of power modes

ADJUSTIK variant ¹	Power mode	Current mode
C15 & Y10	Better Power Stability	Better Frequency Stability
E15 & X15	Better Performance	Not Recommended

1. Both ADJUSTIK & ADJUSTIK HP



Note: Variants that support both modes are configured from the factory to operate in *Power mode* by default.



Note: To set the operating mode, see “[Power /current mode](#)” on page 55.

Trigger A trigger logic input or output pin (see [Table 19](#)) is available on the Modulation connector. Use the trigger pins to:

- apply (input) a logic signal that initiates laser emission (A logic high initiates emission.)
- output a logic signal that indicates laser emission. (Active high is output.)

For more information on connecting the trigger, see “[Connecting the trigger input or output](#)” on page 100.

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



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

Power verification This feature internally 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 of power versus pump current is different for each individual laser due to variations in emission efficiency.

The power verification feature prevents for example, the output power reaching its maximum value if feedback is unexpectedly disconnected from the power control function.

Optical interface

The laser has two optical outputs on the front panel. The optical outputs are assigned as:

- **Main** – this is the laser’s primary optical output (Class 3B or Class 4) near which, a laser aperture label is affixed.
- or –
- **Monitor** – this is a low power output intended for monitoring purpose only. The output is classified as a laser CLASS 1 and therefore it does not require a laser aperture label.

Contact NKT support for information on how the laser’s optical ports are assigned. See [“Support contact details” on page 110](#).

Optical fibers, connectors and adapters

The optical outputs can be configured as either:

- fiber patch cords with FC/APC connectors (FC/APC pig-tail)
- or –
- connector adapters (FC/APC adapter or SC/APC adapter)

Polarization maintaining output

The output fiber of the laser is polarization maintaining; the slow axis is by default aligned to the connector key. Consequently, the laser polarization (E-field) is parallel to the key.

Table 3 Example optical interface specifications¹

Parameter	SMF28	PM980	PM 1550
Fiber mode field diameter ¹	~10 microns	6.6 microns	~10 microns
Numerical aperture	0.14	0.12	0.125

1. Mode field diameter is approximate - contact NKT Photonics Support for more information – see [Support contact details on page 110](#).

1. Example specifications listed are design intent and are subject to change. Contact NKT Photonics [Support](#) to determine available fibers, connectors or adapters suitable for your application.

Laser Control

User interface The laser and any associated accessories are controlled either from a PC using NKT Photonics CONTROL management software or the front panel interface.

As an option, the laser can also be controlled using NKT's Software Development Kit (SDK) for custom applications. For further information regarding the SDK refer to the software and drivers link at NKT's support webpage:

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


A PC or a custom microprocessor system can connect to the laser using either the USB serial port on the front panel or the 10/100 BASE-T Ethernet port on the rear panel.

[Section 2](#) includes chapters describing the front panel interface, NKT's CONTROL software, and how to control and turn on the laser.

Status LEDs

The front panel houses four status LEDs as described in [Table 4](#). The LEDs are located on the front panel as shown in [Figure 1](#).

Table 4 Status LEDs

LED Name	Condition	Description
Power	ON Green	AC mains connected and power switch is in the ON position.
	ON Red	Fault with the DC power supply
	OFF	System switched off or no AC mains power
Status	OFF	One of the following: <ul style="list-style-type: none"> • Interlock is reset but there is no emission from the system • Alternatively, firmware is being uploaded to the system main control board. During firmware upgrade the interlock cannot be reset and no emission from the system is possible.
	ON Orange	Interlock fault or the interlock needs to be reset.
	Flashing Orange	The system main control board is scanning for modules attached to the system and accessories connected to the external bus.
	ON Green	Laser emission enabled and the system is stabilized.
	Flashing Green	Laser emission enabled but the system has not stabilized.
	ON Red	One of the following: <ul style="list-style-type: none"> • One or multiple modules in the system or connected to the External Bus have shut down. • Interlock open or has been opened.
	Flashing Red	Firmware is being uploaded to modules in the Koheras ADJUSTIK system or accessories connected to the External Bus.
Emission	ON Red	Laser emission is ON. 
	OFF	Laser emission is OFF.



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

Chassis labels

The laser chassis has a number of labels on it that indicate hazards, regulatory, or manufacturing information. The labels are located on the panels described in [Table 5](#) with the panels shown in [Figure 5](#) and [Figure 6](#).

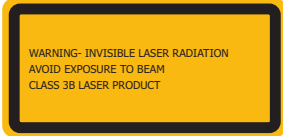
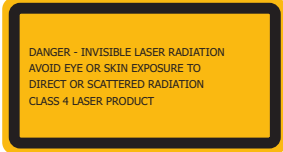
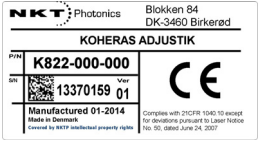
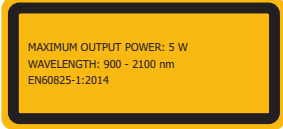


Figure 5 Top panel label locations



Figure 6 Rear panel label location



Table 5 Module labels

Label	Panel	Description	
Classification - Emission Hazards <i>Koheras ADJUSTIK</i>	Top	Safety information stating the laser emission hazards and the laser's class rating.	
Classification - Emission Hazards <i>Koheras ADJUSTIK HP</i>	Top	Safety information stating the laser emission hazards and the laser's class rating.	
Manufacturing	Rear	Manufacturing information including address, part and serial number, date manufactured and regulatory compliance.	
Product Information	Top	Safety label showing the emission specifications of the laser.	
Laser Radiation Warning	Top	Safety information alert indicating this area of the laser is near a source of dangerous laser emission.	
Laser Aperture	Fiber connector	Safety information alert indicating the location of the aperture where laser radiation is emitted from the laser. Note: If the module includes a monitor output, this is a class 1 laser output and does not require a label.	

2 Modulation

This section presents further information on how to implement:

- Wavelength modulation (fast) – “Fast wavelength modulation” on page 39
- Amplitude modulation – “Amplitude modulation” on page 46
- External cavity stabilization – “External cavity stabilization” on page 47



Note: Wavelength modulation must be specified when ordering the laser.



Note: An E15 ADJUSTIK variant is capable to decrease output power down to 30% of the nominal level. However, the laser’s performance will vary depending on the level of the output power set. Therefore, the E15’s performance is only guaranteed at the nominal (maximum) output power setting.

Fast wavelength modulation

If the fast wavelength modulation option is included with the laser, the output wavelength can be modulated using: an external varying electrical signal, the internal function generator, or both.

Configuring wavelength modulation

The wavelength of the laser can be modulated with:

- an external electrical signal applied to the modulation input.
- the internal function generator.
- a combination of the above.

The firmware in the laser is designed so at least one of the two is enabled. [Table 6](#) provides a description with cross-references of the settings involved when using fast wavelength modulation.

Table 6 Wavelength modulation settings

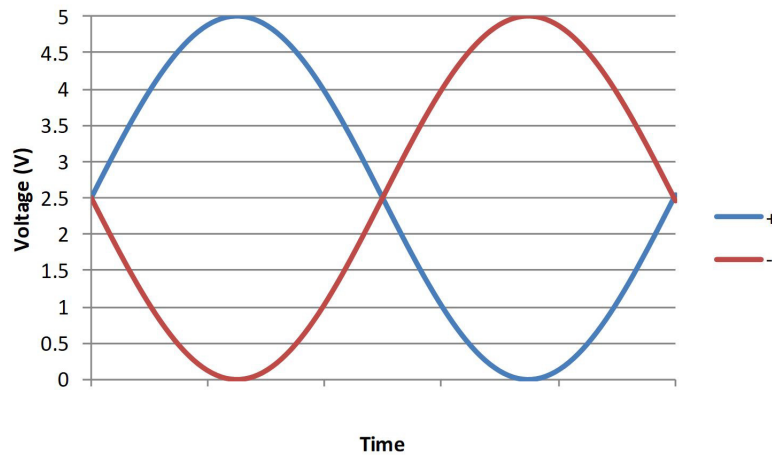
Setting	Function	For CONTROL see	For SDK see
External wavelength modulation	Sets wavelength modulation to external signal mode.	page 75	page 84
Internal function generator	Sets wavelength modulation to internal function generator mode.	page 77	page 84
Modulation frequency	Sets the frequency of the internal function generator. The settable range is from 0.008 Hz to 100 kHz.	page 78	page 85
Modulation amplitude	Sets the modulation maximum amplitude to between 0 & 100% when using the internal function generator mode.	page 78	page 86
Waveform	When set to internal function generator mode, waveform sets the signal type to either sinusoidal or sawtooth.	page 77	page 86
Signal output	Sets the wavelength+/- pins to output the internal function generator signal.	page 77	page 87
Wavelength modulation	Toggles all wavelength modulation functionality and settings on or off.	page 78	page 88

Wavelength+/- signal The *Wavelength+/-* pins (see [Table 19](#)) are a differential input/output used for wavelength modulation of the laser. You can configure the wavelength modulation option so that the interface is used either as input or output. It is preferential to use a differential signal for the modulating signal applied. When using a differential signal, the combined voltage of the *Wavelength+* and *Wavelength-* pins modifies the wavelength with the following results:

- A negative voltage results in a lower output wavelength.
- A positive voltage results in a higher output wavelength.

Differential input When configured as an input, the *Wavelength+/-* input can be connected to a differential signal with an amplitude up to $2 \times 5 \text{ Vpp}$ as shown in Figure 7.

Figure 7 Differential input signal graph for wavelength modulation

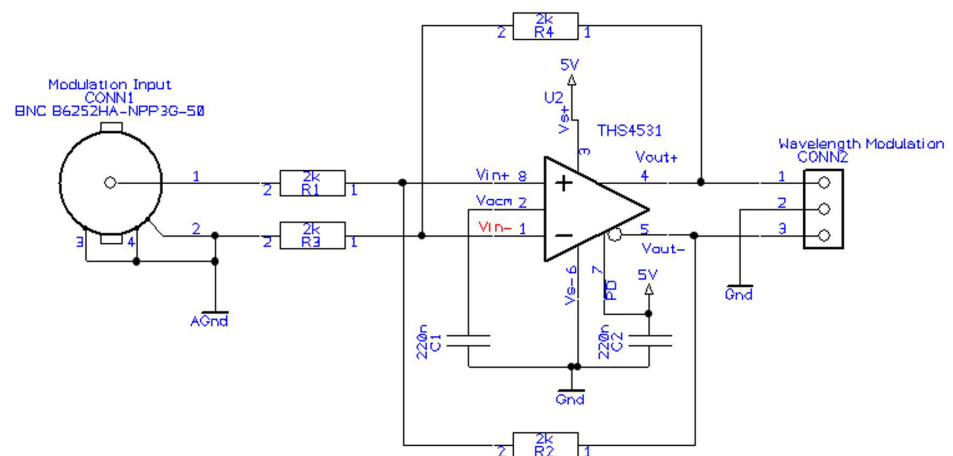


Note: To prevent noise being induced that could create undesired phase noise, it is recommended to disable the wavelength modulation setting when it is not in use.

Single-ended to differential

The circuit shown in Figure 8 is an example of how to generate a differential signal from a single-ended input. In this example, a 5 Vpp single-ended input signal with a 0 V common-mode voltage generates a $2 \times 5 \text{ Vpp}$ differential signal with a 2.5 V common mode voltage.

Figure 8 Single-ended to differential circuit example



Singled-ended input

If a differential signal is not available, a single-ended signal as shown in Figure 9 can be applied to the *Wavelength+* input. In this case, connect *Wavelength-* to

2.5 V or AGND. A single-ended 5 Vpp signal generates half the modulation compared to a differential 2x5 Vpp input.

Figure 9 Single-ended input signal with 2.5 V graph

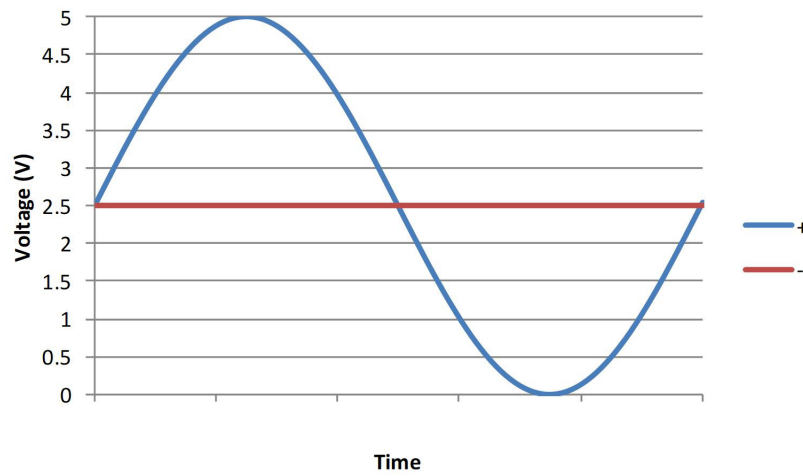
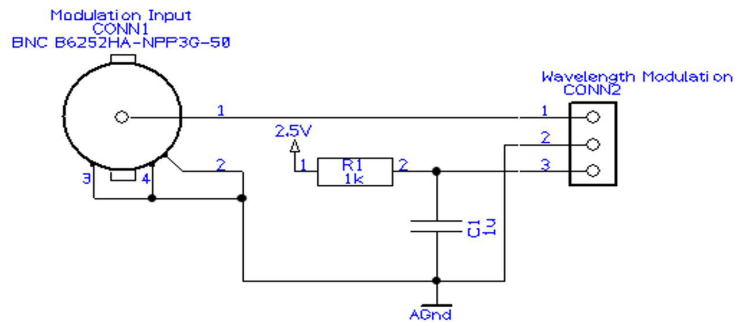


Figure 10 shows the *Wavelength-* pin connected to the same potential as the common mode voltage of the *Wavelength+* signal, the optical output will be modulated around its center wavelength.

Figure 10 Single-ended input w/2.5 V on an unused branch example circuit



Wavelength- to AGND In [Figure 12](#), the *Wavelength-* signal is connected to AGND and the *Wavelength+* signal is modulated between 0 and 5 V as shown in [Figure 11](#), the optical output is modulated above its thermally controlled wavelength.

Figure 11 Single-ended input signal with GND on an unused branch graph

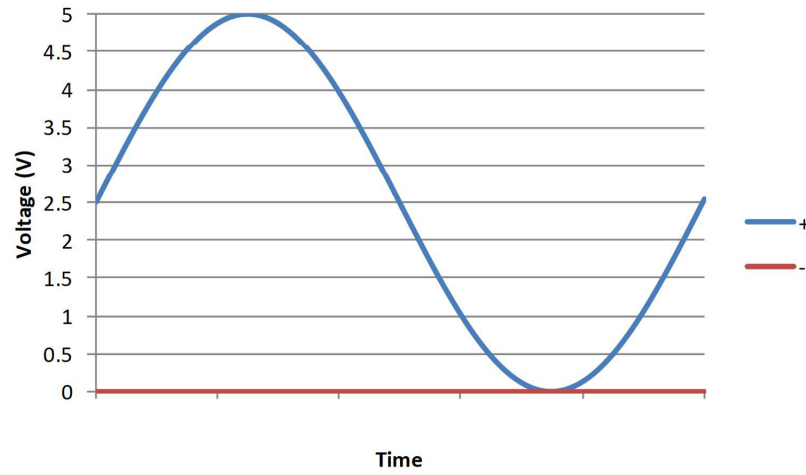
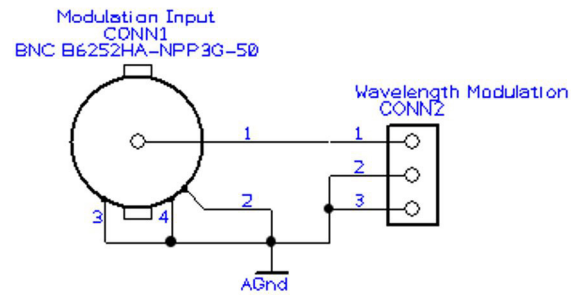
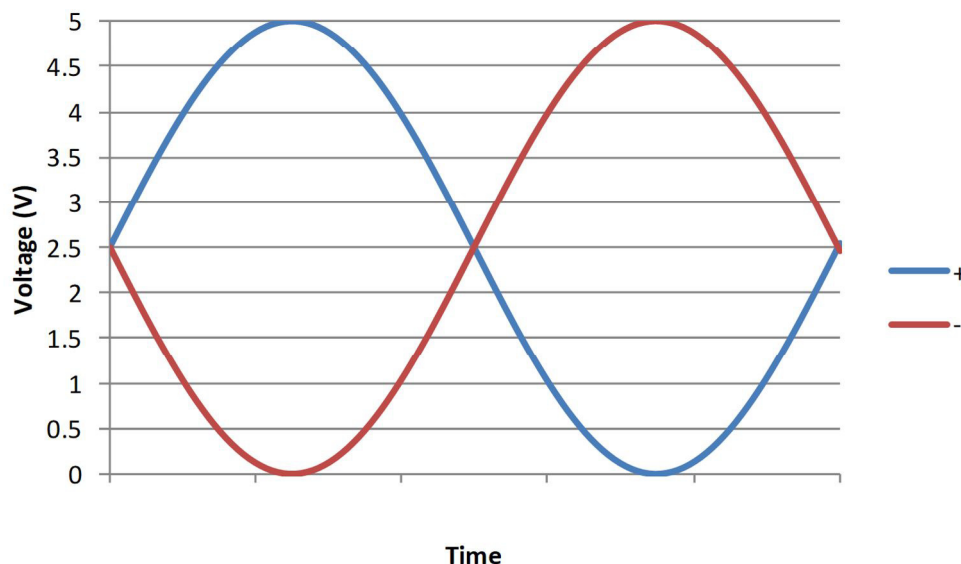


Figure 12 Single-ended input connections with 0 V on an unused branch



Differential output If the *Wavelength+/-* pins are configured as an output, a differential signal will be present at the pins as shown in [Figure 13](#). The differential signal amplitude can be up to $2 \times 5 \text{ V}_{pp}$ with a common mode voltage of 2.5 V.

