BDU-Series
ps-Diode Lasers

QUICK OPERATION GUIDE

Software 1.0.0.93, Firmware C2, Rev. 3.0

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Thank you…

… for choosing a quality Becker & Hickl smart picosecond diode laser. Please read this guide carefully as it contains the necessary steps for installation and operation of the system.

Safety Information

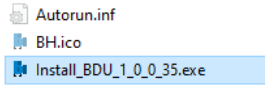
Your unit is a class 3B laser module. Please adhere to laser safety precautions at all times, this is your responsibility. Relevant safety precautions include but are not limited to: avoid looking into the laser beam, do not wear reflective jewellery while working on the beam path and ensure that the laser cannot move. Please check with your institute if a connection to the rooms laser interlock system is required.

Software Installation

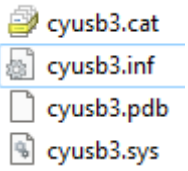
The BDU control software can be found on the USB key included with your new BDU laser. It can also be downloaded at www.becker-hickl.com.

Run Installer

- Execute the installer contained in the installation package



- Check marks for “Allow BDU to communicate on networks” to allow remote controlling of the laser if required.
- The default installation path is C:\Program Files (x86)\BH
- The **LabView runtime 2017 SP1** is required to operate the laser. It is installed together with the laser software. The runtime can be used to operate software written with LabView without having a LabView license. It can also be downloaded from www.ni.com.

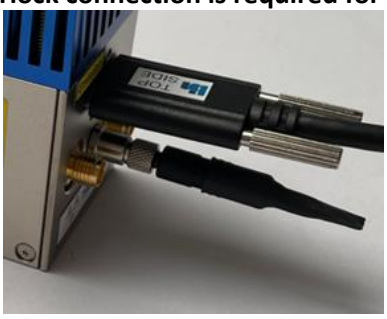


- The device driver is Cypress FX3. It is typically installed with the installation package.
- If selected during the installation process, the BDU software shortcut is now available. Otherwise the Link is found in the BH folder in the start menu.

Operating the Laser

Power and PC Connection

- Power and PC interface is provided through USB-C. **Please use ONLY THE ORIGINAL USB CABLE and ensure the plug is oriented with the indicated top side facing up.** Wrong cable orientation will power the laser but there is no communication to PC. Low quality USB-C cables or long cables with length >2m may cause failure of the laser due to insufficient powering.
- **Interlock connection is required for laser emission.**



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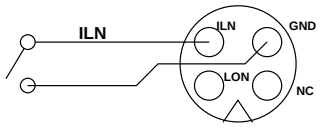
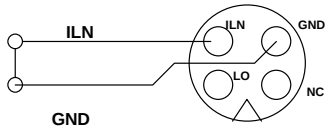
Interlock / Modulation Input

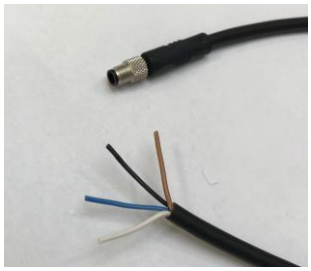
The laser-safety interlock inputs must be connected to Ground to enable laser function. An open circuit will suppress laser emission. The interlock acts on the power supply of the laser. Input current is -0.1 mA for the ILN pin. The interlock signal connector is located at the back panel of the laser. A laser interlock cable is delivered with the laser.

No emission: Safety Shutdown
Open circuit

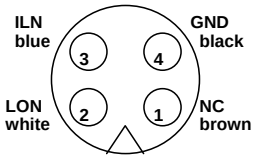


Emission: Normal Operation
Closed circuit





Pin numbers and colours in connection cable



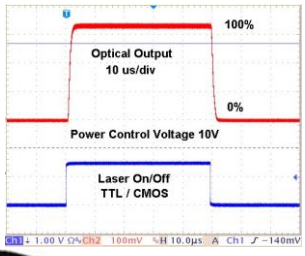
View on device input connector

Fig.: Laser-safety interlock connector and pin assignment.

- Ensure that ILN is grounded. Connect the included interlock cable which shortens ILN (Pin 3, blue) and GND (Pin 4, black).
- Ensure that LON (Pin 2, white) is floating. When LON is connected to GND the laser emission is suppressed (modulation input). To use the LON input an adapter cable is provided with SMA connector.

