

FemtoFiber smart

Ultrafast
Fiber Laser

Manual

Manual: M-056 Version 08
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Dear Customer,

Welcome to the TOPTICA community!

We have designed this product to be easy to use and reliable so that you can focus on your work. If you have questions or need advice on how to integrate it into your setup, please contact us immediately so we can walk you through the process. We will provide you with quick and competent help through our service staff and product managers.

You can contact us in the following ways:

- Internet: service.toptica.com. In our support section you can find a list of frequently asked questions and a service contact form
- Email: service@toptica.com
- Phone: +49-89-85837-150

Our customers in the USA and Canada may contact TOPTICA Photonics Inc.:

- Phone: +1-585-657-6663

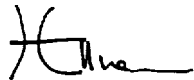
Our customers in Japan may contact TOPTICA Photonics K.K.:

- Phone: +81-42-306-9906

Please have your product ID and serial number ready when contacting us-so we can quickly retrieve all relevant information.

As we are constantly improving our products, we greatly value all customer feedback. We encourage you to tell us what you like about our products as well as any suggestions for improvement.

Best regards,



Harald Ellmann
Director Service
TOPTICA Photonics AG

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1 General Description of the FemtoFiber smart System

Ultrafast fiber lasers provide an ideal combination of system parameters: Small form factor at low cost, but on the other hand reliable and having brilliant laser performance. Various bulky and cost-consuming solid-state laser concepts are therefore getting more and more replaced by robust and reliable turnkey fiber lasers.

TOPTICA's FemtoFiber smart lasers are the most compact and cost-effective laser sources for Terahertz generation. Other applications benefiting from the FemtoFiber smart laser solutions are e.g. metrology systems, light sources for microscopy, ophthalmology or medical surgery/ examination.

The FemtoFiber smart laser systems are based on rare earth doped fibers and saturable absorber mirror (SAM) mode-locking technology. Generally, the fiber technology ensures a very compact design and highest robustness against vibration or mechanical shocks. The use of mass produced fiber components with the proof of Telcordia standards provides an unique cost-benefit ratio. The passive SAM device ensures self-starting and reliable mode-locking.

Key Features for all systems of the FemtoFiber smart family:

- Turnkey
- Compact
- State of the art FemtoFiber technology: robust and reliable all- fiber setup
- Fiber coupled output
- All necessary control electronics inside
- Telcordia proved components

NOTE ! Please refer to the website www.toptica.com for detailed specifications of the FemtoFiber smart.
For individual laser system specifications, please refer to the Production and Quality Control Data Sheet.

The FemtoFiber smart lasers are plug & play systems for both OEM integrators and single unit customers. They provide an electrical interface for remote control and only need 12 ± 2 V DC filtered supply input for all internal electronics. For single system users the supplied Switch Box provides all switches, supply and status lines to run a FemtoFiber smart as a stand-alone system without integration environment. Alternatively, FemtoFiber smart laser heads can also be controlled via an USB-interface.

1.1 Ytterbium Fiber Lasers

PicoFYb 1030/1064

The PicoFYb laser systems are fiber-based picosecond oscillators for seeding industrial laser systems, e.g. for micro-machining. The PicoFYb laser pulses with excellent amplitude and frequency jitter parameters are amplified to typical multi-Watt levels in the MOPA (master oscillator, power amplifier) laser or regenerative amplifier systems of our customers. Typical amplifiers are slab, rod and disc lasers operating in the 1 μ m wavelength regions.

FemtoFYb 1030

The FemtoFYb laser systems are fiber-based sub-picosecond to femtosecond oscillators for seeding industrial laser systems, e.g. for micro-machining. The FemtoFYb laser pulses with excellent amplitude and frequency jitter parameters are amplified to typical multi-Watt levels in the MOPA (master oscillator, power amplifier) laser or regenerative amplifier systems of our customers. Typical amplifiers are slab, rod and disc lasers operating in the 1 μ m wavelength regions.

1.2 Erbium Fiber Lasers

FemtoFerb 1560

The FemtoFerb 1560 is a very robust all fiber-based femtosecond laser system with excellent amplitude and frequency jitter parameters. Applications benefiting from the most stable, compact and cost-effective FemtoFerb 1560 are e.g. Terahertz or metrology systems, light sources for microscopy, ophthalmology or medical surgery/examination.

FemtoFerb 1560 FD6.5

The FemtoFerb 1560 FD6.5 is the fiber delivery version of the FemtoFerb 1560 providing a 6.5 m external SM PM 1560 fiber and transform-limited pulses at the fiber end. This allows replacing complex beam delivery setups by flexible and convenient fiber solutions. Applications benefiting from the most stable, compact and cost-effective FemtoFerb FD6.5 are e.g. Time-Domain Terahertz, medical applications like endoscopy or metrology systems.

FemtoFerb 1560 and FemtoFerb 1560 FD6.5 with THz Option

This option includes a special technology called QuTE (Qu-Switch Termination) allowing the laser to be connected permanently and directly to the THz antennas. This option prevents possible Q-switch pulses to reach the antennas, which may occur at the laser start-up procedure.

FemtoFerb 780

The FemtoFerb 780 is a very compact all fiber-based femtosecond laser system with integrated miniaturized second-harmonic generation unit. It unites both supply electronics and laser unit in one box, being thus one of the smallest fiber laser units on the market. The system only needs 12 ± 2 V DC filtered power supply and comprises a free-beam output with mechanical shutter.

FemtoFerb 1950

The FemtoFerb 1950 laser is a very robust all fiber-based femtosecond laser system with excellent amplitude and frequency jitter parameters. A frequency shifted solitonic pulse is generated by nonlinear effects. The unit is used for seeding Thulium doped amplifiers and also for other purposes in the 2 μ m wavelength range

1.3 FemtoFiber smart Switch Box (Optional)

The FemtoFiber smart Switch Box is a small tool which provides all switches as well as supply and status lines necessary to run a FemtoFiber smart laser as a stand-alone system without integration environment and therefore is recommended especially for single-system users.



Figure 1 FemtoFiber smart Switch Box

NOTE ! All FemtoFiber smart lasers are principally designed for OEM integration. For stand-alone operation of a FemtoFiber smart: In order to achieve full accordance with general and nation-specific laser safety regulations (IEC 60825, CDRH, etc.), it is necessary to supply a FemtoFiber smart laser with a Switch Box at all time !

1.3.1 USB-Control

All FemtoFiber smart laser heads are equipped with a serial USB interface for remote control of the laser and to integrate it into software environments.

In order to establish an USB connection a USB cable (max. 2 meters length) and a suitable computer with a free USB 2.0 port are needed. For further details of the USB-Control please refer to section 4.3.3.

NOTE ! A FemtoFiber smart laser system operated without Switch Box, but instead with 12 V direct power supply and USB remote control, is officially not approved by TOPTICA for stand-alone applications. This combination would circumvent the general laser safety regulations (no interlock mechanism, no lockable power key-switch etc.). TOPTICA waives all liabilities for such setups.
This note is not valid for OEM integrators.

2 Safety Instructions and Warnings

The following Safety Instructions and Warnings should be read and complied with during operation or maintenance of FemtoFiber smart. Failure to do so could result in damage to FemtoFiber smart or/and personal injury or death.