Figure 13 Differential output signal graph



The differential output signal can be used for example, as the input signal for other Koheras ADJUSTIK or ADJUSTIK HP lasers.

Wavelength modulation coupling You can select either internal AC or DC coupling of the modulation signal. If AC coupling is chosen, the laser’s high pass filter function has a cut-off frequency of 1.6 Hz. Setting an X15 variant to DC coupling allows the laser to lock to an external reference signal that for example, uses the Pound Drever Hall technique. In this mode, the laser adjusts its wavelength so the differential error signal level on the *Wavelength+/-* input leans towards 0 V.

Narrow vs. Wide modulation range You can set the wavelength modulation operation to either narrow or wide range. As detailed in [Table 7](#), the operation characteristic of each range depends on the laser type (X15 or E15/C15/Y15).

Table 7 Narrow vs wide band wavelength modulation

	X15 variant	E15/C15/Y10 variants
Narrow	Very limited modulation can be obtained, i.e. maximum ~30 MHz. The extremely low phase noise is maintained in this mode.	Maximum 0.8 GHz modulation for E15/C15 and 1 GHz for Y10.
Wide	Maximum ~600 MHz modulation, but its extremely low phase noise is NOT maintained in this mode.	Maximum 8 GHz modulation for E15/C15 and 10 GHz for Y10. Small negative impact on low frequency phase noise.

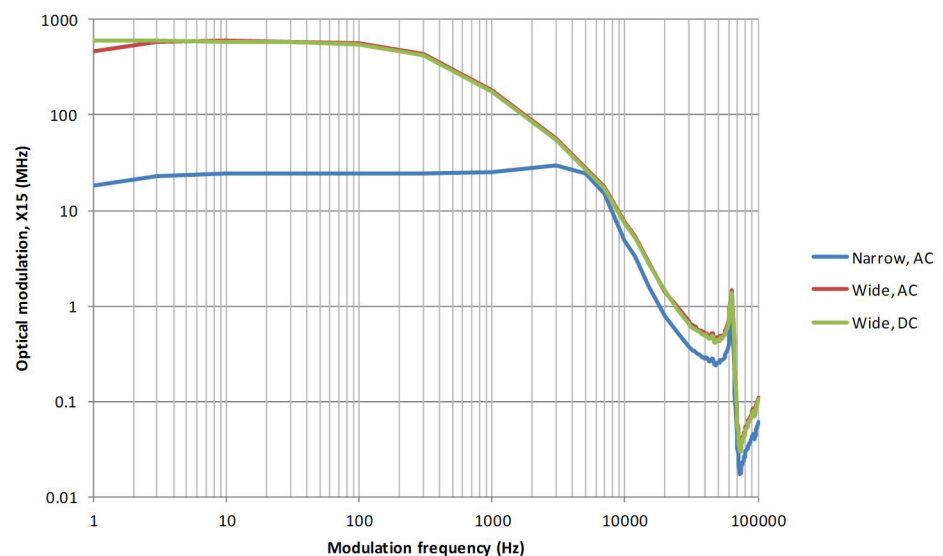
Frequency response For X15 variants, the frequency response of the wavelength modulation feature differs from that of the E15/C15/Y10 variants. The graphs in [Figure 14](#) (X15) and [Figure 15](#) (E15/C15/Y10) shows the response when the modulation signal varies from 1 to 100 kHz.

X15 variant frequency response

[Figure 14](#) shows the measured frequency response of an X15 variant for both wide and narrow ranges:

- **Wide** – 600 MHz tuning at low frequencies with a smooth roll-off to a 3 dB cut-off at 300 Hz.
- **Narrow** – 30 MHz tuning with a slight peak at ~3 kHz.

Figure 14 X15 variant wavelength modulation response graph



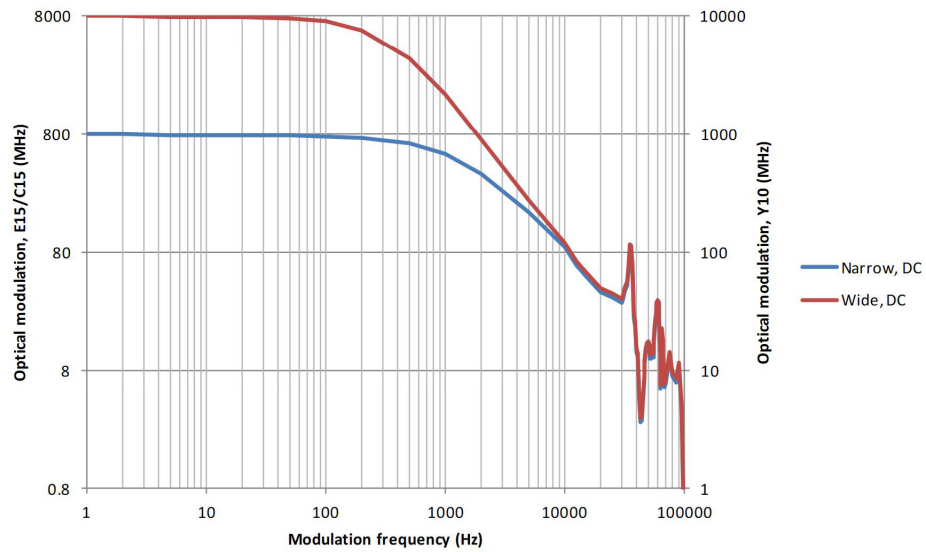
E15/C15/Y10 variant frequency response

[Figure 15](#) shows the measured frequency response of the E15/C15/Y10 variants for both wide and narrow ranges:

- **Wide** – E15/C15 – 8 GHz with a 3 dB cut-off at 200 Hz
Y10 – 10 GHz with a 3 dB cut-off at 200 Hz

- **Narrow** – 10x (times) less with a 3 dB cut-off at 1 kHz

Figure 15 E15/C15/Y10 variant wavelength modulation response graph



Amplitude modulation

If the laser includes the amplitude modulation option, the output emission power level can be modulated. The power amplitude can be modulated with either an electrical input signal or the built-in function generator. When the output power is modulated, the maximum level cannot exceed the configured output power setpoint.

Amplitude+/- Signal The *Amplitude+/-* pins of the electrical interface are a differential input used for amplitude modulation or power control of the laser.

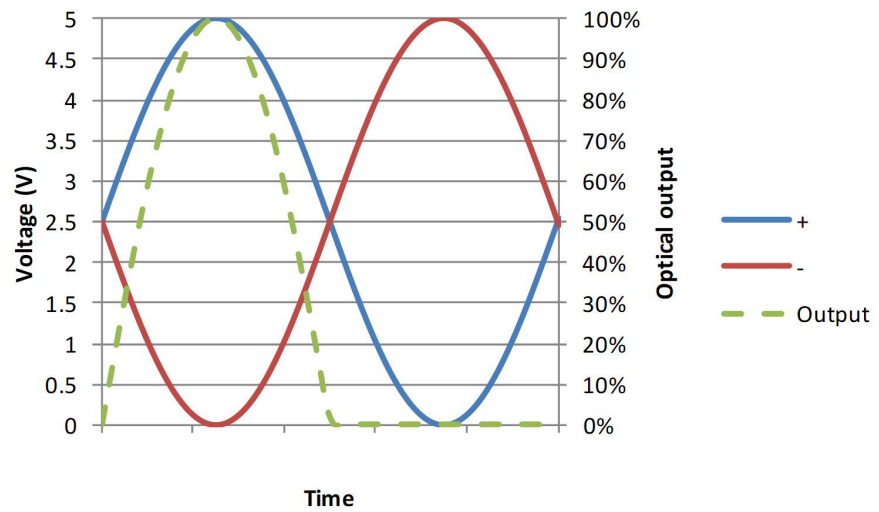
Unlike the *Wavelength+/-* pins, the *Amplitude+/-* pins are input only.

Input signals

- **Figure 16** shows a differential signal consisting of two 5 Vpp input signals connected to the *Amplitude+/-* pins. When the summation of the two signals is 0 V or below, the result is no output power. Output power will increase

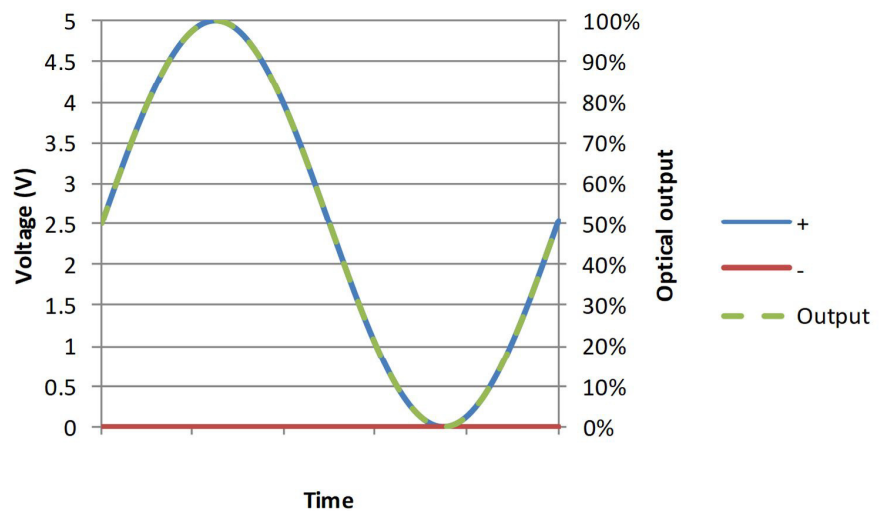
when the summation exceeds 0V and reaches its maximum (the power setpoint) +5 V separation.

Figure 16 Differential input for amplitude modulation graph



- Alternatively, [Figure 17](#) shows the *Amplitude+/-* negative pin connected to ground with the positive branch connected to a signal that varies between 0 V and +5 V.

Figure 17 Single-ended input for amplitude modulation graph

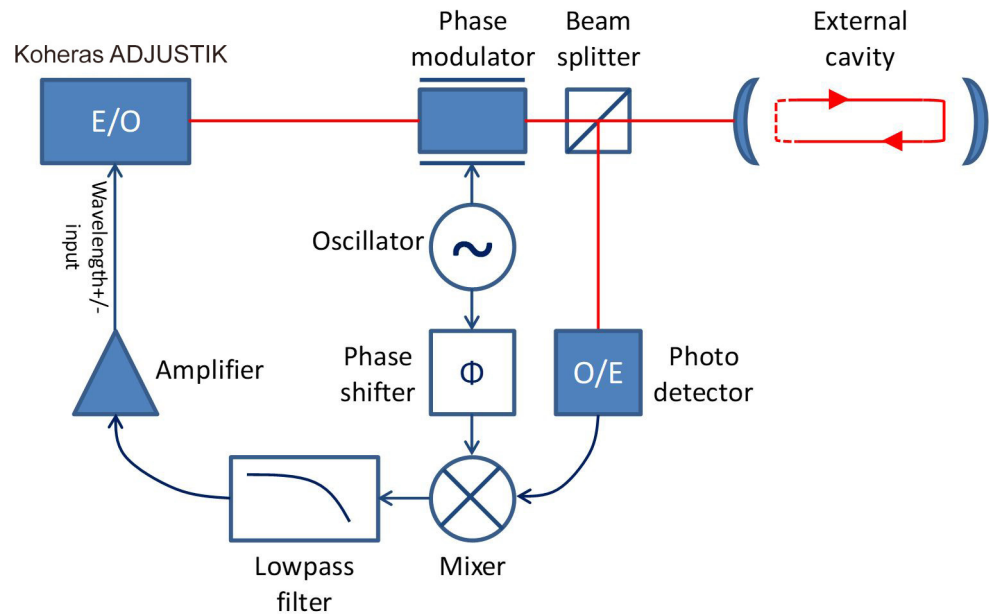


External cavity stabilization

The lasers can be locked to an external cavity to obtain lower low-frequency phase noise by using the Pound-Drever-Hall technique. [Figure 18](#) depicts a

general layout of the devices in a Pound-Drever-Hall configuration used with the laser.

Figure 18 Koheras ADJUSTIK in a Pound-Drever-Hall configuration



Setting up external cavity stabilization

Follow the steps below to configure and enable external cavity locking:

1. Enable external modulation (see “[Modulation Source](#)” on page 75).
2. Configure the wavelength modulation input as DC coupled (see “[Modulation Coupling](#)” on page 77).
3. Configure the laser to operate in narrow modulation range (see “[Modulation Range](#)” on page 77).
4. Turn wavelength modulation on (see “[Turning on wavelength modulation](#)” on page 78).
5. Set the update interval (see “[Integrating update interval](#)” on page 77).

Once enabled, the laser constantly adjusts its wavelength so that the Pound-Drever-Hall loop results in a 0 V differential applied at the *Wavelength+/-* input pins.

When using external cavity stabilization, differential input is preferred to achieve the lowest noise performance.

SECTION 2

OPERATING THE LASER

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

- “Front Panel Menu” on page 51
- “Communicating with the Laser” on page 59
- “Turning ON the Laser” on page 63
- “Using CONTROL” on page 69

3 Front Panel Menu

Overview

The front panel features an LCD system menu and controls you can use to configure and operate the laser. The menu items available are listed in [Table 8](#).

Table 8 Front panel menu items

Menu Item	Function	See
Top menu	Displays the wavelength, output power and system messages.	Top menu on page 52
Wavelength	Sets the wavelength using either an absolute or relative value.	Wavelength on page 53
Wavelength display	Sets laser to display the wavelength as either absolute or relative values.	Wavelength display on page 53
W1 Modulation	Enables external or internal wavelength modulation	W1 modulation on page 53
W1 mod. Gain	Gain adjustment for the wavelength modulation signal.	W1 mod. Gain on page 54
W1. mod. Source	Selects to use either an external or internal signal for wavelength modulation.	W1 mod. source on page 54
W1. mod. Coupling	Selects either AC or DC coupling to be used with wavelength modulation.	W1 mod. Coupling on page 54
W1. mod. Range	Selects to use either narrow or wide range for wavelength modulation.	W1 mod. Range on page 55
Power/current mode	Configures the laser to operate in either power or current mode.	Power /current mode on page 55
Power	Adjusts the emission output power level.	Power on page 55
Power unit	Sets the power units displayed and configured in either mW or dBm.	Power unit on page 56
Watchdog timer	Sets a watchdog timer in seconds to disable emission if CONTROL communications is lost.	Watchdog timer on page 56
Display backlight	Adjusts the intensity of the LCD panel light.	Display backlight on page 56
IP Address	Configures the IP address of the laser.	IP Address on page 57

General operation Enter button

Press the enter button to perform the following:

- Enter a sub-menu from the top level.
- Confirm selection of a parameter item in a menu when modifying settings.
- Sets the parameter item when modifying settings.

Return button

Press the return button to go back one level (the parent level).

Selection dial

Turn the selection dial left or right to:

- Navigate to sub-menu's from the top level.
- Adjust parameter values when they are selected using the enter button.

Emission button - see [“Emission button” on page 57](#)

Press this button to:

- Enable laser emission.
- Disable laser emission.

General navigation

When idle, the display panel always returns to the top menu level. To access sub-menu items, press the enter button and turn the selection dial until the desired sub-menu appears. Press the return button to exit a sub-menu and return to the top or parent menu.

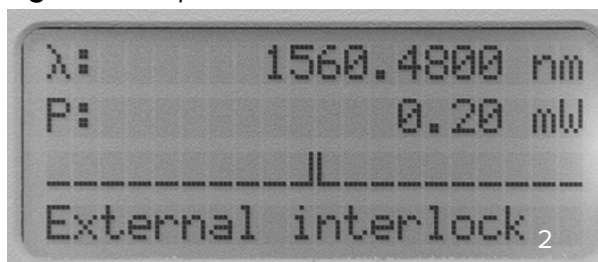
Modifying parameter values

Press the enter button multiple times to select a digit of a parameter's numeric field. When the digit is flashing, use the selection dial to modify the value. Press the enter button again to move to another digit of a parameter.

Menu items

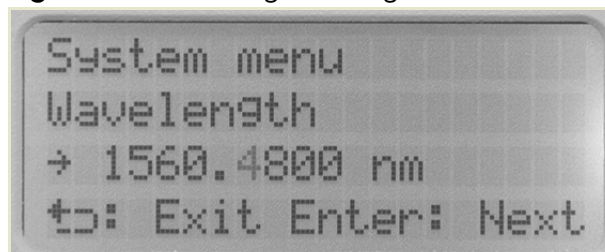
Top menu [Figure 19](#) shows the top level menu, it displays the emission wavelength (absolute or relative), emission power (dBm or mW) and any operational messages such as for example, an interlock warning. When the front panel controls are idle for a set period, the panel automatically returns to the top menu.

Figure 19 Top level menu



Wavelength You can change the center wavelength of the laser emission using the *Wavelength* menu shown in [Figure 20](#). You can set the center wavelength either as an absolute wavelength or configure a relative offset from the nominal wavelength.

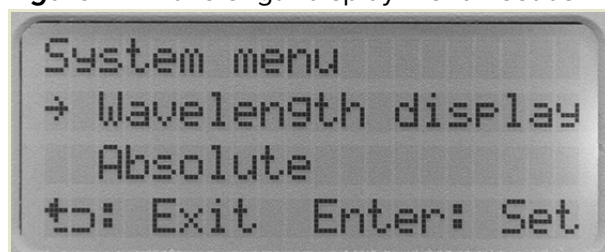
Figure 20 Wavelength setting menu



Wavelength display The *Wavelength display* menu ([Figure 21](#)) sets the center wavelength to be displayed as either absolute (the actual wavelength) or relative (the offset from the standard wavelength). Changing between absolute and relative with this menu affects both the *Top* menu and *Wavelength* menu.