Modulation Input – Fast Laser ON, Multiplexing, PLIM

The laser emission can be modulated with a TTL 'Laser ON/OFF' signal at pin 2 (LON) of the lemo connector of the laser. An adapter cable is provided with SMA connector for LON and lemo connector for interlock. The logic level is TTL /CMOS. In the standard version of the BDU-laser, High state is 'Laser ON', Low is 'Laser OFF'. The laser is 'ON' if the input is left open. Other configurations are also available on request. The response time of the Laser modulation is ~1 µs, see figure on the right. The trigger output of the laser for timing synchronization (SYNC) becomes inactive when the Laser is in the 'OFF' state. When several lasers are multiplexed their SYNC signals can be combined into a single SYNC line to a TCSPC module by a simple resistive power combiner.



Adapter:
modulation & interlock

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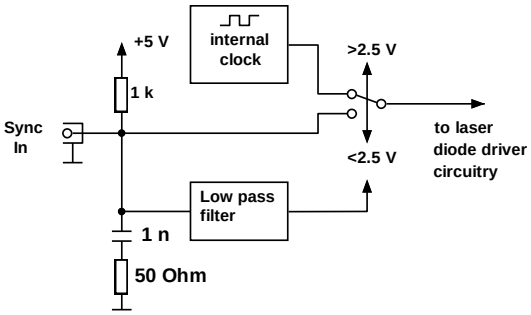
Trigger Input

The synchronization input, **'**TRG **In'**, is used to synchronize a BDU laser to an external clock source. The input signal must be TTL/CMOS compatible, and DC coupled into the synchronization input from a 50 Ω source. The pulses must be positive, with a duty cycle of no more than 30 %. The mean voltage applied to the input automatically switches the laser to ext. synchronization operation. The driving clock path switches from the internal clock generator to the synchronization input.

The principle of clock source switching is shown in the figure below. The average voltage at the **'TRG-In'** input connector is monitored via a low-pass filter. The output voltage from the filter sets a switch. If the average voltage is > 3 V the internal clock generator drives the emission, if the voltage is < 3 V the laser waits for external pulse trigger. The active edge of the input signal is the rising edge. Signal repetition range is from single pulse to 80 MHz.



Sync Input:	open	TTL High	TTL Low		
Average voltage:	>3 V	>3 V	<3 V	<3 V	>3 V
Clock source:	internal	internal	external, but no clock. Don't use	external	internal Don't use

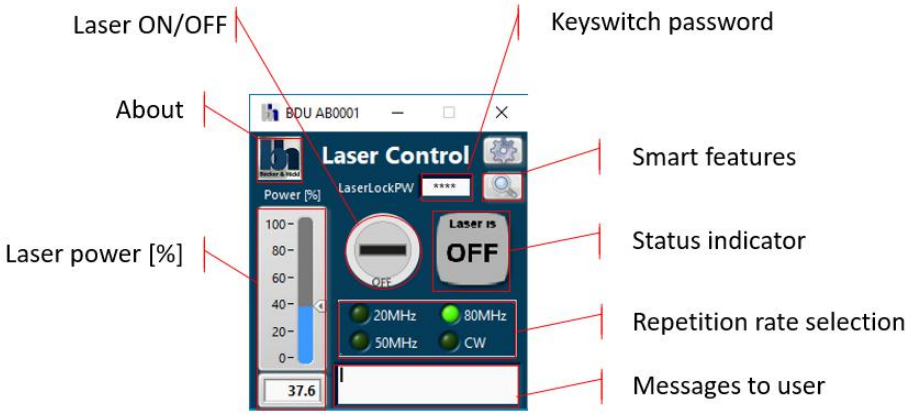
Principle of switching between the internal clock generator and an external clock source

Synchronisation Output – TRG Out

- The laser delivers a synchronization (SYNC) output for TCSPC modules at the **TRG Out**. The pulse polarity is negative, the amplitude is about -1.2 V. The pulse duration is about 1 ns. The SYNC output is inactive when the laser is in the 'OFF' state (Laser ON/OFF = Low). When lasers are multiplexed their SYNC Out signals can be combined by a simple resistive power combiner.