2.1 General Safety Terms


FemtoFiber smart is manufactured according to the Laser Safety Standard EN 60825-1:2014 and complies with US law 21 CFR §1040.10 and §1040.11.

The following safety terms are used in this manual:

The **DANGER !** heading in this manual explains hazards that could result in personal injury or death. The **CAUTION !** heading in this manual explains hazards that could damage the instrument. In addition, a **NOTE !** heading gives information to the user that may be beneficial when using the device.

DANGER ! Before operating the FemtoFiber smart please read this manual carefully to prevent personal injury and damage to the device. The following safety instructions must be followed at all times.

DANGER ! CAUTION !  **Possibility of electrical shock !** Wherever this symbol is attached, the possibility of an electrical shock may appear. Use only equipment and accessories supplied by TOPTICA.

 **Caution !** Wherever this symbol is attached read and understand the manual before operating the device. The manual must be consulted in order to find out the nature of the potential HAZARDS and any actions which have to be taken to avoid them.

DANGER ! CAUTION ! **OEM use of the FemtoFiber smart Laser Source (integration into an end device, operation without Switch Box):** The operator or designer of the end device is responsible for integration of a key switch and an interlock circuit to the 12 ± 2 V DC Supply as well as to install redundant laser emission warning lamps, a shutter and to apply the according laser safety labeling according to the Laser Safety Standard EN 60825-1:2014.

DANGER ! CAUTION ! The Laser Driver Electronics (Switch Box) and the Laser Head are both equipped with LEDs that indicate laser emission. (Please refer to sections 4.1 and 4.2 in this manual for detailed information).
Be aware of laser emission when at least one of these LEDs lights up.

- DANGER !** During installation, maintenance and service, all persons in the room must wear appropriate laser safety goggles while the laser is in operation. The recommended protection stage is dependent on the laser system.
Use appropriate eyewear and other protective means in order to keep radiation exposure below the maximum permissible levels allowed by applicable regulations (examples: OSHA limits in the US, BGV B2, BGI5092, TROS Laserstrahlung in Germany).
To determine the protection level of the laser safety goggles required for e.g. FemtoERb 780 laser system, please refer to the following example: FemtoERb 780 with collimated beam, beam diameter 1.6 mm, wavelength = 780 nm, repetition rate 100 MHz, laser power up to 60-70 mW generates a peak power density of $H_M \sim 0.3 \text{ mJ/m}^2$ (approximately). From Table 3 in BGI5092 this leads to a required protection level of 780 D LB 4 + M LB 1 for your eyewear.
- DANGER !** Laser safety goggles selected for adjustment purposes do not protect against an intentionally focused direct beam which will increase the optical power densities by a few orders of magnitude.
- DANGER !** Regular functional checks and performance inspections at the supplier are recommended for all laser safety goggles.
- DANGER !** Do not position the equipment so that it is difficult to operate the disconnecting device.
- DANGER !** Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.
- DANGER !** If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.
- DANGER !** The FemtoFiber smart uses very powerful lasers (up to class 3B). Therefore, it is imperative to take great care and observe the statutory warning labels on the unit.
- DANGER !** **Do not open the device at any time.** FemtoFiber smart is a hands-off laser system. Reflections of the laser beam may cause serious injury to your eyes. Internal tuning as well as the replacing of components may only be carried out by TOPTICA. Under certain circumstances there may be dangerous voltages, even if the device is disconnected from the mains supply.
- DANGER !** Do not look into the beam from the Laser Output (depending on the version: free beam, FC/APC connector(s) on front panel or FC/APC connector at the fiber pigtail) as the output can exceed the limits for class 1 specified by US laws 21 CFR 1040.10 and 2 CFR 1040.11 and the Laser Safety Standard EN 60825-1:2014. Take precautions to eliminate exposure to a direct or reflected beam.
- DANGER !** FemtoFiber smart may not be operated in surroundings of flammable gases or fumes.
- CAUTION !** Special precautions are necessary if FemtoFiber smart is to be operated in surroundings of high electro-magnetic radiation such as close to a plasma discharge. Please refer to TOPTICA for technical support.
- CAUTION !** Since the FemtoFiber smart has power levels which may already destroy optical fibers, please pay special attention to a clean fiber facet at the output fiber connector. We also recommend to always switch-off the laser emission before the fiber connector is opened/closed!
- CAUTION !** **FemtoERb 1560 standard version:** While starting the laser it may occur that higher level pulses are sent out by the laser. This transient phenomenon is due to the fact that the amplifier of the system starts simultaneously with the oscillator. We therefore recommend blocking the output beam at the moment when the laser is switched on, or adding the THz option.

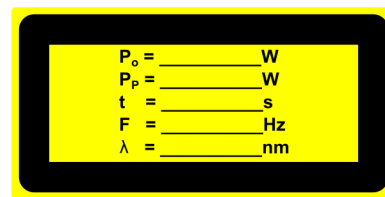
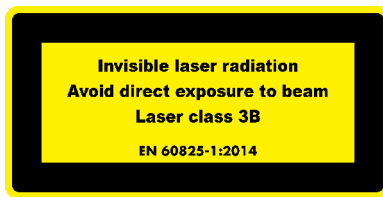
2.2 Safety Labels

2.2.1 Laser Beam

FemtoFiber smart emits invisible pulsed laser radiation of up to 170 mW power. It is classified as Class 3B product.

DANGER ! FemtoFiber smart emits invisible pulsed laser radiation of up to 170 mW power (Class 3 B laser product). Avoid exposing eyes and skin to the laser beam, including any laser stray light !

The following labels are affixed to the outer side of the FemtoFiber smart laser protective housing according to EN 60825-1:2014:



Size: 52 mm x 26 mm
 Color: yellow/black
 Location: Outer side of the FemtoFiber smart laser protective housing

2.2.2 Apertures

During operation, depending on the individual system, the laser beam is emitted at the laser beam aperture(s), either free beam, from the FC/APC fiber connector at the front panel or from the fiber pigtail.

DANGER ! FemtoFiber smart emits invisible pulsed laser radiation of up to 170 mW power (Class 3B laser product). Avoid exposing eyes and skin to the laser beam, including any laser stray light !

The following labels are affixed to the outer side of the FemtoFiber smart laser protective housing next to the laser beam aperture(s) according to EN 60825-1:2014:

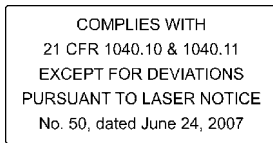


Size: 26 mm x 13 mm
 Color: Yellow/black
 Location: Besides laser beam aperture(s)

Size: 15 mm x 15 mm
 Color: Yellow/black
 Location: FemtoFiber smart laser protective housing

2.2.3 CFR Compliance

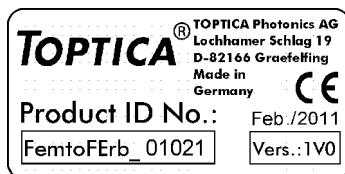
Compliance with US laws 21 CFR §1040.10 and §1040.11 is declared by the following label:



Size: 38 mm x 19 mm
Color: silver/black
Location: FemtoFiber smart Laser Head
housing

2.3 Identification of Manufacturer

Manufacturer (name and address), production date, FemtoFiber smart model, serial number, article number and compliance with CE standards are noted on the identification label:



Size: 38 mm x 19 mm
Color: Silver/black
Location: Outer side of the FemtoFiber smart laser protective housing

2.4 Safety Features

2.4.1 External Interlock

An interlock circuit to connect e.g. a door switch can be set up by using the Interlock Connector on the Switch Box (for location please refer to Section 4.2). For first operation, a bridged interlock plug is supplied to close the interlock circuit. For safety reasons the installation of an external interlock circuit is strongly recommended.