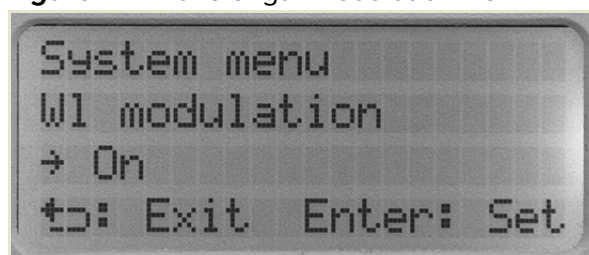
- **Absolute** – sets the panel to display the actual wavelength in both the *Top* and *Wavelength* menus.
- **Relative** – sets the panel to display the relative offset wavelength from the nominal wavelength in both the *Top* and *Wavelength* menus.

Figure 21 Wavelength display menu - set as Absolute



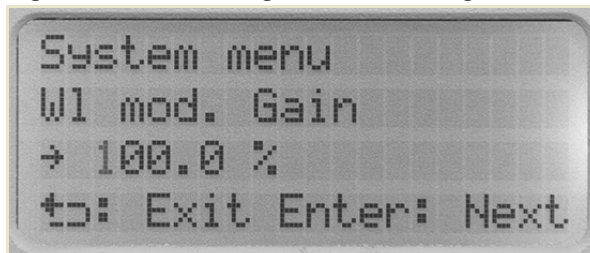
W1 modulation Enter the *W1 modulation* menu to turn ON or OFF the wavelength modulation feature. When set *On*, inputting a signal to the *Wavelength+/-* pins modulates the wavelength. (see [“Fast wavelength modulation”](#) on page 39)

Figure 22 Wavelength modulation - ON



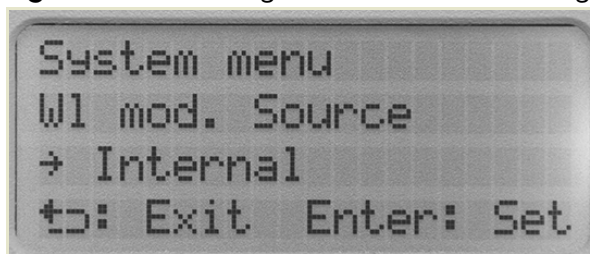
W1 mod. Gain Use the *W1 mod. Gain menu* to adjust the gain of the signal used to modulate the wavelength. Enter the menu and adjust the gain from 0 to 242.5%.

Figure 23 Wavelength modulation gain setting menu



W1 mod. source The *W1 mod. Source* menu sets the modulation source used for wavelength modulation. Set the source to either *Internal* (internal generator) or *External* (signal applied to the wavelength modulation pins).

Figure 24 Wavelength modulation source signal set to internal



W1 mod. Coupling Use this menu to set the how to couple the wavelength modulation signal. Enter the *W1 mod. Coupling* menu and set the signal coupling to either *AC* or *DC* coupling.

Figure 25 Wavelength modulation signal coupling set to AC



W1 mod. Range In the *W1 mod. Range* menu (Figure 26), you can set the depth of the modulation range to either *Narrow* or *Wide*. Refer to “[Narrow vs. Wide modulation range](#)” on page 44 for more information on how to set the range.

Figure 26 Wavelength modulation range set to Narrow



Power /current mode Use the *Power/current mode* menu (Figure 27) to set the operation mode of the laser to either (constant) *Power* mode or (constant) *Current* mode. Refer to “[Operating mode](#)” on page 31 for further information on setting the mode.

Figure 27 Operation mode set to constant power mode



Power Use the *Power* menu to tune the level of the laser’s output emission power. The maximum output power level for the ADJUSTIK is dependent on the laser variant. Refer to power specifications listed in [Table 1](#).

Figure 28 Power tuning menu



Note: For C15 and Y10 variants the power is fixed and cannot be adjusted.

Power unit You can set the output power to be displayed in either milliwatts (mW) or decibel-milliwatts (dBm). Select this *Power unit* submenu and turn the selection dial left or right to set the power units to either *mW* or *dBm*.

Figure 29 Power unit menu - set to mW



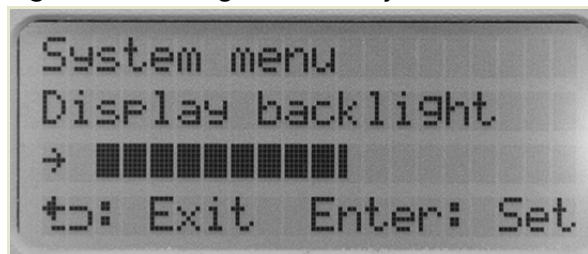
Watchdog timer If the communications link between the laser and the CONTROL GUI on a PC is lost, you can enable the laser's watchdog timer to disable emission. When the timer is enabled, the laser monitors the communications link. When the laser detects that the link is broken, the watchdog timer begins to countdown. If the timer expires before the link is restored, emission is shutdown. The timeout period for the watchdog can be set between 1 and 255 seconds. To turn off the function, set the *Watchdog Timer* to *OFF*

Figure 30 Watchdog timer setting



Display backlight Use the *Display backlight* menu to adjust the backlight intensity of the LCD display panel. Enter the menu and turn the selection dial left or right to vary the intensity.

Figure 31 Setting the intensity level of the LCD panel backlight



IP Address The rear panel of the laser supports a standard 10/100 BASE-T Ethernet port. Use the *IP Address* menu to set the IPv4 address of the laser.



Note: The Ethernet port is set to use TCP/IP as default.

Figure 32 IP address setting



Emission button Press the *Emission* button to turn laser emission ON or OFF. When laser emission is ON, the *Emission* LED on the front panel is ON RED.



Warning: You must follow all safety regulations required for the location where the laser will be operated. Doing otherwise, may result in injury, damage, or fire.



Warning: Turning on the laser will emit hazardous laser Class 3B or Class 4 radiation. Ensure to observe and implement all safety regulations, warnings and cautions in this guide and in either the *Koheras ADJUSTIK Safety, Handling and Regulatory Information* or *Koheras ADJUSTIK HP Safety, Handling and Regulatory Information* document before continuing.



Caution: Do not turn on the laser if it has been exposed to temperature and humidity beyond the operating specifications. The Koheras ADJUSTIK is designed to operated in a non-condensing environment from +18 to +30°C (or 35°C). Before turning on the laser, allow it at least 30 minutes to reach room temperature. Turning on a laser that is too cold or hot may lead to the system being damaged.

Further, ensure the laser is securely installed and connected according to the procedures in [“Mechanical Installation” on page 93](#) and [“Connecting the Laser” on page 97](#). This means the laser should be installed in the recommended environment with power applied and at the very minimum, the door switch interlock connected.

4

Communicating with the Laser

You can manage the laser using NKT Photonics CONTROL software installed on a PC.



Note: Alternatively, you can use the NKT Photonics Software Development Kit (SDK) to integrate the laser with a custom control system.

This chapter focuses on how to obtain and install CONTROL on a PC, and then setup CONTROL communications to the laser using either a USB or Ethernet connection.

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 CONTROL software

After downloading the CONTROL installer software onto a PC (CONTROL PC), double click the installer and follow the built-in wizard. Further details on installing the software is available in [Appendix D](#).

Connecting the laser to a CONTROL PC

To connect the laser to a CONTROL PC using either a USB or Ethernet cable, follow the steps in:

- [Procedure 1](#) to connect to the laser using a USB cable.
- [Procedure 2](#) to connect to the laser using an Ethernet cable.

Procedure 1 Connecting a PC to the laser using a USB cable

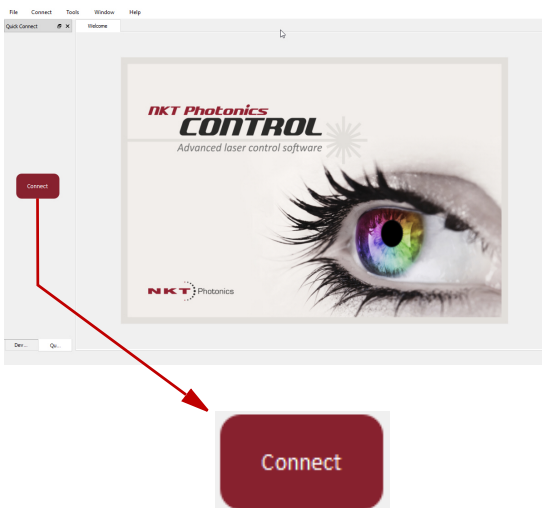
Action	
1	Using a USB Type A-B cable, connect a USB Type A port of the CONTROL PC to the laser's USB Type B port. – see Figure 3 .
2	Connect power to the laser – see Connecting power on page 99 .
3	If necessary, wait for the Windows device manager to install USB drivers for the connection.

Action

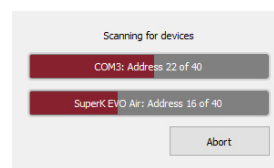
- 4 Launch the CONTROL software by either:
 - clicking on Windows – Start – Programs – NKT Photonics –CONTROL
 - or –
 - double clicking the CONTROL shortcut on the desktop



- 5 The CONTROL window opens. Click on the “Connect” button in the left side of the window.

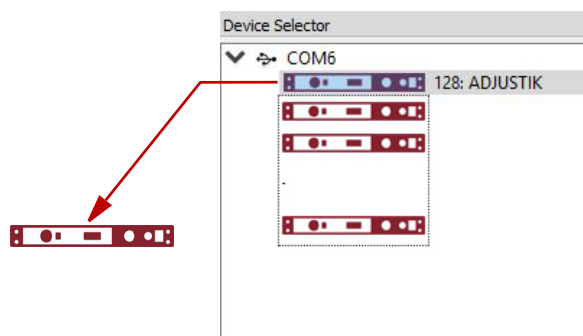


- 6 CONTROL automatically scans for any connect lasers and accessories available on both COM and configured Ethernet ports.



- 7 The CONTROL and STATUS panels for the laser will open.

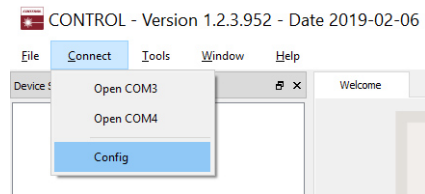
If multiple lasers are connected to the PC as shown in the device selector, click on the icon representing the laser to open its panels.



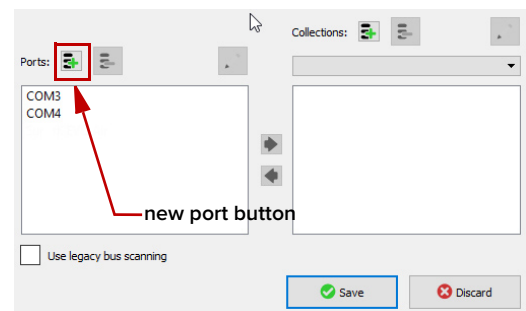
Ethernet connection To connect the laser to the PC using Ethernet, the PC and the laser must have their Ethernet ports connected to the same or separate IPv4 subnets. If separate subnets are used, ensure each subnet is reachable from the other.

Procedure 2 Connecting a PC to the laser using Ethernet**Action**

- 1 Configure the ADJUSTIK IP address using either CONTROL connected over USB ([Ethernet on page 80](#)) or the front panel controls ([IP Address on page 57](#)).
- 2 Using a CAT5 or better Ethernet cable, connect the laser's Ethernet port either directly to a CONTROL PC Ethernet port or to a subnet accessible by the PC.
- 3 Open CONTROL and from the Connect menu list, select *Config* to open the Port Configuration window.



- 4 In the *Port Configuration* window, click on the *Create new port* button.



- 5 The *Create new network port* window appears. Configure the port parameters as described below:

Name – Enter a name for the Ethernet connection (e.g. Lab-Laser-2).

Host IP Addr. – Select a host IP address from the drop down list of the computer's available network adapters. Ensure to select the address assigned to the Ethernet port of the PC connected to the laser.

System IP Addr. – Enter an IPv4 address for the laser's network adapter - see [IP Address on page 57](#).

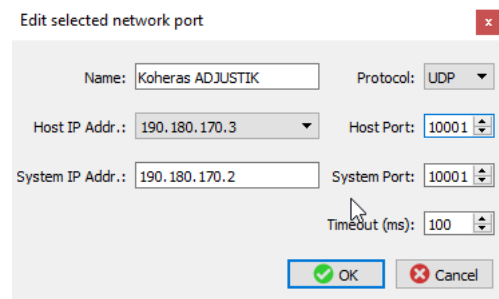
Protocol – Select either UDP or TCP. TCP is the default and recommended.

Host Port – Enter a TCP or UDP port the PC will use for communications with the laser. The default value is 10001.

System Port – Enter a TCP or UDP port the laser will use for communication with the CONTROL PC. The default value is 10001. **Note:** If you connect multiple lasers over IP to the same NKTP CONTROL PC, configure each laser with a unique local system port.

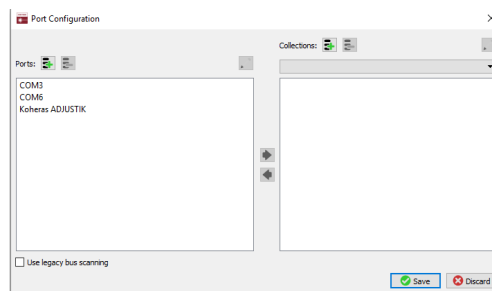
Timeout (ms) – Enter a timeout value in milliseconds. When CONTROL sends a request to the laser, it waits for a reply from the laser until this timeout value expires. Default value is 100 milliseconds.

Click *OK* to accept the configuration of the new *Ethernet connection* port.

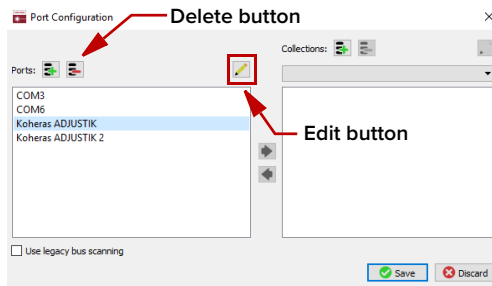


Action

- 7 Click the *Save* button to save the configuration of the new Ethernet connection.

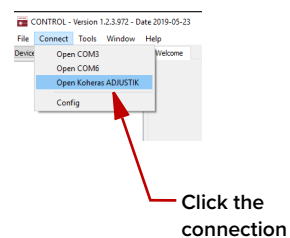


- 8 To delete or modify a configured port:
 1. Highlight the port and click the delete button
 - or -
 2. Click the edit button
 3. Click *Save* when finished.



- 9 From the *Connect* drop down menu, click on the Ethernet connection configured in step 3 to connect CONTROL to the laser.

Note: If CONTROL cannot access the port configured for the laser, verify that the CONTROL PC has connectivity with the laser by executing a PING test.



5 Turning ON the Laser

Safety

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

Koheras ADJUSTIK Safety, Handling and Regulatory Information

– or –

Koheras ADJUSTIK HP Safety, Handling and Regulatory Information

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

Preparation

The laser is ready to be turned on when the following steps are completed.

1. The laser is securely installed and connected according to the procedures in [“Mechanical Installation” on page 93](#) and [“Connecting the Laser” on page 97](#). This means the laser is installed in the recommended environment with power applied and at the very minimum a door switch interlock.
2. The laser is connected to a PC through either a USB or Ethernet connection and the PC has CONTROL installed on it and executing according to the procedures in [“Communicating with the Laser” on page 59](#).
3. The FC/APC connector is placed so that any emission are contained within the working application such as a beam dump that can safely absorb the emitted beam power.



Warning: Turning on the laser emits hazardous laser Class 3B or Class 4 radiation. Ensure to observe and implement all safety regulations, warnings and cautions in this guide and the *Koheras ADJUSTIK 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. See [“Cleaning of fiber facets” on page 102](#).



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



Caution: Do not turn on the laser if it 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 turning on the laser, allow it at least 30 minutes to stabilize at the operating room temperature. Turning on a laser that is too cold or hot, may lead to the system being damaged.

Back reflection When building and connecting your optical system, you must be careful to avoid creating a path where back reflection (BR) can occur. BR occurs when a laser beam is reflected back into the laser cavity. This increases noise and may cause the laser beam to scatter causing damage or injury.

You must always reduce the risk of BR into the laser. For example, in a bulk-optic system, ensure all reflective optics are securely fixed, minimizing the risk of back-reflected light into the laser. Also, before turning on the laser the first time, check the optical path to confirm no BR is possible from the application light path.



Warning: Back reflection is a hazard and may cause injury or damage to the laser.

Enabling and disabling emission

Enable emission (CONTROL) To turn on the laser using CONTROL follow the steps in [Procedure 3](#).

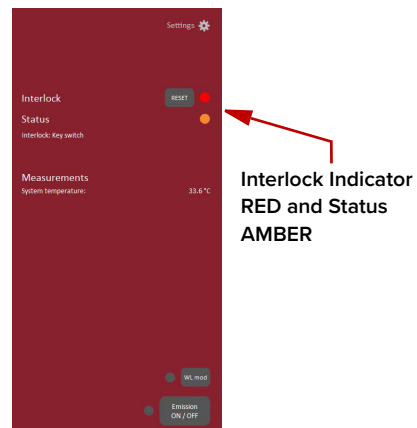


Note: The laser is equipped with internal temperature sensors that monitor the temperature of sensitive components. If these components are outside their specified temperature range, the laser halts emission.

Procedure 3 Turning on the laser using CONTROL

Action
1 Connect to the laser using the procedures in Communicating with the Laser on page 59 .

- 2 If the *Interlock* indicator in the status panel is RED and *Status* is AMBER, check the following:
- a. The door interlock circuit is open – [Connecting the safety interlock on page 97](#)
 - b. The external bus is not looped back with a bus defeater – [Connecting the safety interlock on page 97](#)
 - c. An interlock alarm requires manual acknowledgment – [Acknowledging interlock alarms on page 98](#).
 - d. The key switch is set to *OFF* – proceed to step 2.



Action

- Turn the key switch on the front panel to the ON position.

NOTE: If the key switch is set ON and the interlock LED on the front panel is still amber, turn the key back to OFF and then ON again. This resets the interlock as long as the interlock circuit is closed.

NOTE: If the interlock LED on the front panel remains RED, even if the interlock circuit is closed, pressing the *Emission ON/OFF* button clears the interlock when emission is enabled. (See the next step: 4.)