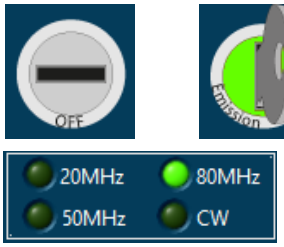
Software Operation – Start the Laser

- Start the BDU application.
- Software panel

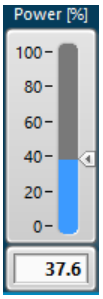


- Enter the password to enable the keyswitch.
  The default password is **1234**.

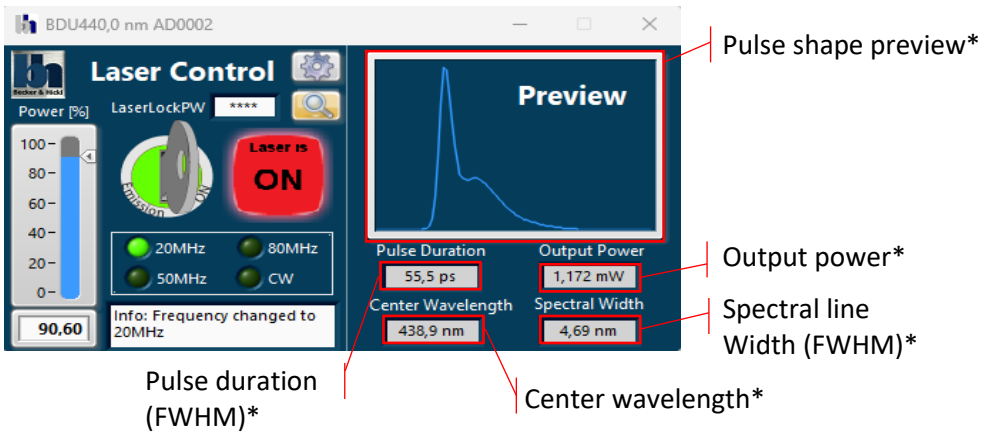
- Start the laser with the virtual key switch.
  The laser will start emitting light.
- Select a repetition rate by clicking the corresponding button.



- Select a laser power either with the slider or by entering it into the text box beneath the slider.



- Show smart features of the laser



*Values represent the laser output measured directly after the laser at the time of production. Values serve as indication of the current emission. The optical path of the experiment will influence the laser pulse on the optical path to the sample. Please always measure the systems instrument response function (IRF).

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Remote Controlling BDU

BDU.exe offers an interface to other applications wanting to remotely control features and actions of the BDU laser. Experienced programmers can write their own script to automate processes.

Three interfaces are provided. Since BDU.exe is natively written in LabVIEW the simple example VI ControlPMS800.vi using the VI-Server exists to allow other LabVIEW applications or code to connect to BDU.exe.

A Python wrapper is available via pip install bhpy.

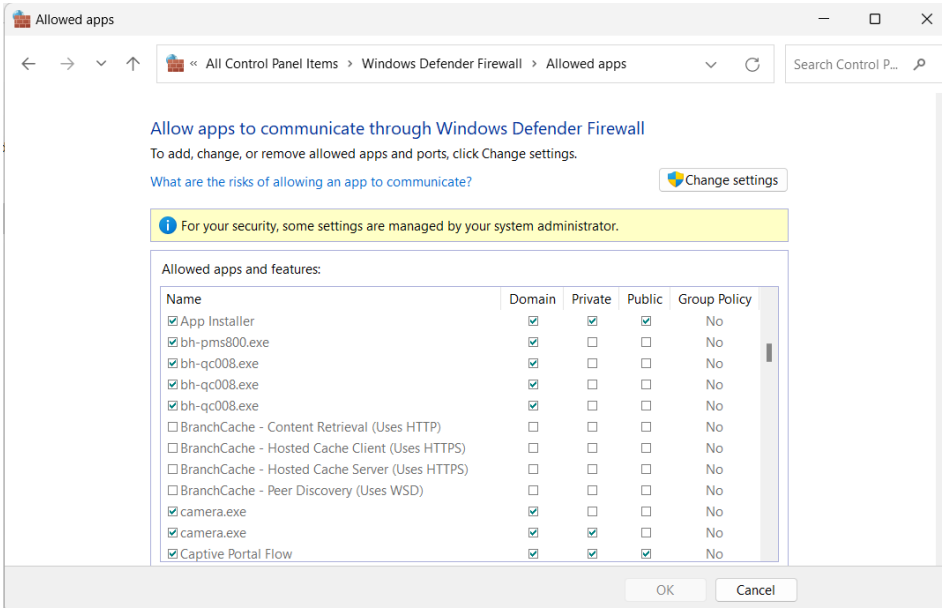
Alternatively, the dynamic link library ControBDU.dll can be used in all other computer languages.