2.4.2 Shutter (Free Beam Version)

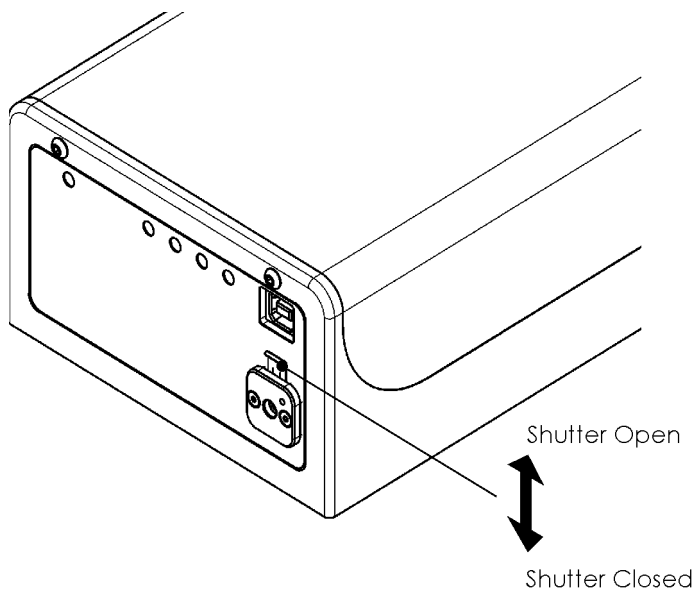


Figure 2 FemtoFiber smart shutter operation (only free beam version)

Shift shutter lever up/down as shown in Figure 2 to open/close the laser beam shutter.

NOTE ! When the emission of the FemtoFiber smart laser is switched on with closed shutter, back reflections from the shutter may disturb the internal photo diode/power regulation. This may lead to unexpected error messages, but is not harmful to the laser.

2.4.3 Protection Cap on Fiber Pigtail or FC/APC Connector

Due to transport and laser safety, depending on the specification the end of the fiber pigtail at the FemtoFiber smart or the FC/APC connector is protected by a cap. It must be removed before the first usage of the laser module.

3 Installation

3.1 Package Contents

Depending on the order, the complete FemtoFiber smart System consists of the following parts:

- 1 FemtoFiber smart Laser
- 1 FemtoFiber smart Manual (optional)
- 1 Production and Quality Control Data Sheet

when ordered with Switch Box (optional):

- 1 Switch Box
- 1 D-Sub 9 Cable (Switch Box/FemtoFiber smart Laser)
- 1 FemtoFiber smart Power Supply with mains cable

when ordered with FIBEROUT option:

- 1 FIBEROUT FemtoFiber smart IR Fiber Collimator (optional)

only FemtoFerb 1560 FD6.5

- 1 Single Mode PM 1560 Fiber with FC/APC connectors on both sides (optional)

3.2 Installation Instructions

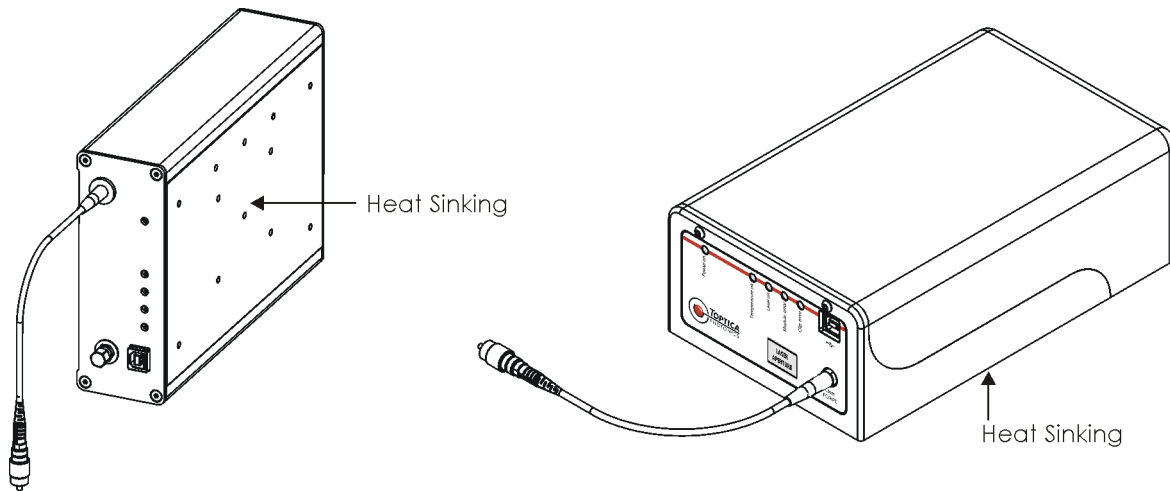


Figure 3 FemtoFiber smart laser (Femto/PicoFYb (left), FemtoFerb (right))

When installing the FemtoFiber smart laser the following instructions have to be observed:

- The FemtoFiber smart laser can be installed in any position. The protective housing has M4 threads for fixing the FemtoFiber smart laser with screws (for main dimensions of the FemtoFiber smart lasers and the location and depth of the M4 threads please see section 6.10).
- The FemtoFiber smart laser should only be installed at place free from vibrations.
- The FemtoFiber smart laser is designed for indoor usage, at altitudes below 2000 m.
- Environmental operating conditions: +15 °C .. +40 °C, the air humidity may not lead to condensation at or inside the laser housing. For a dew point table please refer to section 6.8.
- Environmental transport/storage conditions: 0 °C .. +40 °C, non condensing.
- Weight: < 2.2 kg
- Depending on the individual system, the laser beam emits from the FC/APC connector(s) at the FemtoFiber smart front panel, from the FC/APC-connector at the end of the fiber pigtail or free beam. For location of the laser beam apertures please refer to section 6.10.
- **For maximum stability, heat sinking of the base plate of the FemtoFiber smart laser to a typical temperature of $22 \pm 2^\circ \text{C}$ is recommended.**
Heat Dissipation: FYb laser heads typ. < 10 W, FErb laser heads typ. < 20 W.

CAUTION ! Avoid back reflection of the laser beam above 100 % (caused e.g. by a connected laser amplifier).