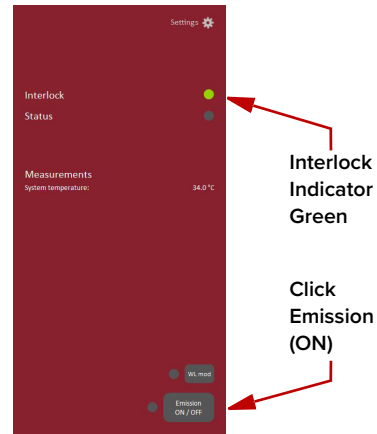


- To enable emission, click the *Emission ON/OFF* button once.

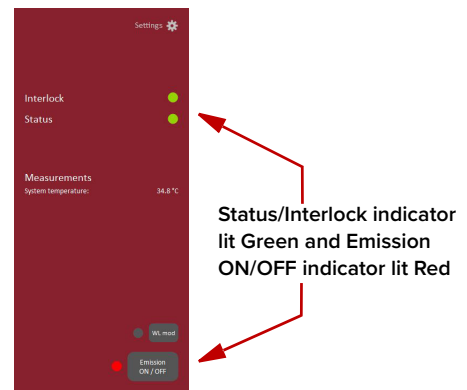
The emission indicator (next to the Emission button) is lit Red.

If the Status indicator is:

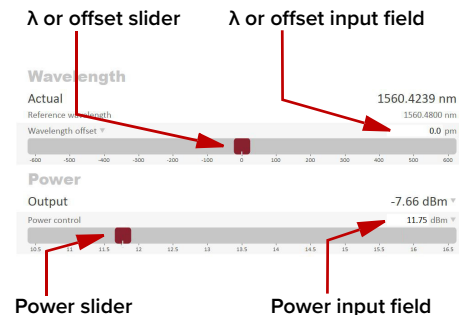
- Green – the laser is operating normally
- Flashing Green – the laser has not reached operating temperature (warming up)
- Red – a system error occurred or the interlock circuit opened when emission was enabled. (Emission is disabled.)



- Observe that the status panel is shown with indicators in the emission enabled state.



- In the Control panel, set the reference wavelength (λ) or its offset using the *Wavelength or offset* slider control. To set it, click hold and move the red slider to adjust the setting.
- 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.
- Set the laser's emitted power using the *Power* slider. To change the power, click hold the red slider to adjust its position along the bar.
- 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

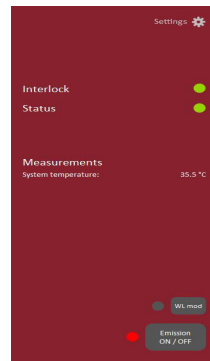


NOTE: To set the scale units, click on the downward pointing arrows for both the wavelength and power settings.



Action

- 7 To disable emission – click the *Emission ON/OFF* button once.



Click Emission to turn OFF the laser

Enable emission (front panel)

To turn on the laser using the front panel controls follow the steps in [Procedure 3](#).



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 4 Turning on the laser using the front panel controls

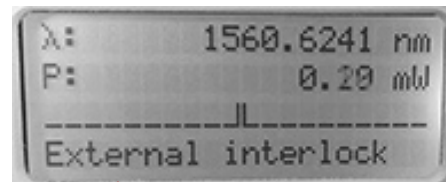
Action

- 1 Connect to the laser using the procedures in [Communicating with the Laser on page 59](#).

- 2 *a.* If the interlock circuit is in an open state or not terminated with the included External bus defeater – the *External interlock* message is displayed.

To clear it, close all bus connections and place the included bus defeater on the External bus port of the last connected device in the chain.

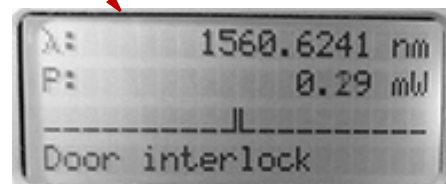
Note if the laser is operating as a standalone device, ensure the bus defeater is connected to its External bus connector.



External bus chain or door interlock circuit open

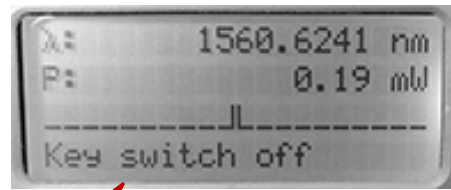
- 2 *b.* *Door interlock* message – the message is displayed when the door interlock circuit is open. Close the circuit to clear the message.

Note After closing all interlock circuits, ensure to acknowledge the alarm using the key switch – [Acknowledging interlock alarms on page 98](#).



Action

- 3 If the *Key switch off* message is displayed – go to step 4.



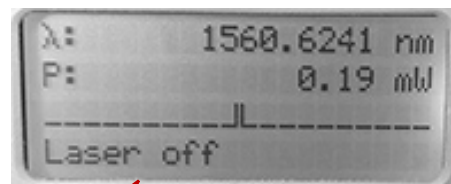
Front panel key switch is in the OFF position

- 4 Turn the key switch on the front panel to the ON position.



- 5 The *Laser off* message indicates laser emission can be enabled.

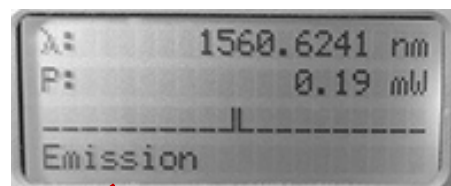
To enable emission, press the emission button on the front panel – see [Figure 3](#).



Laser is ready to enable emission

- 6 *Emission ENABLED* message – the emission wavelength and power level is displayed.

Warning: When this message is displayed, emission is enabled and Class 3B or Class 4 emission is present.



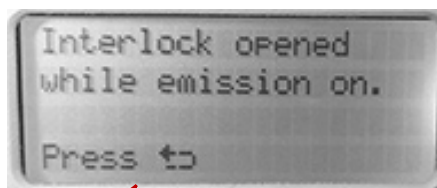
Emission is ENABLED

Action

- 7 *Interlock opened* message – this message is displayed if there is a break anywhere in the interlock circuit.

Emission is disabled and the status LED on the front panel is lit ON Red.

See [Connecting the safety interlock on page 97](#) for further information.



Emission is
DISABLED

- 8 a. Adjust wavelength – Press the enter button and using the selection dial, select the *Wavelength* setting menu. Once selected, use the selection dial and enter button to adjust the wavelength (λ).



Wavelength and
Power menu items

- b. Adjust power – to modify the output power, use the selection dial and enter button to select the *Power* menu item. In the menu, use the selection dial and enter button to adjust the power level.



- 9 To disable emission – click the Emission ON/OFF button once and *Laser off* message is displayed on the front panel.



Laser emission
is disabled

6 Using CONTROL

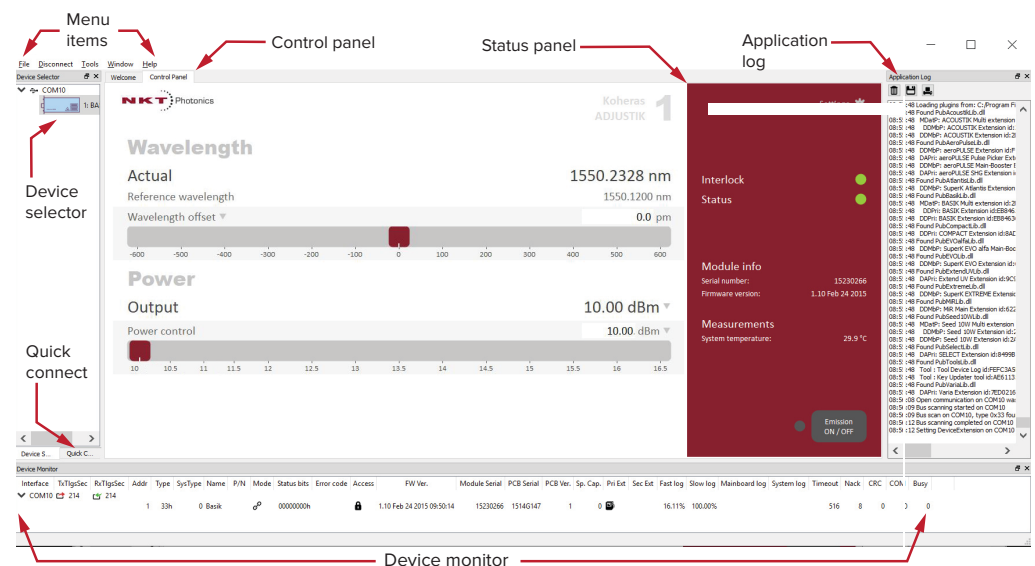
CONTROL overview

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 33](#) are briefly described [Table 9](#) with links to more details descriptions.

Table 9 CONTROL panels and menu items

Panel	Function	See
Status Panel	This panel displays the selected device status, emission control and a CONTROL settings menu.	Status panel on page 73
Menu Items	Five drop down menus with multiple functions.	CONTROL menu items on page 83
Quick Connect	Contains a button when clicked, scans all available PC ports for connected NKTP products.	Connecting to the laser on page 71
Device Selector	Icons representing currently connected devices, click to access the device.	Device Selector on page 72
Control Panel	The <i>Control</i> panel contains controls for the laser. For example, It contains configuration controls to set wavelength and output power.	CONTROL – Control panel on page 87
Application Log	This panel displays a debugging log that can be saved to a file.	Application log on page 89
Device Monitor	To also help debugging issues, this panel displays multiple port and device parameters.	Device monitor on page 88

Figure 33 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 34**.
 - 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 35**)

Figure 34 Panel dragged to a new location in the main window -

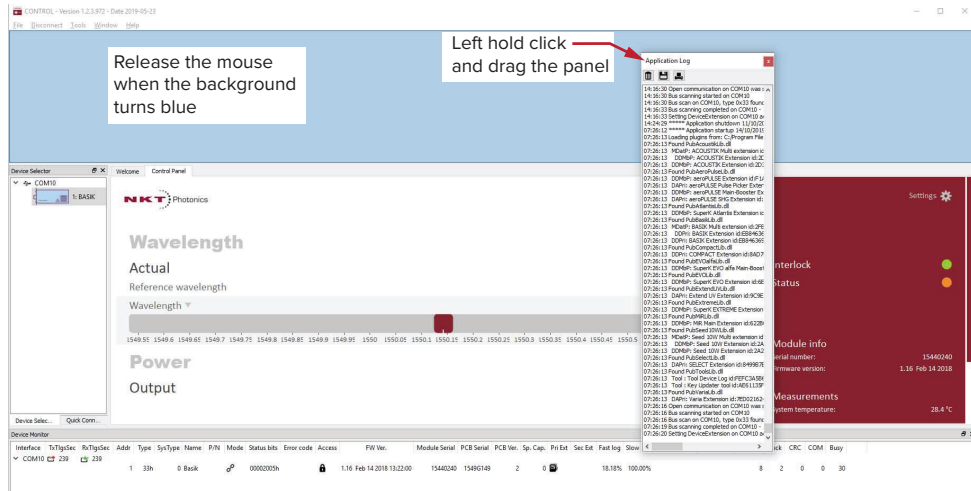
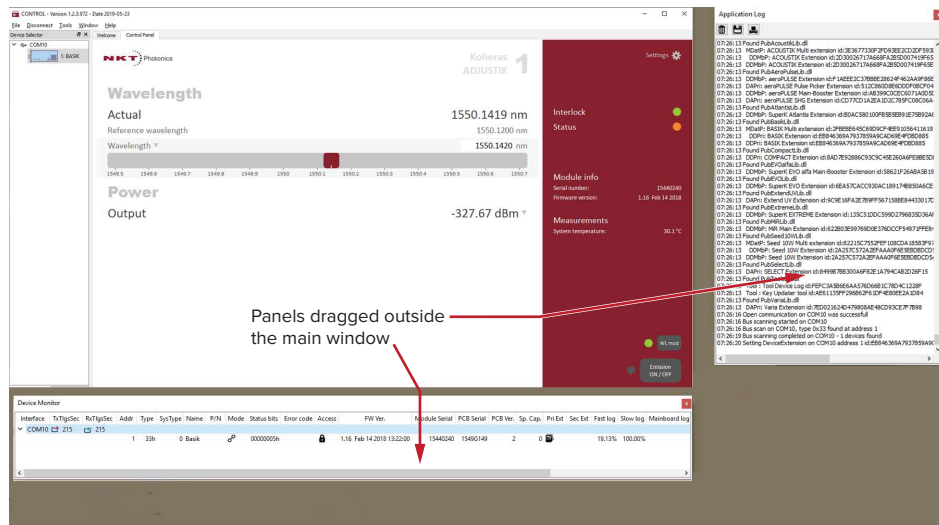
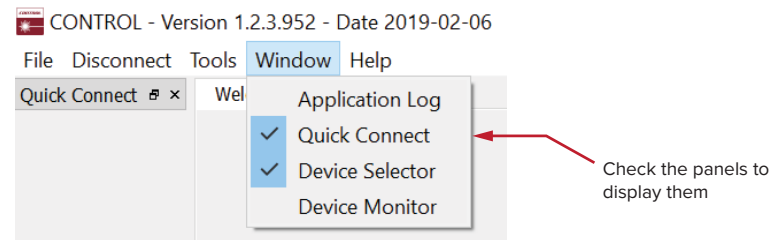


Figure 35 Panels dragged outside the main window



Toggle 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 36 Toggling panel visibility

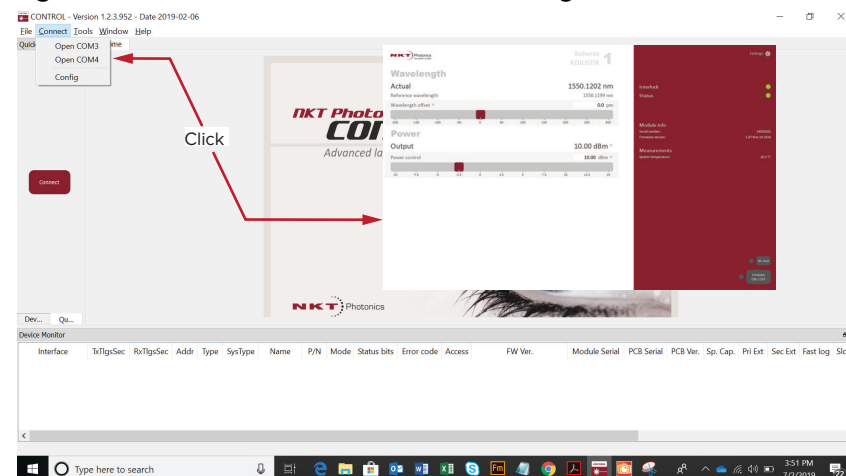


Note: To close a panel, click the X at the upper right corner of the panel.

Connecting to the laser When CONTROL is launched, the *Welcome* screen is displayed as in [Figure 37](#). 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.

See “[Connecting CONTROL to the laser](#)” on page 50

Figure 37 Welcome screen and connecting



Quick connect

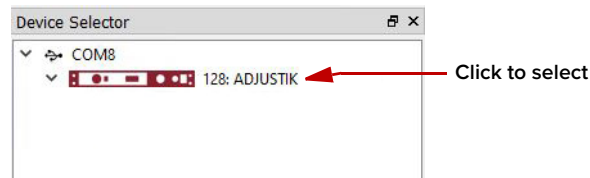
Click the *Connect* button and CONTROL scans all available ports for NKTP devices that it can connect to. Once CONTROL finishes the scan, a list of the devices is presented.

Figure 38 Connect button



Device Selector The *Device Selector* panel shows an icon for each connected device. [Figure 39](#) shows the device selector for an ADJUSTIK laser. If multiple lasers are detected by CONTROL, click on the ADJUSTIK icon to bring up its controls. To modify the ICON text, see [“View” on page 82](#).

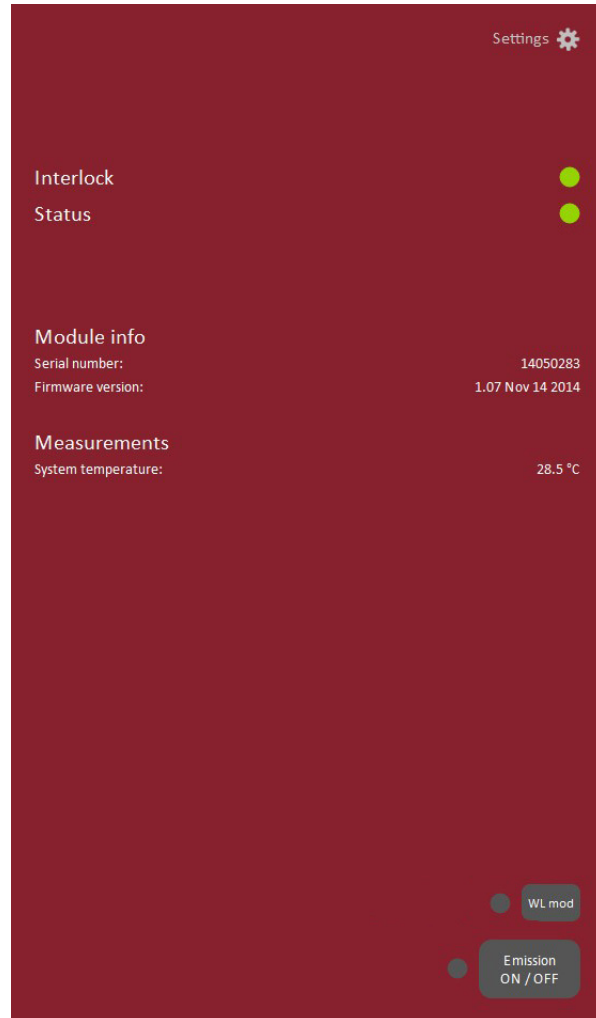
Figure 39 Device selector panel



Status panel

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

Figure 40 Status panel



Status indicators The panel includes the following indicators:

Interlock

Indicates the status of the interlock circuit.

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

Status

Indicates the laser thermalization and operation capability:

- ON Green – The laser has reached the set point temperature and has stabilized.

- ON Amber – The laser is in the process of warming up or a system error is detected.