You will find the C and LabVIEW interface adapters in the *C:\Program Files\Becker-Hickl\BDU\ControlBDU* folder.

All available actions in the BDU application have their corresponding remote commands which can be sent by writing well defined strings to a control, while the result can be read from another string control.

Check the appendix for a list of all available remote commands.

Note: A connection with BDU.exe is not possible if you have not set the check marks for “Allow BDU to communicate on networks” during the installation process. You can allow access later-on in the Windows Defender panel.



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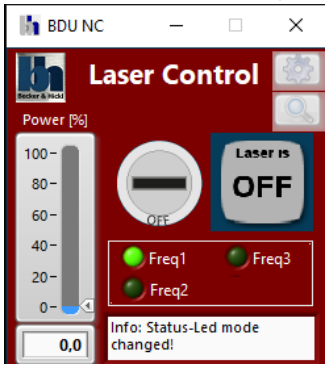
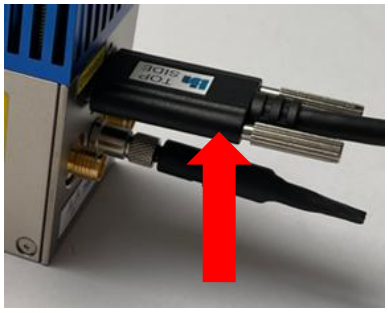
Troubleshooting

- **My laser will not turn on**
  - If no laser is connected, the software panel will be red



  Restart the application after connecting the laser. Ensure that the laser is connected with the original USB cable without any intermediate USB-hubs.
  - If the ON/OFF connector of the BDU-Lasers is shorted the laser will not emit light.
  - The Interlock IN port needs to be connected.

- **The laser is connected but the software does not recognize the laser.**
  - Please ensure that the USB connector is oriented such that the 'top side' sticker points towards the blue side of the laser. Please tighten the USB connector screws and ensure that both sides of the USB cable are inserted fully into the respective ports.



- **The software crashes when the laser is set to high output power.**
  - The current draw on the USB port is proportional to the laser power. If the laser turns off/crashes at high power settings the USB port it is connected to is not powerful enough. Please reduce the load on that USB port module in your computer or choose a different power.

Appendix

Remote Control Commands

All remote commands are named similar to the corresponding button, input field or menu item in the application window, but do not include white spaces. Commands are not case sensitive.

Some commands are sent on their own, while others have an argument separated by a white space.

All successful set commands will reply with a string “OK” followed by a white space and a checksum. The chksum is calculated by adding the ASCII values of the complete sent string. This allows a remote application to confirm that a received OK is the actual response expected.

Sending a misspelt command will return an error message instead.

The get commands will return the requested values as strings. You should ignore the error status for get commands.

When misspelling a command, you will receive a “Error: Unknown Job-command”

Note: Continuous polling of the interface might hinder the display of application errors.

Command	**Parameter**	**Reply**	**Comment**
Armed	"On" or "Off"	OK *chksum*	arms the laser on or off
Power	float value	OK *chksum*	sets the laser power
Frequ	string as visible in GUI	OK *chksum*	sets the laser frequency or CW
GetEmissionStatus		Replies: *LaserON* or *LaserOFF* in Result	
GetSN		Replies the SerialNumber in Result	
GetWL		Replies the WaveLength in Result	
GetFreq		Replies the Frequ in Result	
GetFwVersion		Replies the firmware version in Result	
GetAppVersion		Replies the application (GUI) version in Result	
GetPower		Replies the laser power in the Result	
GetArmed		Replies the arm state of the laser in the Result	
GetFreqStrings		Replies all possible Frequ settings semicolon seperated	
Stop			Closes the app