4 Operation

4.1 Operator Controls FemtoFiber smart Laser

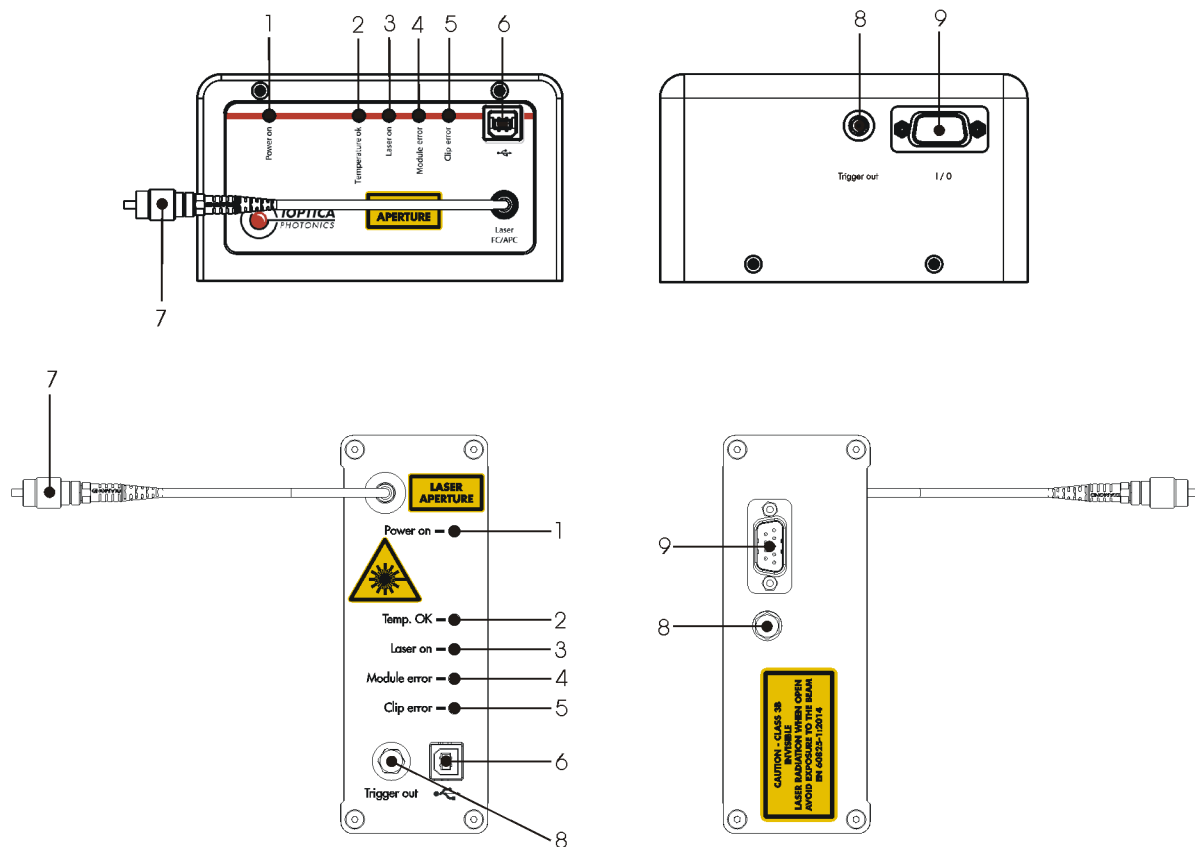


Figure 4 Front and rear panel of FemtoFiber smart laser (FemtoFERb (top), Femto/PicoFYb (bottom))

- | | | |
|---|--------------------|-------------------------|
| 1 Power ON LED | 4 Module Error LED | 7 Laser Output |
| 2 Temperature OK LED | 5 Clip Error LED | 8 Trigger Out |
| 3 Laser ON LED
(Laser Radiation Emission
Warning LED) | 6 USB-connector | 9 I/O D-Sub 9 Connector |

1 Power ON LED	The Power ON LED (blue, 1) lights up when the supply voltage (12 ± 2 V DC filtered) is applied to the respective pins of the D-Sub 9-connector (9). For pin assignment please see section 6.2.
2 Temperature OK LED	The Temperature OK LED (green, 2) lights up after the system is internally stabilized and ready for operation.
3 Laser ON LED (Laser Radiation Emission Warning LED)	<p>The Laser ON LED (orange, 3) indicates that the TTL input (Pin 7 of Input/Output connector (9)) is in state high, i.e. the laser is ON and the laser beam is emitted from the Laser Output (7).</p> <p>DANGER ! When the orange Laser ON LED (Laser Radiation Emission Warning LED) lights up, one has to be aware of laser emission.</p>
4 Module Error LED	The Module Error LED (red, 4) indicates a faulty connection between Switch Box and laser head or a laser internal error. When the LED (4) lights up continuously, please contact TOPTICA.
5 Clip Error LED	The Clip Error LED (yellow, 5) indicates that the laser did not start to operate after the TTL input (Pin 7 of Input/Output connector (9)) was set to state high. When the LED (5) lights up continuously, please contact TOPTICA.
6 USB-connector	USB output connector type B for computer connection and control via terminal program.
7 Laser Output	FemtoFerb 780 Free beam laser output with mechanical shutter.
	PicoFYb 1030/1064 FemtoFYb 1030 FC/APC connector with connector tolerance for polarization maintaining fibers (narrow key, 2.02 mm)
	FemtoFerb SC FemtoFerb 1560 FD6.5 One FC/APC connector with connector tolerance for polarization maintaining fibers (narrow key, 2.02 mm).
	FemtoFerb 1560 Fiber pigtail (approx 20 cm long) with 3 mm cevlar reinforced tubing and FC/APC-connector at the end.
8 Trigger Output • SMA-connector	<p>Output synchronous to the laser pulses for monitoring or triggering purposes (please refer to the Production and Quality Control Data Sheet for signal properties).</p> <p>NOTE ! FemtoFerb systems are using the direct output of a photo diode as Trigger signal. There is no further (amplifying) electronics in order not to increase the signal jitter. Hence the amplitudes of the signal are low, in the range of a few tens of millivolts by nature. Please refer to the Production and Quality Control Data Sheet for individual values.</p>
9 Input/Output • D-Sub 9-connector	General I/O connector for FemtoFiber smart operation. For pin assignment please see section 6.2.