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

- Laser serial number
- Laser firmware version

Measurements Displays the system temperature.

WL mod button and indicator **Button**
The *WL mod* button turns wavelength modulation ON or OFF.

Indicator

Green – wavelength modulation is ON.

Grey – wavelength modulation is OFF.



Note: The *WL mod* button and indicator is only displayed by CONTROL if the wavelength modulation feature is included with the laser, see “[Fast wavelength modulation](#)” on page 39.

Amp mod button and indicator **Button**
The *Amp mod* button turns amplitude modulation ON or OFF.

Indicator

Green – amplitude modulation is ON.

GREY – amplitude modulation is OFF.



Note: The *Amp mod* button and indicator is only displayed by CONTROL if the amplitude modulation feature is included with the laser, see “[Amplitude modulation](#)” on page 46.



Note: Before using this button, ensure to configure the amplitude modulation settings, see “[Amplitude modulation](#)” on page 78.

Emission button The *Emission ON/OFF* button turns the laser emission ON – see “[Enabling and disabling emission](#)” on page 64.

The button indicator turns ON Red when any laser emission are generated. Otherwise, it will be OFF Grey.



Warning: Class 3B or Class 4 laser emission are emitted when the Emission button LED is ON Red.

CONTROL settings


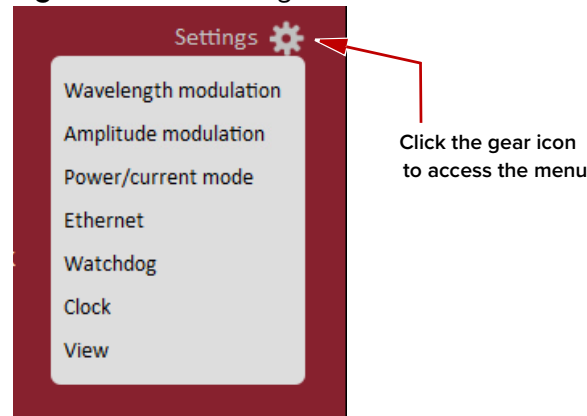
The GUI settings are accessible by clicking the gear icon  in the upper right corner of the status panel. Clicking the gear icon, drops down a menu of setting items as shown in [Figure 41](#):

Figure 41 GUI settings



Setting Item ¹	Function	See
Wavelength modulation	Displays the wavelength modulation configuration panel.	Wavelength modulation on page 75
Amplitude modulation	Displays the amplitude modulation configuration panel.	Amplitude modulation on page 78
Power/current mode	Drop down menu arrow to set the laser to operate in either power or current mode.	CONTROL – Control panel on page 87
Ethernet	Displays the IP configuration panel for the laser's Ethernet port.	Ethernet on page 80
Watchdog	Displays the panel to enables and set the watchdog timeout.	Watchdog on page 81
Clock	Displays the panel to set the laser's clock.	Clock on page 82
View	Displays a panel with a check box to enable the display of system information within the status panel.	View on page 82

1. Setting items available may vary and are based on the internal module type.

Wavelength modulation You can modulate the wavelength of the laser using either the internal function generator or an external signal. To configure wavelength modulation, select *Wavelength modulation* from the *Settings* (gear) drop-down menu. [Figure 42](#) and [Figure 43](#) shows the *Wavelength modulation* configuration panels for the two modulation sources. Within these panels you can configure multiple parameters that affect the modulation functionality.



Note: The *Settings - Wavelength modulation* menu item is only available if the laser includes the wavelength modulation feature.

Modulation Source

The signal source used to modulate the wavelength is selectable. Click on the *Source* drop-down menu to select one of three source modes:

- **Internal** (Figure 42) – the wavelength is modulated by the internal function generator signal.
- **External** (Figure 43) – the wavelength is modulated by a signal connected to the *Wavelength+/-* pins.

You can connect an external modulation signal to either the laser’s interface board connectors as described in “[Connecting modulation signals](#)” on page 100 or directly to the main electrical interface pins. The pin assignments are described in [Table 19](#) on page 111. For information regarding example signal generation circuits, refer to section “[Fast wavelength modulation](#)” on page 39.

Figure 42 Wavelength modulation - internal source

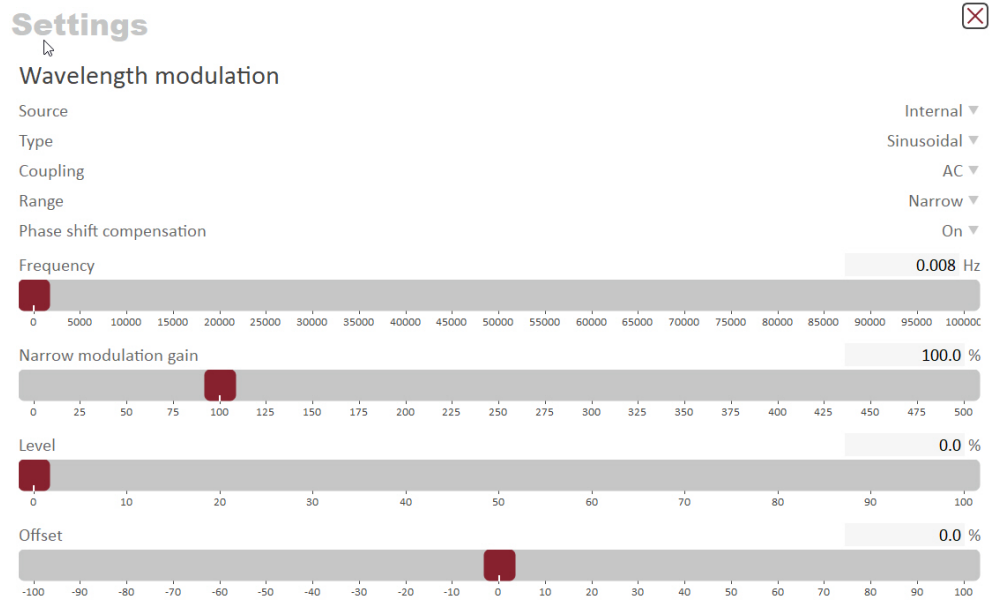
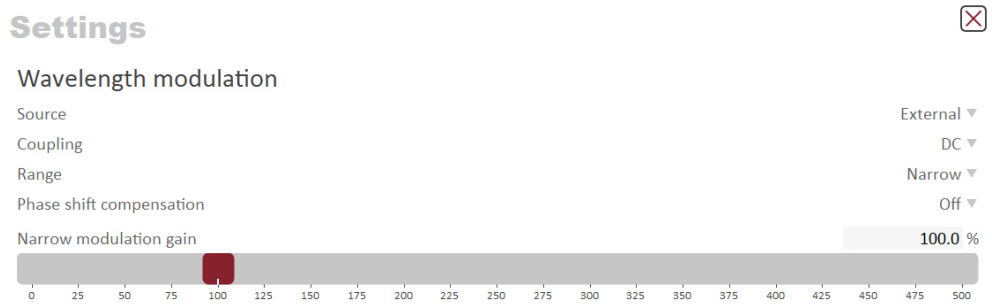


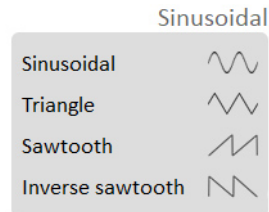
Figure 43 Wavelength modulation - external source



Modulation Type (internal mode)

If the Modulation source is set to *Internal*, you can set the signal waveform type that is generated internally. Click the *Type* drop-down menu arrow and select either *Sinusoidal*, *Triangle*, *Sawtooth* or an *Inverse sawtooth* waveform.

Figure 44 Internal generator waveform selection – Type



Modulation Coupling

You can select to couple the modulation signal using either AC or DC coupling. Click on the *Coupling* drop-down menu arrow and select either *AC* or *DC* coupling. Refer to “[Wavelength modulation coupling](#)” on page 44 for further information.



Note: When using wavelength modulation with an X15 laser, and the modulation *Range* parameter is set to *Narrow*, the modulation signal will be AC-coupled, and the DC-component enters a software integrating function that tunes the wavelength up or down when the DC-voltage varies either positive or negative respectively. The speed of wavelength tuning is set with the *Integrating update interval*.

Modulation Range

For X15 lasers, you can use the modulation *Range* drop-down menu to set the modulation range to either narrow or wide.

When set to *Narrow*, modulation depth is limited but the X15’s low phase noise is maintained. To increase the modulation depth, change the range setting to *Wide*. When the modulation range is set to *Wide*, phase noise increases.

Note: Refer to “[Narrow vs. Wide modulation range](#)” on page 44 for further information on configuring the modulation range.

Signal output

You can output the internal generator signal (internal modulation) from the wavelength modulation pins of the laser. To output the signal from the pins, set the Modulation type to *Internal* and the *Signal output* selector to *Enabled*. To disable the output signal, set the *Signal output* drop-down menu to *Disabled*.

When multiple lasers are used, one laser can be set as a master signal generator with the other lasers configured as slaves.

1. For all the lasers, connect the *Wavelength+* pins together and the *Wavelength-* pins together.
2. Designate one laser as the master by setting it to operate in *Internal* modulation mode with *Signal output* set to *Enabled*.

- All other lasers operate in slave mode by setting them to *External* modulation mode.

Internal generator Frequency

When the modulation source is set to *Internal*, you can adjust the frequency of the internal generator signal to between 8 MHz (0.008 Hz) and 100 kHz (100,000 Hz). To adjust the frequency, use either the slider or the direct input field in the upper right corner of the slider.

Narrow and Wide modulation gain

You can use this slider to increase the gain of an external modulation signal connected to the *Wavelength+/-* pins. Increasing the gain, directly increases the wavelength modulation achievable with the signal.

Internal generator power Level

You can set the output power level of the internal function generator to between 0 and 100%. Use the slider or the text input field in the upper right corner of the *Level* slider to adjust the modulation level.

Internal generator Offset

You can adjust the offset of the internal modulation signal to between -100 and +100% depending on the modulation level. For example, if the modulation level is set to 40%, the offset can be adjusted between -60 and +60%. The sum of modulation level and the absolute offset can be a maximum of 100%.

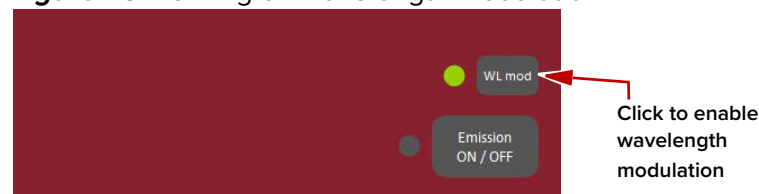
Integrating Update Interval

You can set the update interval of the software integration function with this setting. The function is only available on X15 systems with *Coupling* configured as *DC* and *Range* set to *Narrow*.

Turning on wavelength modulation

To enable wavelength modulation, in the status panel lower right click the *WL mod* button. The indicator next to the button turns ON Green. Click the button again to turn off the feature.

Figure 45 Turning on wavelength modulation



Amplitude modulation If the amplitude modulation option is included, you can modulate the output power using an external signal or the internal generator.

External signal

To use an external signal, change the *Source* setting in the *Settings* panel to *External* and connect a differential input signal to the amplitude modulation pins

– see “Amplitude modulation” on page 46 and “Interface Pin Assignments” on page 111. To use the internal generator, see “Internal generator” on page 80.

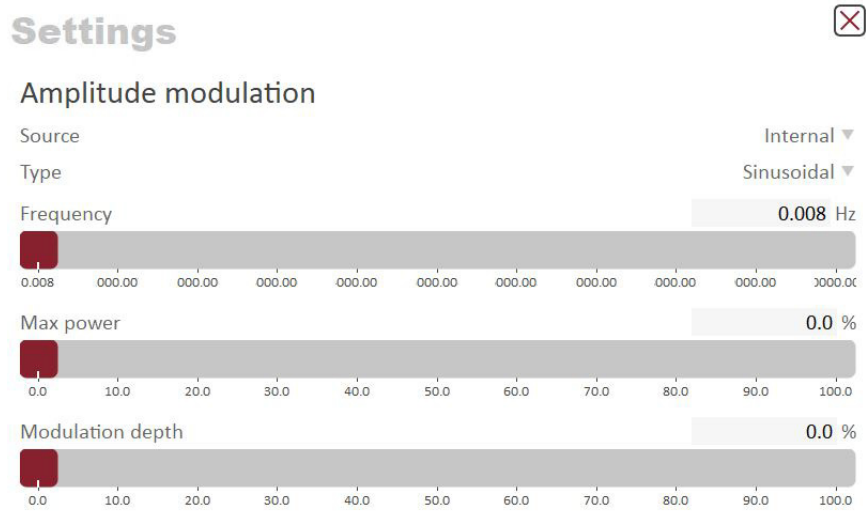
Figure 46 Amplitude modulation source settings



Internal generator

To modulate the output power using an internal generator, set the amplitude modulation source to *Internal*. Figure 47 shows the internal generator settings.

Figure 47 Internal generator amplitude modulation settings



Type – Select the modulation waveform type: *Sinusoidal*, *Triangle*, *Sawtooth*, or *Inverse Sawtooth*.

Frequency – Sets the modulation frequency from 0.008 to 10000 Hz.

Max power – Sets the maximum modulated output power in percent of the laser's output power.

Modulation – Sets the depth of the modulation in percent.

Ethernet System IP Address

The *System IP address* is used to configure the IP address settings for the laser. Ensure that the IP address of the laser is on the same subnet or a subnet reachable from the computer used to control it.

System Port

The *System port* defines what port number the laser should use for reception of a TCP packet. This port number should match the *Remote Port* setting in CONTROL's Ethernet connections. Default setting is 10001.

Host IP Address

You can configure the laser to only accept packets from a defined IP address. Use the *Host IP address* field to define what IP address the laser responds to. If the *Host IP address* is set to 000.000.000.000 (default setting), the laser is responds to any IP address reachable from the connected network.

Host Port

The *Host port* defines what port the laser uses for transmission of packets to the computer. If the computer port is set to 0, this means that the laser uses the

same port for transmission as for reception (i.e. as configured under the *System port*). Default setting is 0. If *Local port* in CONTROL's Ethernet connection is configured differently than the *Remote port*, the CONTROL computer's port should match the *Remote port*.

MAC Address

The *MAC address* for the laser's Ethernet frames is shown in the bottom of the Ethernet settings. The *MAC address* is not configurable but unique for every laser.

Figure 48 Ethernet setting

Settings		Koheras ADJUSTIK
Ethernet		
System IP address		190.180.170.002
System port		10001
Host IP address		190.180.170.001
Host port		10001
MAC address		40:D8:55:1C:C1:BB

Watchdog The laser features a watchdog for monitoring of USB or Ethernet communication. If CONTROL is disconnected from the chassis, the watchdog disables emission after the watchdog timer expires.

Enable Watchdog

To turn the watchdog on, select ON from the drop-down menu next to *Enable watchdog*. To turn the watchdog off, select OFF.

Watchdog timeout

When CONTROL communications is disconnected, the *Watchdog* timer starts. When the timer reaches the *Watchdog timeout* setting, emission is disabled. Set *Enable Watchdog* to ON to enable the feature.

Figure 49 Watchdog setting

Settings		Koheras ADJUSTIK
Watchdog		
Enable watchdog		ON ▼
Watchdog timeout		255 s

Enables the Watchdog

Clock Within the *Clock* setting menu, you can update the system date and time from the connected PC.

Date

Displays the system date in the format DD/MM/YYYY.

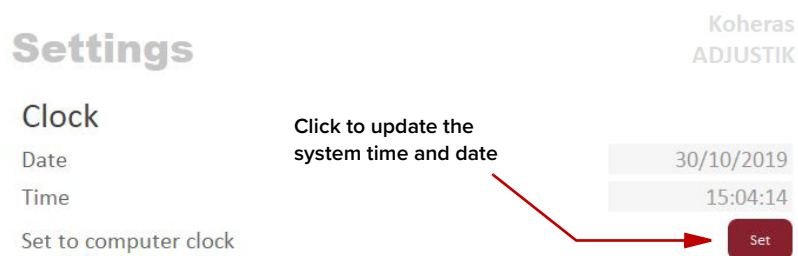
Time

Displays the system time in 24 hour format: HH:MM:SS.

Set to computer clock

Click the *Set* button to update the system time and date from the connected PC's current time and date setting.

Figure 50 Clock setting



View Check the *System info* box to display the laser serial number, firmware release number or system temperature within the status panel.

You can also input the name of your system in the *User text* input field. The text is displayed next to the laser's icon in the *Device Selector* panel.

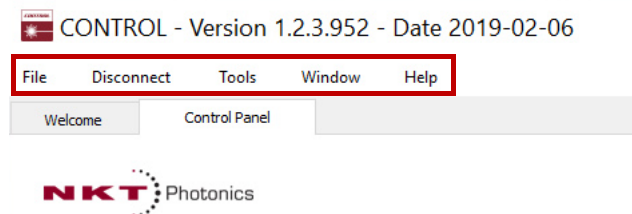
Figure 51 View setting



CONTROL menu items

There are four drop down menus in the main control window as highlighted in Figure 52. Click on the items in the menu to reveal the drop down menus.

Figure 52 Menu items



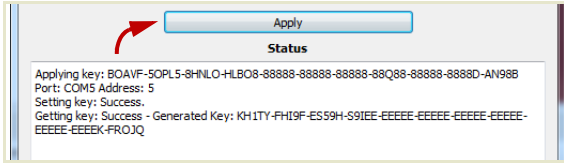
Menu Item	Function
File	Exits the GUI program.
Connect / Disconnect	Disconnects the currently connected device from GUI.
Tools	Select from one of three special tools to use with your laser. Tools available are: <ul style="list-style-type: none"> • Key Updater tool on page 83 • Log Downloader on page 84 • Extensions Overview on page 85
Window	Selects whether or not to display the Application Log and the serial monitor.
Help	Displays the current version of GUI and provides access to the included GUI user help.

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	
<p>1 Enter a key code in the field "Enter key code".</p> <p>NOTE: Key codes are generated by NKT Photonics.</p>	
<p>2 In the list of modules, check the box on the right of each applicable module.</p>	

Action	
3	<p>Click “Apply”</p> 

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.

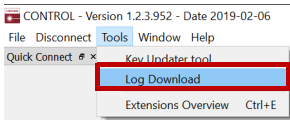
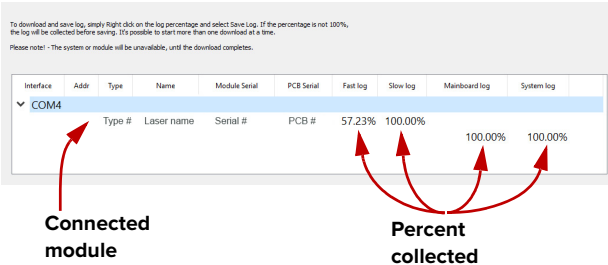
Log Downloader If your laser requires support from NKT Photonics, our support engineers may request you send them log files collected by the laser. You can use the log downloader tool to save laser log files to your CONTROL PC.

NKTP 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 NKTP modules, including the Koheras ADJUSTIK 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

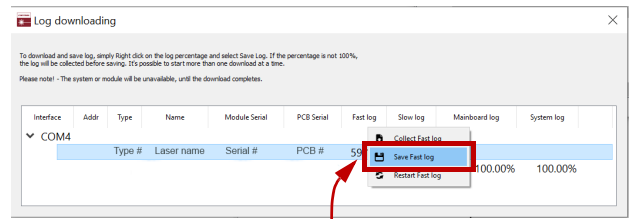
Action	
1	<p>Click the <i>Tools</i> menu and click on <i>Log Download</i> to start the Log Downloader tool.</p> 
2	<p>The tool displays all connected modules with log capability. To decrease the download time of the module log files, CONTROL continuously collects module log data and stores this log data 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.</p> 

Action

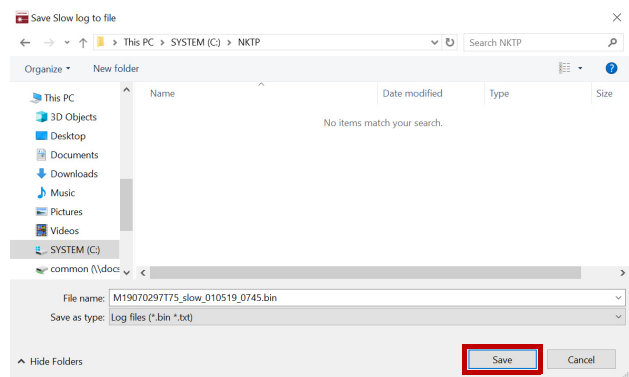
3 To download and save a log file to the CONTROL PC, right click the percentage indicator and select either:

- **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.

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

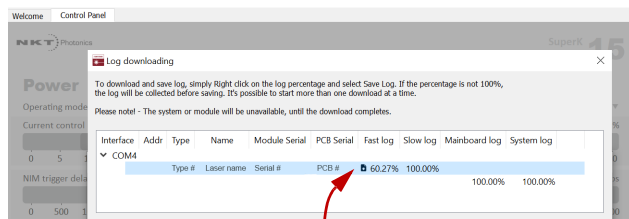


Right click the % indicator



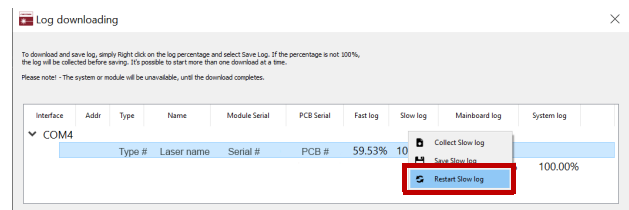
5 If you select Collect log, the log is collected and saved in dedicated mode. The CONTROL panel turns grey and all other functions are disabled.

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



Dedicated Collection Mode

6 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 53](#).

Figure 53 Extensions Overview

Extension	Modules	Type
ACOUSTIK Extension	(0x34, 0) Acoustik, at all addresses	Mainboard Device Primary
ACOUSTIK Extension	(0x34, 1) Adjustik, at all addresses	Mainboard Device Primary
ACOUSTIK Extension	(0x34, 1) Adjustik, at all addresses	Mainboard Device Primary
PubAeroPulseLib.dll - 1.0.8.302 - Release notes		
SuperK aeroPULSE Extension	(0x71, 0) AeroPulse, at all addresses	Mainboard Device Primary
aeroPULSE Pulse Picker Extension	(0x7B, 0) Pulse Picker, at all addresses	Accessory Primary
aeroPULSE Main-Booster Extension	(0x78, 1) aeroPULSE Main-Booster, at all addresses	Mainboard Device Primary
PubAdstkLib.dll - 1.1.2.303 - Release notes		
ADSTKMulti extension		Multi Primary
ADSTK Extension		
ADSTK Extension		
ADSTK Extension		
PubCompactLib.dll - 1.0.5.257 - Release notes		
COMPACT Extension		
PubEVOlib.dll - 1.0.0.305 - Release notes		
SuperK EVO Main-Booster Extension		
PubExtendUVLib.dll - 1.0.4.257 - Release notes		
Extend UV Extension		
PubExtremeLib.dll - 1.0.5.257 - Release notes		
SuperK EXTREME Extension	(0x00, 0) Extreme, at all addresses	Mainboard Device Primary
PubMiRLib.dll - 1.0.5.276 - Release notes		

ADSTK plugin release notes

- 1.1.2 Corrected integrating control slider visibility issue.
- 1.1.1 Corrected slider control calculations.
- 1.1.0 Corrected some minor bugs related to phase shift compensation.
- 1.0.9 Corrected bug regarding sliders sometimes being to short.
- 1.0.8 Corrected a wavelength slider enable issue in Basik-mikro.
- 1.0.7 Implemented support for new functions in Basik PCB version 2.
- 1.0.6 Corrected some features, in Basik-mikro.
- 1.0.5 Added new features and Basik-mikro support.
- 1.0.4 Initial release.



Note: To show a short description of the release notes as seen in Figure 53, hover the mouse pointer over the “Release notes” text

The Pub*****Lib.dll details highlighted in Figure 53 shows the version of the .dll file (x.x.x.xxx), the included extensions and which module types they support.



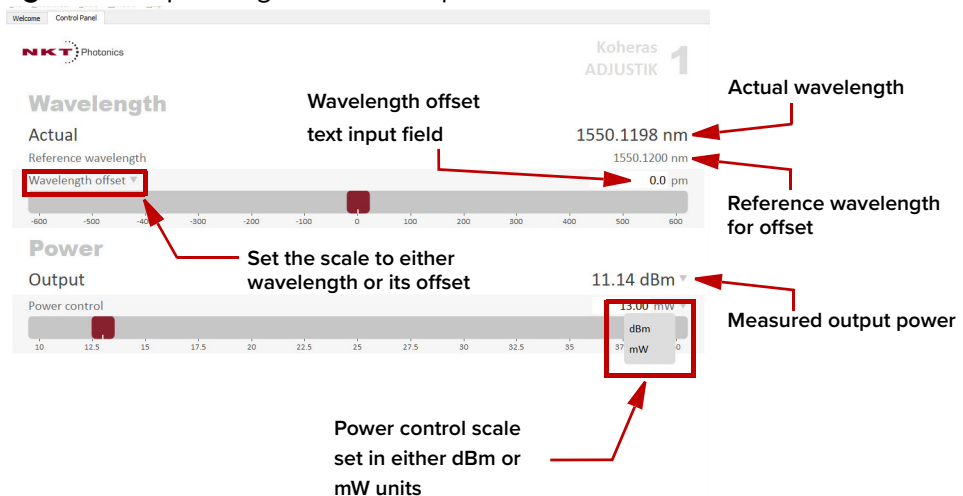
Note: Multiple extensions for a wide range of NKTP lasers types are typically installed when using the default installation of CONTROL.

CONTROL – Control panel

You can configure the *Control* panel to present different operating mode controls by setting the laser operating mode 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 “CONTROL settings” on page 75.

Power mode When set to 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 and measurement that can be scaled in either mW or dBm.

Figure 54 Operating mode set to power

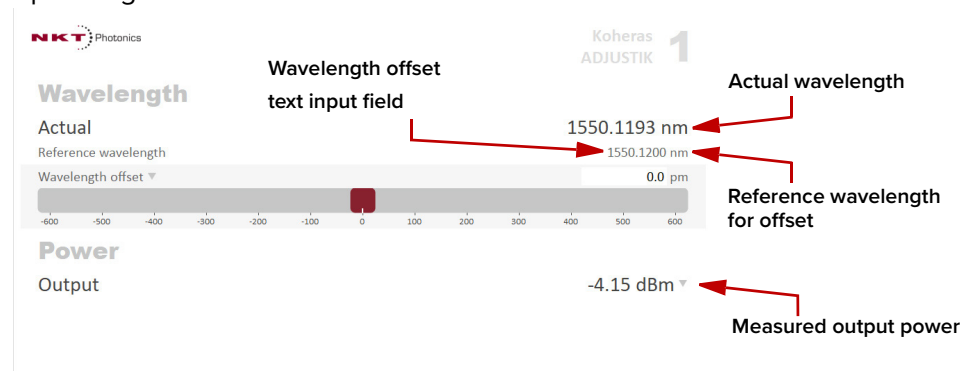


Note: For C15 and Y10 variants the power is fixed and cannot be adjusted. For these module variants, a power slider control is unavailable.

Note: The range of the power control varies and depends on the power capability of the ADJUSTIK or ADJUSTIK HP.

Current mode When set to *Current* operating mode, the current in the fiber pump is kept at a constant level. Only the wavelength (or its offset) control is available in the control panel menu.

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 10](#).

Table 10 Device Monitor parameters

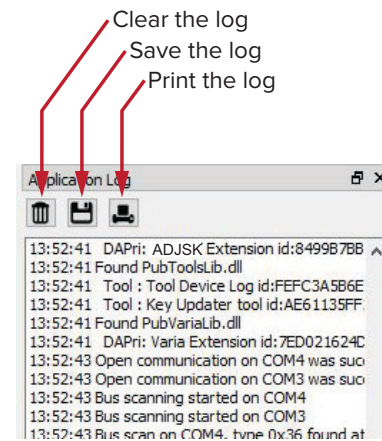
Parameter	Description
Interface	The PC port interface the device(s) is connected to. Click the “greater than” symbol to the left of the port to display the connected device(s) parameters.
TxTlgsSec	The number of telegrams per second being transmitted to the connected device.
RxTlgsSec	The number of telegrams 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.
Nack	Total number of negative acknowledgments received from the device module.
CRC	Total number of received telegrams with CRC failures.

Parameter	Description
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 useful for debugging serial communications. The panel displays time stamps for COM port open, 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 55 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".

SECTION 3

INSTALLING THE LASER

This section provides information on how to install the laser and includes the chapters:

- “Mechanical Installation” on page 93
- “Connecting the Laser” on page 97

7 Mechanical Installation

The laser chassis is designed to be installed on a flat surface or rack-mounted in a standard 19-inch rack. This section describes how to mount the laser module to ensure optimal function and ensure that heat generated by the laser, is adequately dissipated.

General

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



Caution: For reliable operation, the laser should not be exposed to corrosive agents or excessive moisture, heat sources or dust.

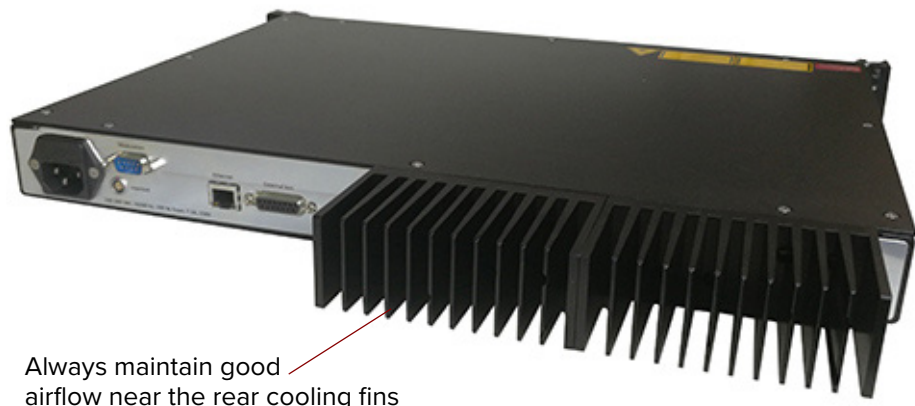
Heat dissipation

The heat generating components within the laser are thermally connected to a large heat sink mounted on the rear panel. Ensure that the installation space provides adequate airflow in the vicinity of the rear panel heat sink.



Caution: For ADJUSTIK HP variants, heat dissipation is vital, ensure the laser's operating temperatures are maintained.

Figure 56 Rear panel heat sink



Always maintain good airflow near the rear cooling fins

Rack mounting the laser

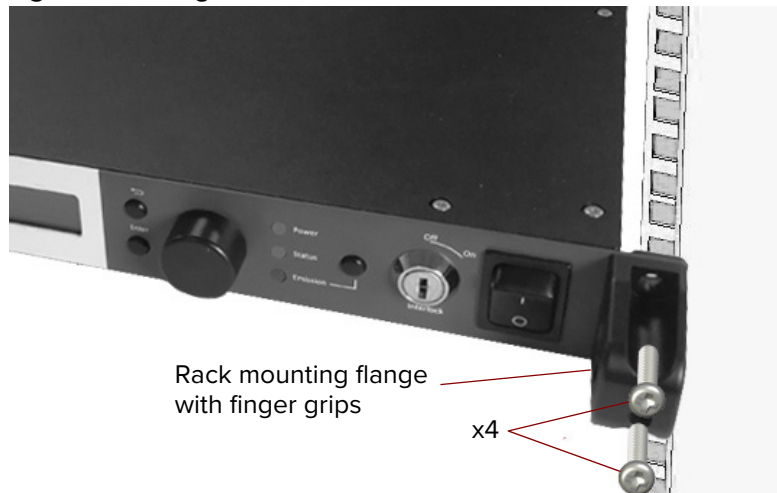
You can mount the laser in a standard 19-inch rack using rack mounting screws and cage nuts. [Figure 57](#) shows the laser's flange on the right side being affixed

to a standard rack. Use the finger grips on the flange to help balance the laser when you are mounting it in a rack. Once mounted in a rack, it is important that there is adequate airflow at the rear of the laser so that the cooling fins can effectively dissipate the heat generated by the laser.



To avoid injury and damage, NKTP recommends that when rack mounting the laser, two persons are present. One person can position the laser while the other fastens it to the rack.

Figure 57 Image of the laser rack mounted



Placing the laser on a table or shelf

For installations where the laser is placed on a level surface, the laser is equipped with four (4) rubber feet on its bottom panel (Figure 58). Be sure to include adequate space at the rear of the laser so that the cooling fins can effectively dissipate the heat generated by the laser. Additionally, the surface should be free from vibrations and any source that could cause temperature variations. Figure 59 shows the laser placed on a solid table-top with no nearby heat sources and with adequate free-space for the cooling fins.



Caution: For ADJUSTIK HP variants, heat dissipation is vital, ensure the

laser's operating temperatures are maintained.

Figure 58 Rubber mounting feet

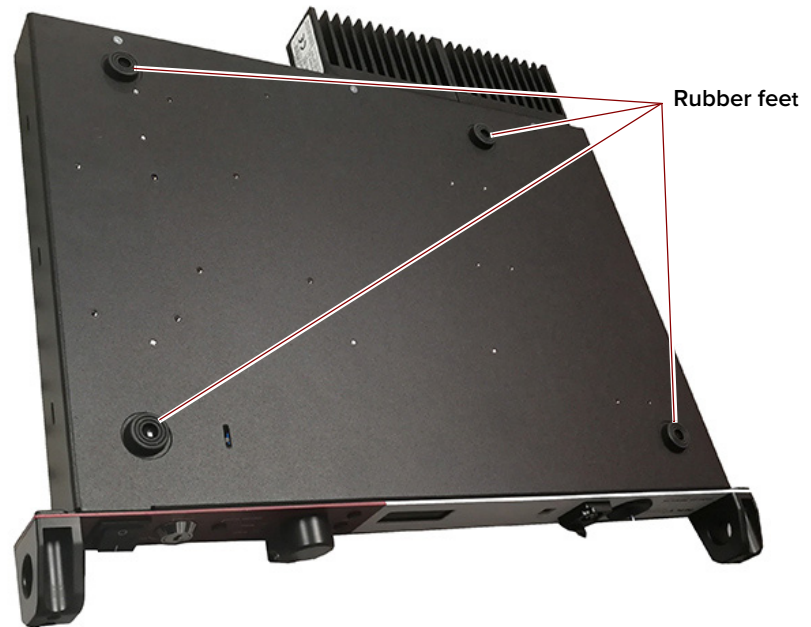


Figure 59 Table or shelf mounting



Operating and storage environment Appendix A details the required ambient operating and storage environment specifications.