4.2 Operator Controls FemtoFiber smart Switch Box

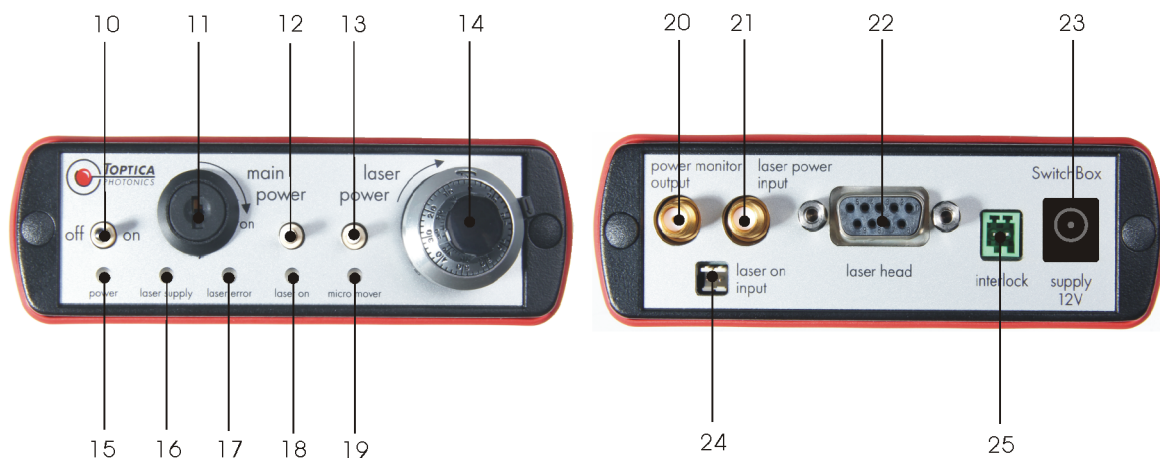


Figure 5 Front and rear panel of FemtoFiber smart Switch Box

- | | | |
|--|---|--------------------------------------|
| 10 ON/OFF Switch | 15 Power LED | 21 Laser Power Input |
| 11 Main Power Key Switch | 16 FemtoFiber smart Supply LED | 22 FemtoFiber smart Connector |
| 12 Laser ON Push Button | 17 FemtoFiber smart Error LED | 23 Power Supply Connector |
| 13 Micro Mover Push Button | 18 Laser ON LED
(Laser Radiation Emission
Warning LED) | 24 Laser ON Input |
| 14 Pump Laser Power
Adjustment | 19 Micro Mover LED | 25 Interlock Connector |
| | 20 Power Monitor Output | |

10 ON/OFF Switch	FemtoFiber smart Switch Box voltage supply and laser voltage supply are switched ON/OFF by switch (10).
11 Main Power Key Switch	General Switch for Switch Box voltage supply.
12 Laser ON Push Button	Push button switches laser emission ON/OFF. Laser emission is indicated by the Laser ON LED (18).
13 Micro Mover Push Button	FYb Systems: When the laser does not start after the Laser ON Push Button (12) has been pressed (i.e. the Clip Error LED (5) lights up), the mirror chip inside the laser head can be moved slightly by pressing the push button (13) twice . Please note that the mirror chip can only be moved with the laser emission switched off.
	FErb Systems: Not supported.
14 Pump Laser Power Adjustment	FErb Systems: Adjustment of the pump diode current from 90 % to 110 % of the nominal pump diode current. The zero position on the dial is equal to 90 %, while position 10 is equal to 110 %. The pump laser current adjustment can be used for fine tuning of the pulse characteristics. NOTE ! For normal operation, please leave the trimpot in mid position (5 = 100 %) ! The system is checked and certified only for trimpot position 5. TOPTICA Photonics AG does not guarantee that the specifications of the laser are met at all other trimpot settings. Please refer to the Production and Quality Control Test Data Sheet for specified values
	FYb Systems: Adjustment of the pump diode current from 90 % to 100 % of the nominal pump diode current. The zero position on the dial is equal to 90 %, while position 10 is equal to 100 %. The pump laser current adjustment can be used for fine tuning of the pulse characteristics. NOTE ! For normal operation, please leave the trimpot in end position (10 = 100 %) ! The system is checked and certified only for trimpot position 10. TOPTICA Photonics AG does not guarantee that the specifications of the laser are met at all other trimpot settings. Please refer to the Production and Quality Control Test Data Sheet for specified values
15 Power LED	This green LED indicates proper voltage supply of the Switch Box.
16 Supply LED	The Supply LED (blue, 16) lights up when the supply voltage is applied to the FemtoFiber smart laser.
17 Error LED	The Error LED (red, 17) indicates a faulty connection between Switch Box and laser head or a laser internal error. When the LED (17) lights up continuously, please contact TOPTICA.
18 Laser ON LED (Laser Radiation Emission Warning LED)	The Laser ON LED (orange, 18) indicates that the laser is ON and the laser beam is emitted from the Laser Output (7). DANGER ! When the orange Laser ON LED (Laser Radiation Emission Warning LED) lights up, one has to be aware of laser emission.

19 Micro Mover LED	FYb Systems: The Micro Mover LED (19) lights up after one push at the Micro Mover Push Button (13) and goes off after the second push, when the mirror chip has been moved.
	FErb Systems: Not supported.
20 Power Monitor Output • SMA-connector	Oscillator Power Monitoring, Output Voltage 0 .. 4.5 V for 0 .. 100 % (does not represent the laser output power exactly)
21 Laser Power Input • SMA-connector	<p>Input for Analog Laser Power Control (for details please refer to section 6.3).</p> <p>FErb Systems: 0 .. 5 mA via $R = 1\text{ k}\Omega$, Range 90 - 110 % additional to the Pump Laser Power Adjustment (14).</p> <p>FYb Systems: 0 .. 5 mA via $R = 1\text{ k}\Omega$, Range 90 - 100 % additional to the Pump Laser Power Adjustment (14).</p> <p>NOTE ! When the laser power is controlled via the Laser Power Input (21), the Pump Laser Power Adjustment potentiometer (14) should be turned to min. position to avoid interference between the two controls.</p>
22 FemtoFiber smart Connector • D-Sub 9-connector	Connection to the FemtoFiber smart laser.
23 Power Supply Connector	Connection to the FemtoFiber smart Power Supply. For pin assignment please refer to section 6.5.
24 Laser ON Input • Tyco AMP 828549 connector	<p>Input to switch laser emission ON/OFF.</p> <p>TTL high (+ 3.3 V..+ 5 V) Laser ON, TTL low (0 V..+ 0.8 V) Laser OFF.</p> <p>Laser emission is indicated by the Laser ON LED (18).</p> <p>For pin assignment please refer to section 6.4.</p>
25 Interlock Connector • Phoenix MC0.5/2-G-2.5 connector	Connector for installation of an external interlock circuit. For first operation, an interlock plug is supplied to close the interlock circuit. For safety reasons, the installation of an external interlock circuit is strongly recommended.

4.3 FemtoFiber smart System Quickstart

CAUTION ! Since the FemtoFiber smart has power levels which may already destroy optical fibers, please pay special attention to a clean fiber facet at the output fiber connector. We also recommend to always switch-off the laser emission before the fiber connector is opened/closed!

CAUTION ! While starting the laser it may occur that higher level pulses are sent out by the laser. This transient phenomenon is due to the fact that the amplifier of the system starts simultaneously with the oscillator. We therefore recommend blocking the output beam at the moment when the laser is switched on, or adding the THz option.

NOTE ! The FemtoFiber smart is specified to be ready for operation within 15 seconds after switch-on, provided that the laser emission start signal is given right after the boot-up sequence, which takes approx. 3 seconds. The end of the boot-up sequence is indicated at the laser head when the Power ON LED (1, blue) and the Temperature OK LED (2, green) light up (all other LEDs are off).
If laser emission is activated before reaching this state, an error may occur, indicated by the Clip Error LED (3, yellow) or Module Error LED (4, red).

4.3.1 OEM Integrated Environment

1. Connect the FemtoFiber smart laser to the application via the I/O connector (9). For pin assignment please see section 6.2.
2. Connect the FemtoFiber smart laser Output FC/APC connector (7) to the application.
3. When the FemtoFiber smart laser supply voltage (pin 1 of the I/O connector (9)) is applied and the TTL input (pin 7 of the I/O connector (9)) is in state high, the laser emission is ON.

4.3.2 Manual Operation via Switch Box

NOTE ! For Switch Box operator controls please refer to section 4.2.