Warning: A Koheras ADJUSTIK laser is either a Class 3B or Class 4¹ laser product, and its operation facility and environmental conditions must comply with the standards listed below or similar:

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

1. ADJUSTIK HP

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 97
- Power – see “[Connecting power](#)” on page 100
- Modulation signal inputs and outputs – see “[Connecting modulation signals](#)” on page 100
- Trigger – see “[Connecting the trigger input or output](#)” on page 100
- The optical output – see “[Connecting the optical output](#)” on page 101

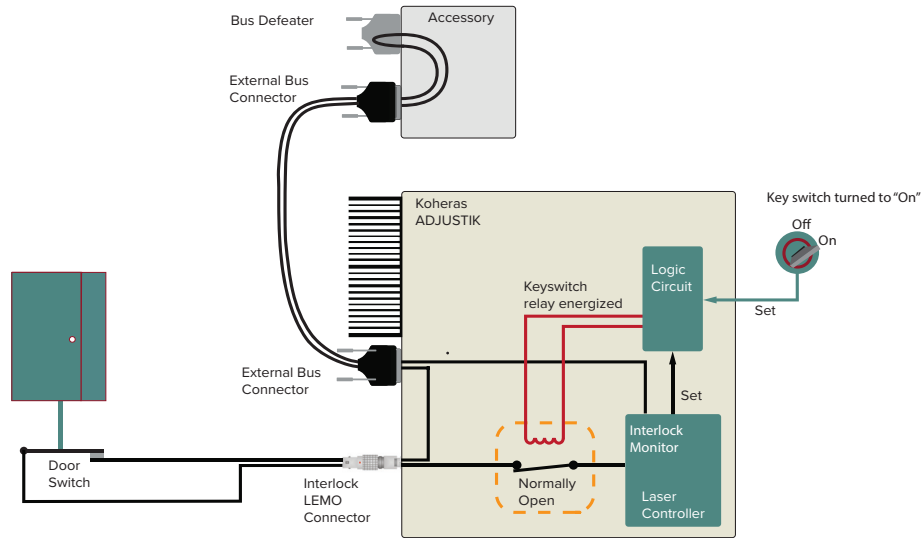
Connecting the safety interlock

To comply with safety regulations and help provide a safe operating environment, the safety interlock of the laser must be connected to a switch activated by the access door to the enclosure where the laser is operating. When the connected switch is opened by the door, it opens the interlock circuit which turns off laser emission.

Simplified Interlock operation **Note:** this section describes the functional operation of the interlock; to connect a door switch to the interlock, follow the steps in [Procedure 8](#).

The interlock circuit in simple terms is a closed loop circuit. When the interlock monitor function of the laser controller detects a break or open in the circuit, the controller immediately shuts down the laser. The loop can be opened by either the keyswitch relay, the door switch circuit or the external bus loop. In [Figure 60](#), the keyswitch is turned to the *On* position. A logic circuit in the laser detects this and energizes the keyswitch relay and so if the interlock circuit is closed, the laser controller permits emission.

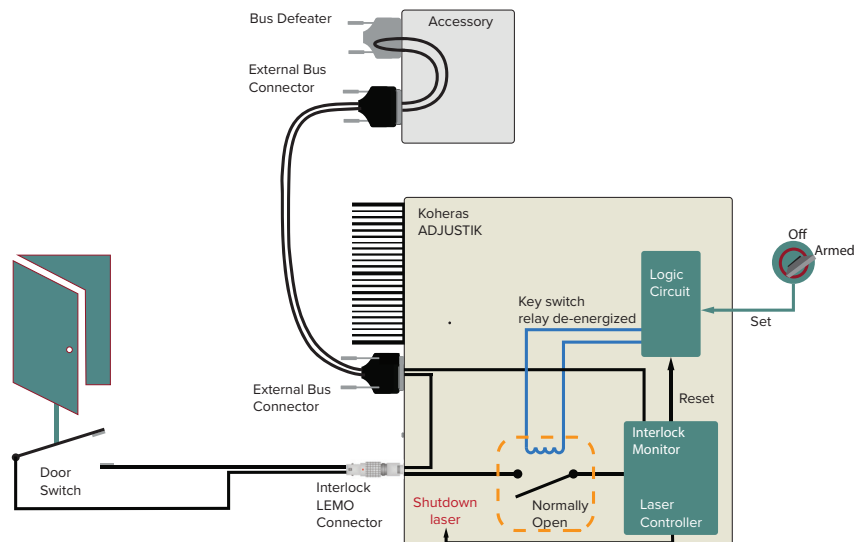
Figure 60 Interlock connected to a door switch - Laser ON



Interlock alarm Figure 61 shows the door switch in the open position. This opens the interlock loop which the interlock monitor detects and the controller immediately sends a shutdown signal to the laser (the laser's pump). In addition, the controller sends a reset to the logic circuit. The reset causes the logic circuit to de-energize the keyswitch and the relay opens.

When the door closes again, use the keyswitch to reset the interlock by turning it off and on. This sets the logic circuit (a D Flip-Flop) to energize the coil again closing the keyswitch relay as shown in Figure 60.

Figure 61 Interlock connected to a door switch - Laser SHUTDOWN



Acknowledging interlock alarms If the door closes again (closing the door switch), the only way to close the relay again is to cycle the key to OFF and then ON (Manual restart). This sets the logic circuit (a D Flip-Flop) to energize the coil again, closing the relay and clearing the interlock alarm as long as the interlock circuit is still in the closed state.



Caution: Do not short-circuit the Interlock input. Short-circuiting the interlock circumvents safety regulations and NKT Photonics does not take liability for any injuries or damage caused by doing so.



Caution: The switch connected to the interlock must be of an approved type. Further, the switch must be installed in a manner so that its operation cannot be fixed in the open state using a tool.



Warning: If the interlock is bypassed using an interlock def eater, 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 installation enclosure is opened. The switch must comply with safety regulations.
2	Using a cable with a maximum wire length of five meters and at a minimum 26 AWG, connect the switch to a LEMO connector. For cable lengths longer than five meters, it is recommended to use shielded cable.
3	Perform a continuity test using a multimeter: <ul style="list-style-type: none"> a. First connect the multimeter leads to the interlock plug terminals. b. Confirm when the enclosure door is closed, the meter shows the circuit as closed. c. Confirm when the enclosure door opens, the meter shows the circuit as open.
4	Insert the LEMO connector into the LEMO interlock connector on the rear panel of the laser.

Bus def eater

When no accessories are connected to the External bus, a bus def eater must be placed on the last device in the External bus chain topology. The bus def eater is placed on the bus output connector of a connected accessory or on the External bus connector of the laser.

Figure 62 Bus def eater



The External bus includes an extension of the interlock circuit. The def eater plug loops the circuit at the last External bus connector in the system with no other devices attached to the bus chain. If no def eater is used, the interlock circuit will be open and so disables the laser in the same manner as the door switch

opening. The defeater is included with the laser, it is a standard male DB-15 connector with the necessary pins looped back – see [Table 20 on page 111](#).

Connecting power

Power is supplied to the laser through the rear AC input connector. The connector is a standard C-14 type designed for use with an AC power cord that is fitted with a C-13 connector. Electrical and cable specifications are listed in [Table 11](#).

Table 11 Power specifications

Item	Description
AC Mains Input	100-240 VAC @ 50-60 Hz
Power cord	The power cord must be capable to safely transmit the laser's specified AC ratings while maintaining a safe connection with the local AC mains outlets. The power cord used must follow local or national regulations.
AC connector (inlet)	IEC 60320 – C14
Power cord connector	The power cord must have an IEC 60320 C-13 connector.

Connecting modulation signals

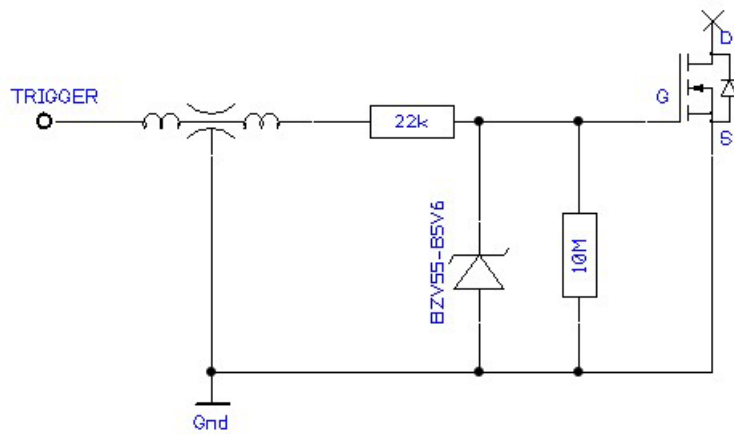
Input and output wavelength modulation signals are described in chapter 2: “[Modulation](#)”. Input modulation signals are connected to the DB-9 pin connector on the rear panel, see “[Modulation input/output](#)” on page 111.

Connecting the trigger input or output

The laser includes a trigger logic input/output signal as part of the Modulation connector (see [Table 19](#)). You can use the trigger signal to either initiate or indicate laser emission.

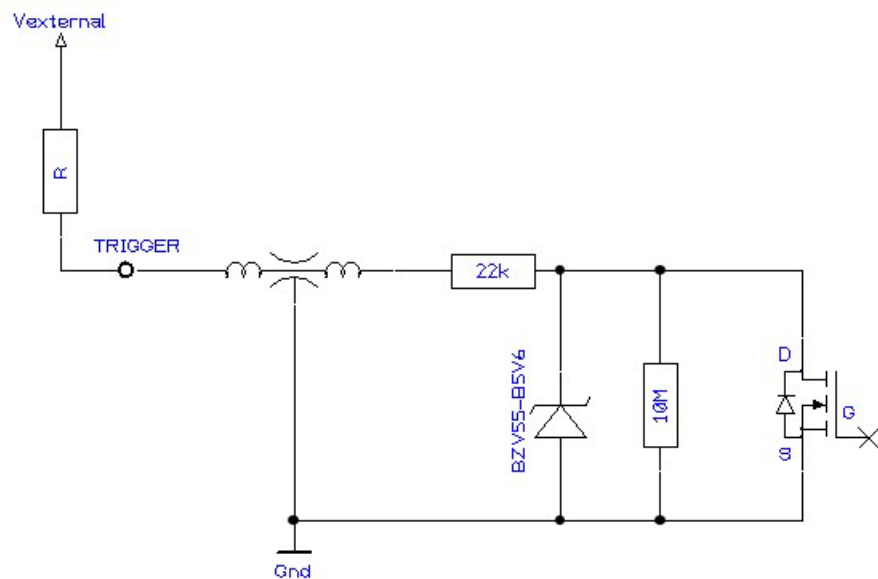
Input trigger When set as an input a positive active high signal must be applied to the trigger pin to initiate emission. The diagram [Figure 63](#) shows the trigger input.

Figure 63 Trigger input circuit



Output trigger When the trigger feature is set as an output, the trigger pin should be connected to an external pull-up resistor. The diagram [Figure 64](#) shows the trigger output circuit.

Figure 64 Trigger output circuit



The high and low voltage levels are defined by the following equations:

$$V_{high} = V_{external}$$

$$V_{low} = V_{external} \times 22k / (22k + R)$$

Connecting the optical output



Caution: Before connecting the optical output connector, 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 connec-

tor. Either clean the connector or contact NKT Photonics support if a replacement is necessary.

The fiber and its connectors are inspected and sealed in a clean environment before shipping. For optimum system performance, follow the guidance below:

- Avoid removing any connector caps when the outputs are not in use and kept in storage.
- When connecting an output fiber, avoid:
 - Excessive strain on the fiber through stretching or twisting.
 - Fiber bend diameters < 10 cm
 - Exposing the fiber and its facets to contaminants.
- Take good care and gently handle output fibers and their connectors to prevent damage to the fiber or its facets.
- Before using the laser, inspect the fiber and its facets for damage and contaminants - if they need cleaning, see [“Cleaning of fiber facets” on page 102](#).

Cleaning of fiber facets

The facets of the system fiber connectors may occasionally require cleaning. Particularly for ADJUSTIK HP variants, as any contaminants might be susceptible to the system’s higher output power. Before making any fiber connections, always inspect the fiber facet of all connectors using an inspection scope. A scope with both coaxial and oblique illumination is useful in exposing any contaminants or defects in the facet. Further, rotating the fiber while under illumination may be necessary to discover irregularities often hidden under certain angles of light.



Warning: Ensure the laser is disabled before inspecting fiber facets.

Cleaning tools When cleaning the facet, only use cleaning tools that are specifically designed to be used with optical fibers. Always use extreme caution when cleaning fibers.

Examples of appropriate cleaning tools are: a lens cleaning tissue (lint free wipes) as shown in [Figure 65](#) or an optical fiber cleaning tool as shown in [Figure 66](#).

Figure 65 Lint-free wipe example



Figure 66 Example of a fiber cleaning cartridge



APPENDICES

The appendices include:

- [Appendix A on page 105](#): Specifications
- [Appendix B on page 109](#): Service and Support
- [Appendix C on page 111](#): Interface Pin Assignments
- [Appendix D on page 113](#): CONTROL Installation
- [Appendix E on page 119](#): Part Numbers

A Specifications

Table 12 Koheras ADJUSTIK optical specifications

	X15	E15	C15	Y10
Laser Emission	CW - inherently single frequency			
Output power (mW)	30	40	> 10	> 10
Beam Quality (M2)	< 1.05	< 1.05	< 1.05	< 1.05
Linewidth (kHz)¹	< 0.1	< 0.1	< 15	< 20
Max. phase noise [dB(μrad/√Hz)/m]	-105 @ 1 Hz (typ.) -125 @ 10 Hz -130 @ 100 Hz -128 @ 1 kHz	- -90 @ 10 Hz -110 @ 100 Hz -130 @ 20 kHz	- -69 @ 10 Hz -89 @ 100 Hz -109 @ 20 kHz	- - - -
Max phase noise [(μrad/√Hz)/m]	3.1 @ 1 Hz (typ.) 0.6 @ 10 Hz 0.3 @ 100 Hz 0.4 @ 1 kHz	- 32 @ 10 Hz 3.2 @ 100 Hz 0.3 @ 20 kHz	- 355 @ 10 Hz 36 @ 100 Hz 3.5 @ 20 kHz	- - - -
Peak RIN (MHz)	~ 0.7	~ 0.7	~ 1.0	~ 1.5
RIN level @ Peak / 10 MHz (dBc/Hz)	<-100 / <-135	<-100 / <-135	<-120 / <-140	<-105 / <-140
Optical S/N (50 pm res.) (dB)	> 50 (typ. > 55)	> 50 (typ. > 55)	> 65 (typ > 70)	> 65 (typ > 70)
Min. Thermal Tuning Wavelength Tuning Range (pm)²	+/- 125	+/- 350	+/- 350	+/- 240
Total thermal tuning range [pm]	350	1000	1000	680
Fast Wavelength Modulation range (GHz)	0.6	8	8	10
Fast Wavelength Modulation (KHz)	up to 20	up to 20	up to 20	up to 20
PM Output - PER (dB)	> 23	> 23	> 23	> 23

1. Lorentzian
2. 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.

Table 13 Koheras ADJUSTIK HP optical specifications

	X15¹	E15	C15	Y10
Laser Emission	CW - inherently single frequency			
Output power (W)	0.2 / 2.0	0.2 / 2.0	0.2 / 2.0	0.2
Operating wavelength	1545-1565	1545-1565	1545-1565	1060-1075
Output power tuneability (%)	10-100	10-100	10-100	10-100
Beam Quality (M2)	< 1.05	< 1.05	< 1.05	< 1.05
Linewidth (kHz)²	< 0.1	< 0.1	< 15	< 20
Peak RIN (MHz)	~ 0.7	~ 0.7	~ 1.0	~ 1.5
RIN level @ Peak / 10 MHz (dBc/Hz)	<-100 / <-135	<-100 / <-135	<-120 / <-140	<-105 / <-140
Optical S/N (50 pm res.) (dB)	> 40	> 40	> 55	> 55
Min. Thermal Tuning Wavelength Tuning Range (pm)³	+/- 350	+/- 350	+/- 350	+/- 240
Total thermal tuning range [pm]	1000	1000	1000	680
Fast Wavelength Modulation range (GHz)	0.5	8	8	10
Fast Wavelength Modulation (KHz)⁴	up to 20	up to 20	up to 20	up to 20
PM Output - PER (dB)	> 23	> 23	> 23	> 23
Output isolation (dB)	30	30	30	30

1. X15 phase noise ~ 20 dB lower in the 1 kHz frequency range compared to the E15.
2. Lorenzian
3. 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.
4. Modulation depth and frequency are typically slew-rate limited, depending on the power.

Table 14 Mechanical dimensions

All chassis models	
Size (H x W x D)	48.5 x 483 x 386 mm (1.91 x 19.02 x 15.20 in)
Weight	< 7 kg (< 15.4 lb)

Table 15 Operating and storage environment

All Chassis Models	
Operating Temperature	15°C to 55°C (59°F to 131°F)
Storage Temperature	-20°C to 60°C (-4°F to 140°F)
Operating Humidity (non-condensing)	0 to 70%

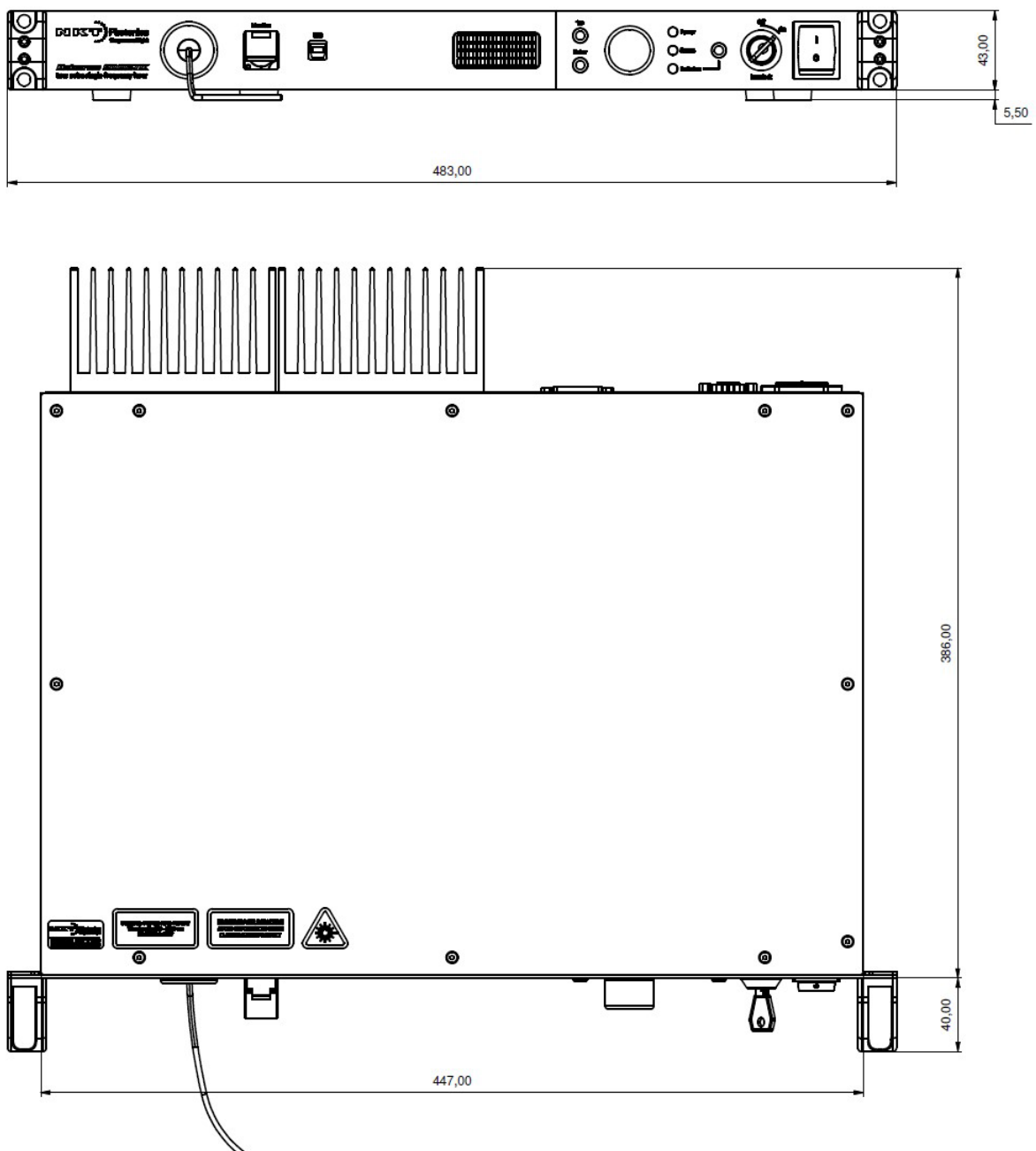
Table 16 Electrical

All Chassis Models	
Supply Voltage	100 – 240 VAC@ 50-60 Hz

Table 17 Safety and regulatory compliances

Safety	Regulatory
EN 60825-1:2014: Safety of laser products Part 1: Equipment classification and requirements [Laser Class 4] 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)

Table 18 Mechanical dimensions



B Service and Support Information

Servicing the laser

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



Caution: Do not open the laser’s modules. The laser modules are equipped with warranty labels (see [Figure 67](#)) on the covers of the laser chassis. The warranty is void if the system is opened.

Figure 67 Warranty seal



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

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

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

Support contact details

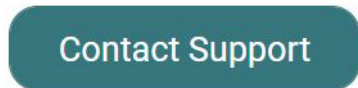
If you need help or have questions regarding your Koheras ADJUSTIK laser or its accessories, contact NKT Photonics through our support website below:

Support website

1. Go to:

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

2. Scroll down and click or press:



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

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

C Interface Pin Assignments

Modulation input/output

The Modulation input/output interface on the laser is a 9 pin male DB-9 connector. The pin assignments are described in [Table 19](#).

Table 19 Modulation connector pin assignment

Pin #	Signal	Description
1	Trigger	Logic input/output for either control or indication of laser emission. Active high. See Trigger for more information.
2	GND	0 volt ground
3	Amplitude-	Negative branch of differential input/output for amplitude modulation.
4	AGND	0 volt analog ground for modulation signals
5	Wavelength-	Negative branch of differential input/output for wavelength modulation.
6	GND	0 volt ground
7	Amplitude+	Positive branch of differential input/output for amplitude modulation.
8	AGND	0 volt analog ground for modulation signals
9	Wavelength+	Positive branch of differential input/output for wavelength modulation.

External bus

The External bus connector on the rear panel of the laser is a female DB-15 connector. The pin assignments are described in [Table 20](#).

Table 20 External bus pin assignment

Pin #	Signal	Description
1	NC	Not connected
2	RS485-	The negative/inverted link of the RS485 communication signal.
3	Interlock loop+	Positive connection of the interlock loop. Must be connected to Interlock loop- (pin no. 4) to enable laser emission from the system.
4	Interlock loop-	Negative connection of the interlock loop. Must be connected to Interlock loop+ (pin no. 3) to enable laser emission from the system.
9	Emission	Collector output with an internal 270 Ω resistor in series. Outputs a logic high when the Koheras ADJUSTIK system has laser emission ON. To indicate emission with an LED, its anode can be connected directly to this pin and its cathode connected to the GND (pins 5,6, 13 or 14).
10	RS485+	The positive/non-inverted link of the RS485 communication signal.
11	Not in use	For future use, do not connect anything to this pin.

Pin #	Signal	Description
12	Interlock Logic Output	Outputs a logic high (5V) when the interlock circuit is closed and has been reset. This signal can be used to control safety related precautions on the External Bus.
5,6,13,14	GND	0 volt ground.
7,8,15	+12 V	12 volt supply voltage for external accessories. Maximum 4 A in total.

D CONTROL Software

Installing CONTROL

Download the software from:

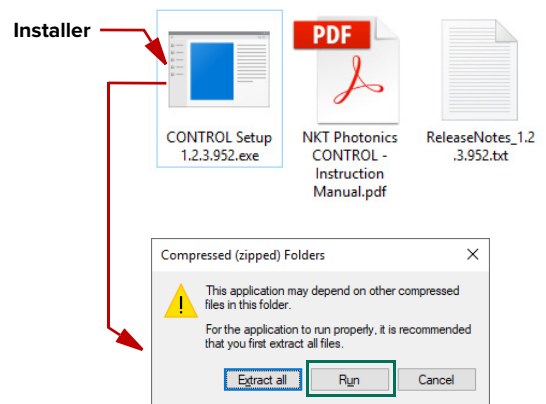
<https://www.nktphotonics.com/support/>

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

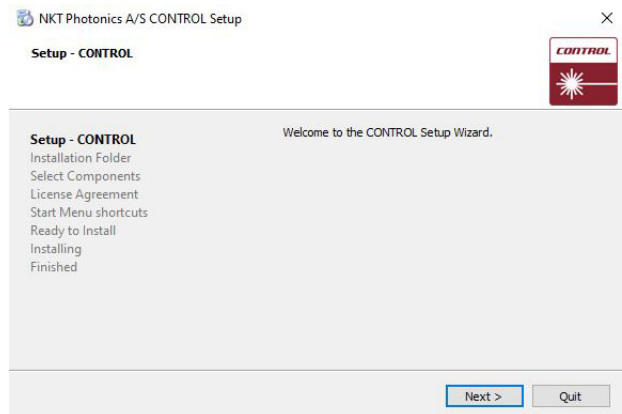
Procedure 9 Installing CONTROL

Action

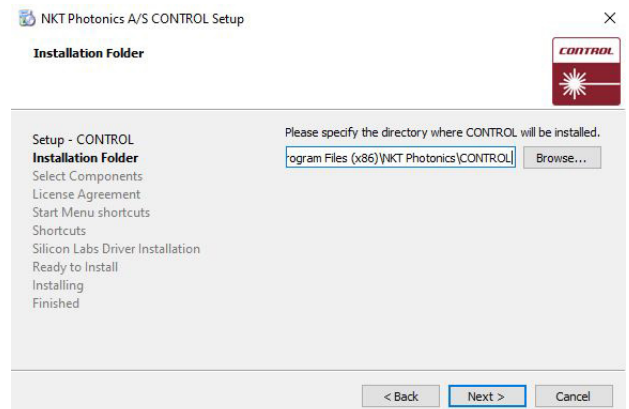
- 1 On the PC, launch the installer package and then click the Run button.



- 2 The installation wizard appears.
Click Next to continue.



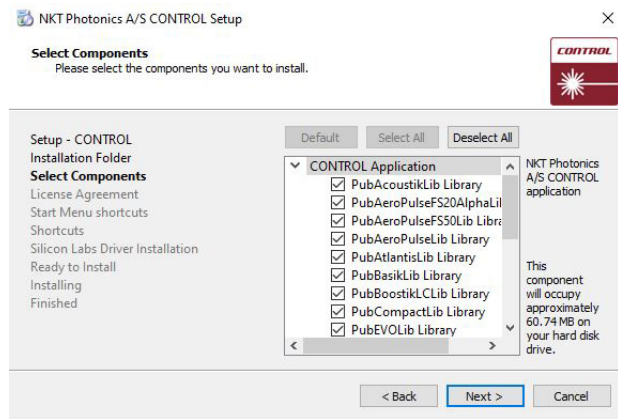
- 3 Accept to use the default installation directory or select another directory by clicking the *Browse* button.
Click *Next* to continue.



Action

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

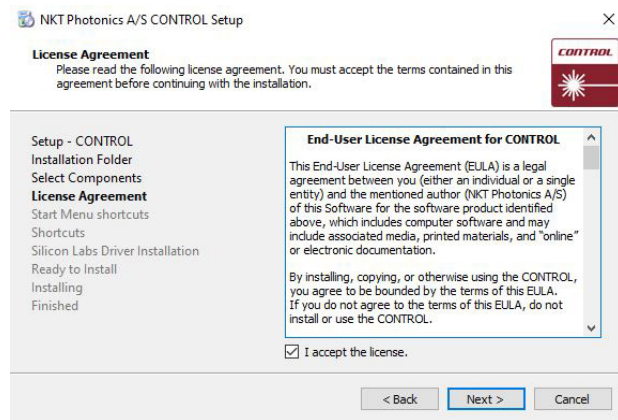
Click *Next* to continue.



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

Not checking the box ends the installation wizard.

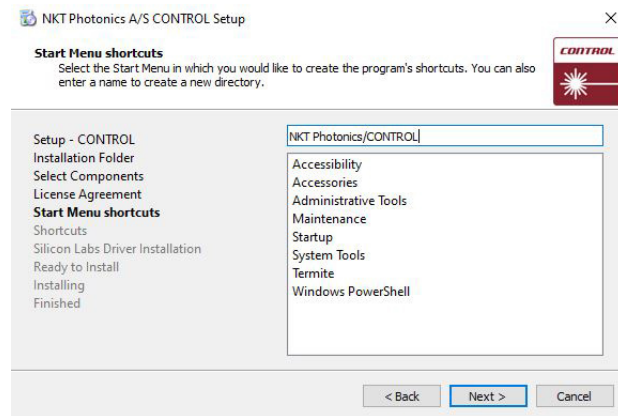
Click *Next* to continue.



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

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

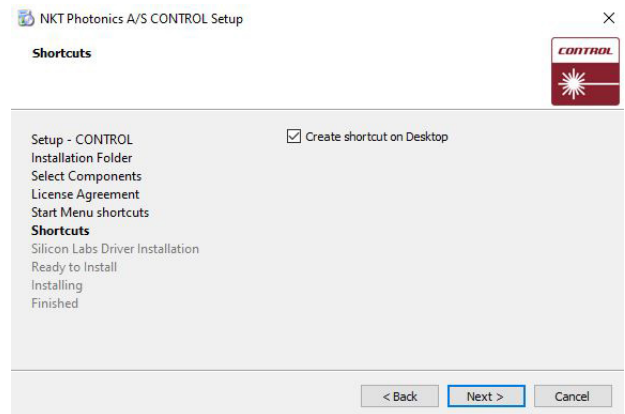
Click *Next* to continue.



Action

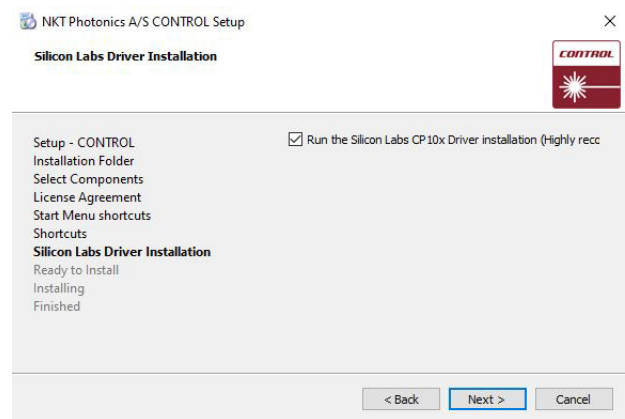
7 Check the box to create a desktop shortcut to access Control.

Click *Next* to continue



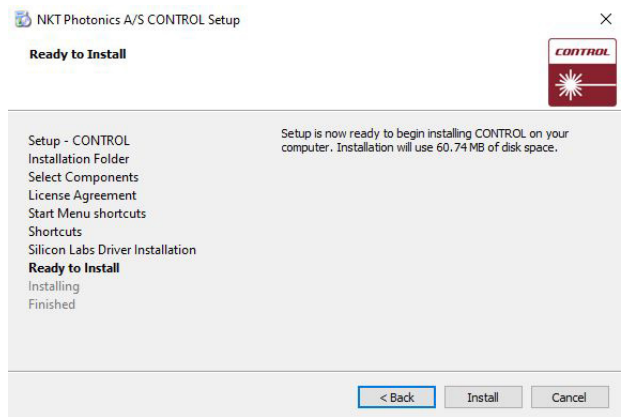
8 Check the 'Run the Silicon Labs CP10x driver installation' box and click *Next*.

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



9 Click *Install* to install NKTP CONTROL software on your PC.

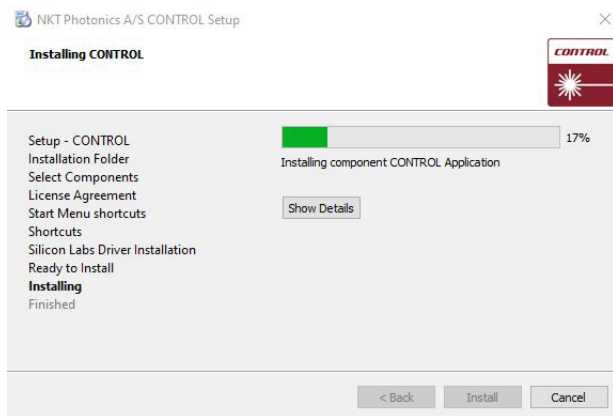
Click *Cancel* if you want to abort the installation.



Action

10 The wizard displays a progress meter for the installation.

Note: a normal install should only take a few seconds.

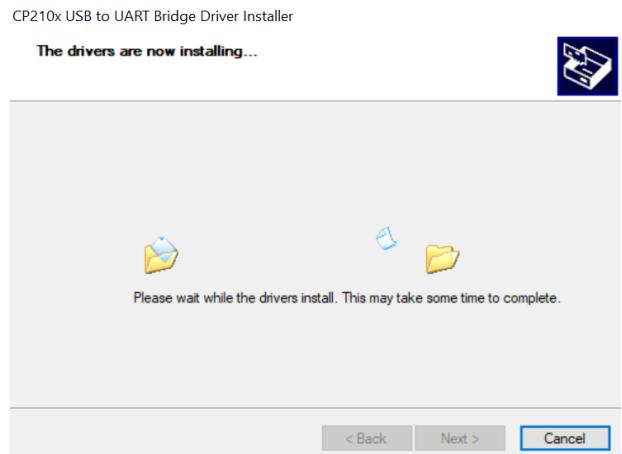


11 Click *Next* to install the UART drivers for the PC USB port.

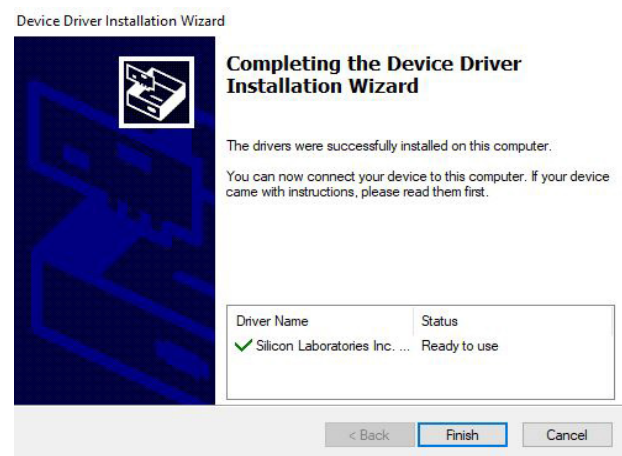


Action

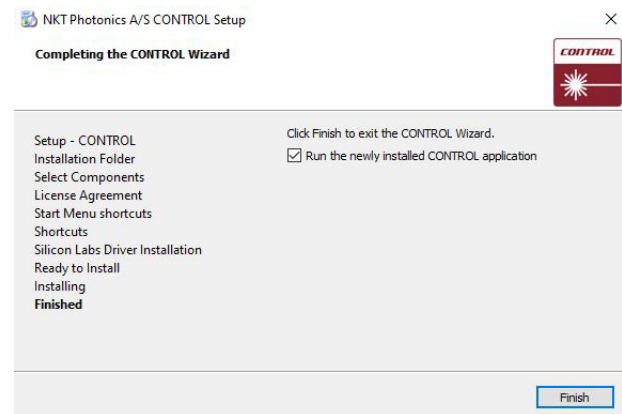
- 12 The drivers are installed.
- Note:** Depending on your computer this occurs so fast you may not see this.



- 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.



E Part Numbers

ADJUSTIK and ADJUSTIK HP lasers variants are listed by their part numbers in the table below

Table 21 ADJUSTIK and ADJUSTIK HP part numbers

Part number	Name	Laser module	Output power
K8222	Koheras ADJUSTIK	E15	40 mW ⁱ
K8221	Koheras ADJUSTIK	C15	> 10 mW ⁱⁱ
K8227	Koheras ADJUSTIK	X15	22.5 mW
K8220	Koheras ADJUSTIK	Y10	> 10 mW ⁱⁱ
K82223	Koheras ADJUSTIK HP	E15	200 mW
K82224	Koheras ADJUSTIK HP	E15	2 W
K82214	Koheras ADJUSTIK HP	C15	2 W
K82213	Koheras ADJUSTIK HP	C15	200 mW
K82274	Koheras ADJUSTIK HP	X15	2 W
K82273	Koheras ADJUSTIK HP	X15	200 mW
K82203	Koheras ADJUSTIK HP	Y10	200 mW

i. Minimum output ~30% of the maximum

ii. Fixed

Item:
Customer Revision:
NKTP Revision:
Release Date:

800-611-01
1.2
3-0
04-2022