1. Unpack all system items.
Systems with fixed fiber: Remove the protection cap from the fiber pigtail and plug in the FC/APC connector into the receptacle of the application, optionally to the FIBEROUT. The connector key is orientated parallel to the slow axis of the fiber.
Systems with FC/APC fiber connector: Use the supplied fiber to connect the FemtoFiber smart to the application. Remove the protection caps from both ends of the fiber. Connect the fiber to the FC/APC connector of the FemtoFiber smart laser and to the receptacle of the application, optionally to the FIBEROUT. The connector key is orientated parallel to the slow axis of the fiber.
Systems with free beam laser output: Make sure the laser beam shutter is closed for safety reasons (please refer to section 2.4.2).
2. Connect the FemtoFiber smart laser to the Switch Box via the D-Sub 9 cable and fix it with the screws.
3. Make sure that the Main Power Key switch (11) is in OFF position. Connect the power supply to the Switch Box and to mains.
4. Remove the protection cap from the Trigger Output (8) and connect to the trigger input of the application (if necessary).
5. Turn the Main Power Key switch (11) into position ON.
6. Set the Pump Laser Power Adjustment potentiometer (14) on the Switch Box to position 10 (FYb systems), respectively 5 (FErb systems).
7. Switch ON the FemtoFiber smart system with the ON/OFF Switch (10) and wait until the green Temperature OK LED (2) on the FemtoFiber smart laser head lights up.
8. To enable the laser emission, press the Laser ON Push Button (12). The Laser On LED (18) will light up and laser light is emitted. The FemtoFiber smart laser can be operated via the operator controls at the Switch Box (see section 4.2).
Systems with free beam laser output: Open the laser beam shutter (please refer to section 2.4.2). When the laser is disabled, close the laser beam shutter for safety reasons.

NOTE ! When the emission of the FemtoFiber smart laser is switched on with closed shutter, back reflections from the shutter may disturb the internal photo diode/power regulation. This may lead to unexpected error messages, but is not harmful to the laser.

4.3.3 FemtoFiber smart Operation via Software Commands

4.3.3.1 Installation of USB Connection

NOTE ! For Switch Box operator controls please refer to section 4.2.

In order to connect a FemtoFiber smart to a computer for the first time, please follow the instructions noted below for the initial installation:

1. Switch ON the computer.
2. Switch ON the FemtoFiber smart.
Switch Box: Switches (10) and (11) in position ON.
OEM: I/O connector (9) connected, 12 ± 2 V DC applied at pin 1
3. Connect the USB cable to the USB-connector (6) on the FemtoFiber smart first and then connect it to the computer (Windows 7 or higher required).
4. Please install the USB driver as described in section 6.7.
5. Open a terminal program and select a serial connection with the following settings:

Baud rate 9600
8 bits
no parity
1 stop bit
no hardware handshake

The COM port for communication with the FemtoFiber smart is usually the newest added **USB Serial Port** or the one with highest COM port number.

6. Switch the laser OFF and ON.
Switch Box: Switch (10) in position OFF and ON.
OEM: I/O connector (9) connected, 12 ± 2 V DC at pin 1 removed and applied.
You should see a prompt appearing at the terminal window which includes the current firmware number.

Example:

```
FemtoFErb 2.0.87>
```

After the USB connection is installed and works properly, the laser can be remote controlled. For a command list, please refer to section 4.3.3.2.

DANGER ! When the FemtoFiber smart is **remote controlled via software commands, the Laser ON LED on the Switch Box does not show the actual status of the laser !**

NOTE ! As per default after start-up, the FemtoFiber smart can only be controlled by the hardware input lines (D-Sub-9 connector), i.e. via Switch Box.
To control a FemtoFiber smart via software commands, the hardware input lines (i.e. Switch Box operation), have to be disabled by the corresponding command (please see section 4.3.3.2). It is not possible to control the laser in both ways at the same time, either hardware (D-Sub-9) or software (USB) control is possible.

NOTE ! After switching off the FemtoFiber smart power supply, all settings will be lost, i.e. the laser is in hardware control mode again as per default.

4.3.3.2 Commands for Remote Control

NOTE ! The syntax must include all shown characters and symbols (brackets, apostrophes, !, #, ...) Mode W = write, Mode R = read.

Command/Parameter Syntax	Return Type	Mode	Description
(param-set! 'hw-input-dis #t)	BOOLEAN	W	Enable remote control (#t: true, #f: false)
(param-ref 'hw-input-dis)	BOOLEAN	R	Remote control status #t: write commands will be executed #f: write commands disabled
(param-set! 'laser:en #t)	BOOLEAN	W	Switch ON/OFF laser
(param-ref 'laser:en)	BOOLEAN	R	Laser ON/OFF status
(param-ref 'laser:i)	INTEGER	R	Laser current in Milliampere (mA)
(param-ref 'laser:pd-i)	INTEGER	R	Photodiode monitor level in arb. units
(param-ref 'tec1:temp)	INTEGER	R	Pump diode TEC temperature in 0.1 celsius degrees (°C).
(param-set! 'poti-pos xxxx)	INTEGER	W	Set output power (0..1000)
(param-ref 'poti-pos)	INTEGER	R	Output power (0..1000) corresponds to: 0 > Switch Box Trimpot Position 0 1000 > Switch Box Trimpot Position 10.00 NOTE ! The system is checked and certified only for 100 % nominal output power. This is equal to Switch Box Trimpot position 5 (FErb systems), or 10 (FYb systems). Please refer to the Production and Quality Control Test Data Sheet for specified values. TOPTICA Photonics AG does not guarantee that the specifications of the laser are met at all other trimpot settings
(param-set! 'powercontrol:en #t)	BOOLEAN	W	Enable power control loop

(param-ref 'powercontrol:en)	BOOLEAN	R	Power control loop status #t: Poti controls power value #f: Poti controls current value
(param-ref 'laseron:time)	STRING	R	Laser operation time in Seconds (s)
(param-ref 'laseron:cycles)	STRING	R	Counter of "laser on" operations
(param-ref 'laseron.uptime)	STRING	R	"Power-on" time in Seconds (s)
(param-ref 'serial-number)	STRING	R	Readout of serial number
(param-ref 'system-type)	STRING	R	Returns a string containing the device type
(param-ref 'system-model)	STRING	R	Returns a string describing the hardware setup device
(param-ref 'fw-ver)	STRING	R	Returns firmware number
(param-ref 'status)	INTEGER	R	Status parameter bit code bit 0 - Current error bit 1 - Low voltage error bit 2 - Laser current clip active bit 3 - TEC1 error bit 4 - Control loop overflow error bit 5 - Modelock error bit 6 - QML error bit 7 - TEC 2 error bit 8 - EEPROM error</description>

4.3.4 FemtoFiber smart Operation with Graphical User Interface

4.3.5 System Requirements

Control computer with Windows operating system, up to Windows 10.

4.3.5.1 Installation of TOPAS FemtoFiber smart

NOTE ! You will need to have administrator rights to run the setup. If you don't have logged in with such rights, you will need to logon as such first. As an alternative, you may also run setup.exe under a different user while using right-mouse-click and select "run as..." The following installation procedure is described with Windows 7/8, other operation systems may show different windows. In this case, please follow the steps accordingly.

For TOPAS FemtoFiber smart installation, please insert the supplied USB flash drive to the control computer and start the installer (TOPAS FemtoFiber smart.exe). The installer will guide you through the installation process.

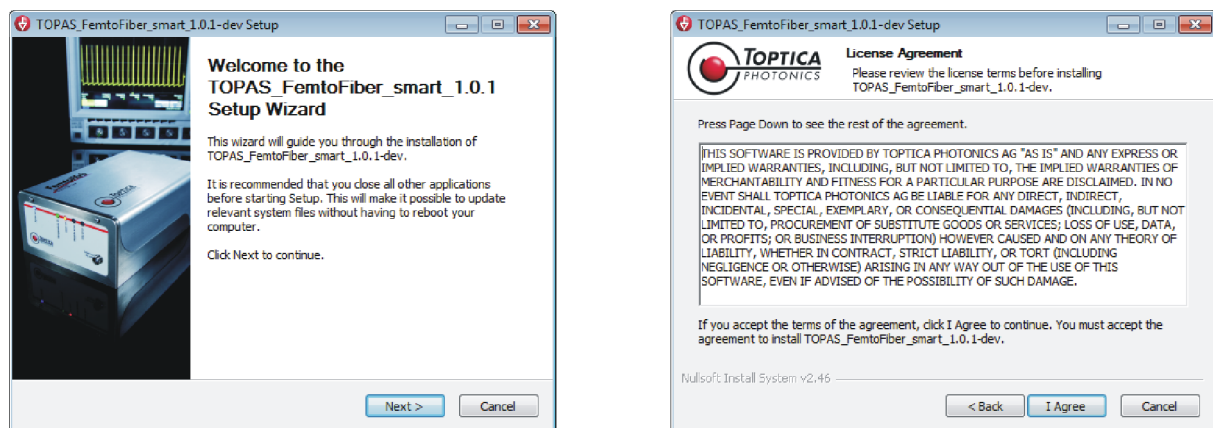


Figure 6 TOPAS FemtoFiber smart installation

Start the installation by clicking **Next** and confirm the license agreement by clicking **I Agree**.

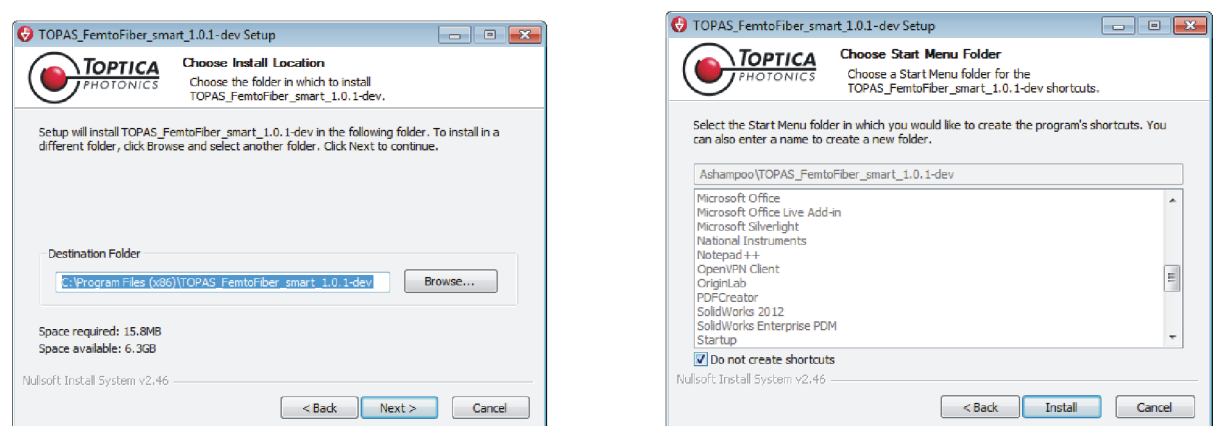


Figure 7 TOPAS FemtoFiber smart installation

Select the folder where TOPAS FemtoFiber smart will be installed. Click **Next** to continue to the following window.

In your software version, all components of TOPAS FemtoFiber smart will be installed. In the next window (Figure 7 right) you may choose the name of a program folder in the start menu. Click **Install** to continue.

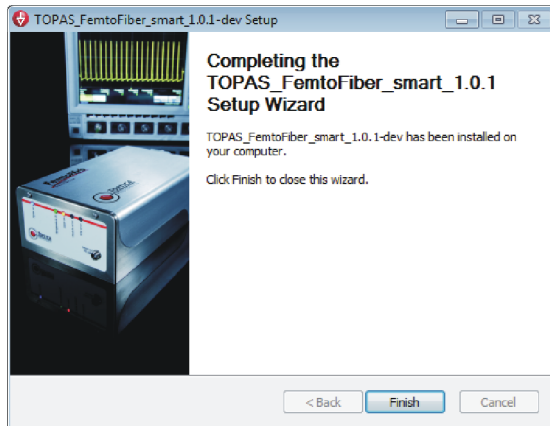


Figure 8 TOPAS FemtoFiber smart installation

After the installation is completed, click **Finish** to close the TOPAS FemtoFiber smart installer.

4.3.5.2 FemtoFiber smart Operation with TOPAS FemtoFiber smart

NOTE ! Please refer to section 4.1 for a detailed description of the operator controls on the FemtoFiber smart front and rear panel and to section 5 for a detailed description of the TOPAS FemtoFiber smart graphical user interface (GUI).

1. Connect the FemtoFiber smart to your OEM environment (see section 4.3.1) or to the Switch Box (see section 4.3.2).
Connect the USB-connector on the FemtoFiber smart front panel with a USB connector of your PC by using the supplied USB cable. Switch ON the FemtoFiber smart laser at the Switch Box.

NOTE ! When no USB serial port is detected, please check whether a FTDI driver is installed on the computer. Verified FTDI drivers can be downloaded from the product pages on the TOPICA website.

2. Start TOPAS FemtoFiber smart.
3. Select Menu > Connection Settings

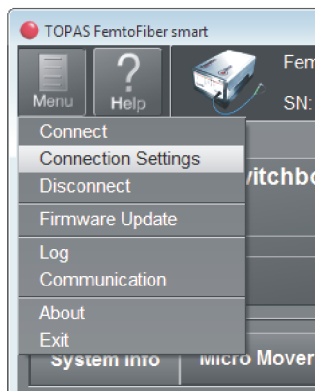


Figure 9 TOPAS FemtoFiber smart menu

To be continued on the next page.

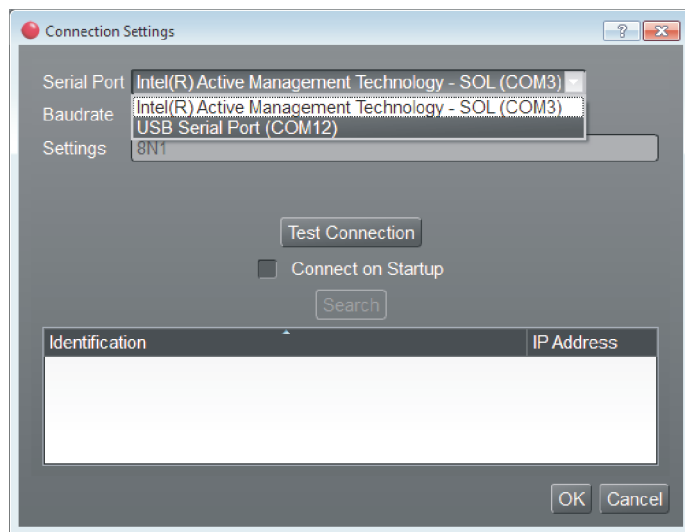


Figure 10 TOPAS FemtoFiber smart Connection Settings window

4. In the Connection Settings window, select the **USB Serial Port** to which the device is connected. **Baudrate** and **Settings** are preset and fixed for FemtoFiber smart operation. Click **OK** to save the settings and to close the window.

NOTE ! If there is no USB serial port found in the TOPAS FemtoFiber smart list of available lasers - although the laser is properly connected, switched on and ready to work, it probably helps to try one of the following solutions:

- 1) Try to run TOPAS FemtoFiber smart in "XP compatibility mode" (right click on the TOPAS icon > properties > compatibility). This feature is forcing Windows to emulate XP conditions and may solve port access issues.
- 2) Try a "right-mouse-click" on the TOPAS icon and select "run as administrator". Independently from the individual user rights of the computer, TOPAS FemtoFiber smart is run under administrator rights, without needing to have a password.
- 3) The USB cable is probably too long or the outputs at the USB port of the computer are very low. The first problem may appear when the USB-cable is longer than 2 meters. The second one often appears when a laptop or a tablet computer is used. In both cases, the signal gets too weak at receiver's side and the communication may be disrupted. In our experience, establishing the first connection is usually still possible, but in some cases exchanged commands get lost and either GUI or laser are not operating properly. Do not use a USB cable longer than the factory supplied one. Alternatively you can try to use a powered USB hub with an external power supply.

5. Select Menu > Connect to establish a connection to the device.
6. The laser can now be operated with the Controls of the GUI (see section 5).

5 TOPAS FemtoFiber smart Control Software

In this section all controls of the TOPAS FemtoFiber smart graphical user interface (GUI) are described in detail.

5.1 Upper and Lower Screen Section

5.1.1 Header

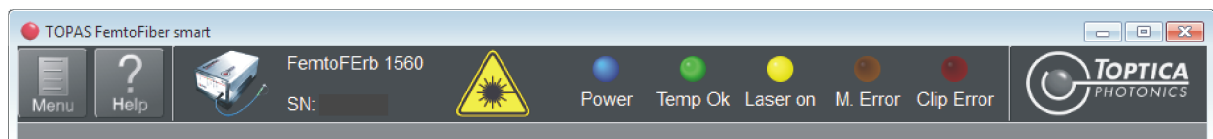


Figure 11 TOPAS FemtoFiber smart header

Menu	Please refer to section 5.1.3.
Help	Please refer to section 5.1.4.
Connected Device	Displays the connected device and its serial number.
Laser Warning Label	The laser warning label appears when laser light is emitted by the connected device (please refer to section 5.2).
Indicators	The five indicators on top to the right correspond to the LEDs on the FemtoFiber smart front panel (please refer to section 4.1).

5.1.2 Footer

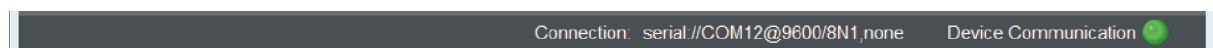


Figure 12 TOPAS FemtoFiber smart footer

Connection:	Displays the connection currently used for communication with the device.	
Device Communication:	Bright green:	Communication.
	Dark green:	No communication.

5.1.3 Menu

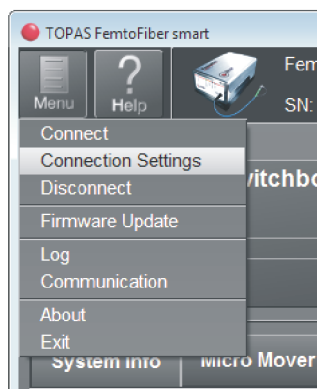


Figure 13 TOPAS FemtoFiber smart menu

Menu > Connect

Establishes a connection to the device selected in the Connection Settings window.

Menu > Connection Settings

The Connection Settings window opens where the connection can be configured.

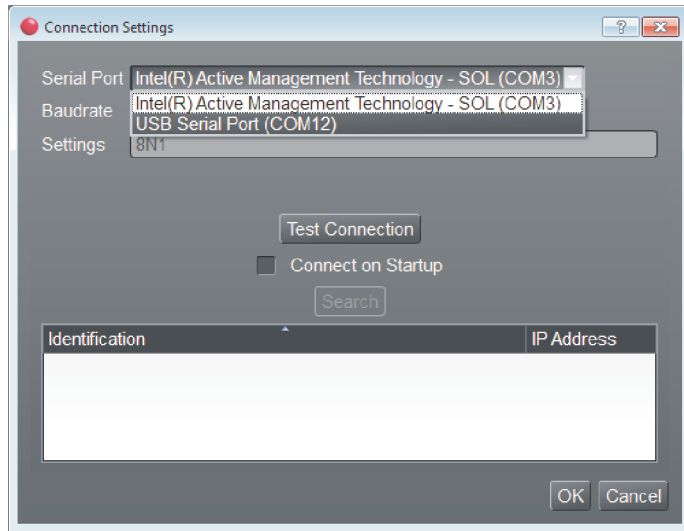


Figure 14 TOPAS FemtoFiber smart Connection Settings Window

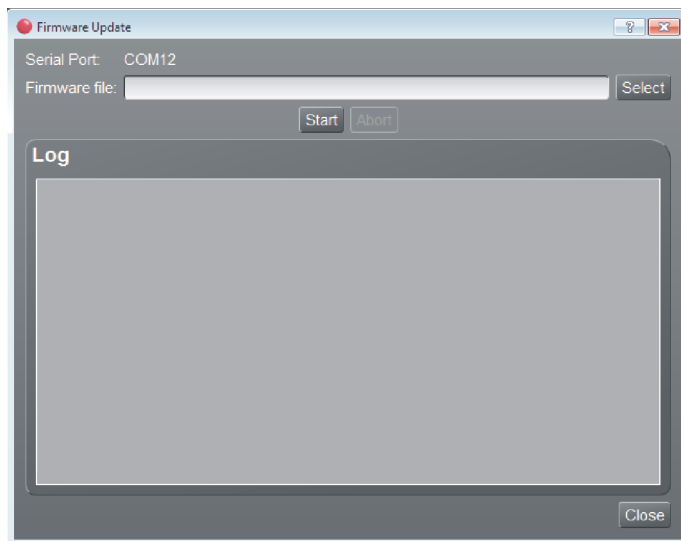
Serial Port	Select the USB Serial Port where the device is connected to.
Baudrate	The Baudrate is fixed to 9600 for FemtoFiber smart operation.
Settings	The Settings for the communication are preset and fixed for FemtoFiber smart operation.
Test Connection	Clicking opens a window where details on the connected device are shown.
Connect on Startup	When checked, the connection saved by clicking OK is automatically established at the next software start.
Search	not active
Display Identification/Address	not active
OK	Saves the settings and closes the window.
Cancel	Closes the window.

Menu > Disconnect

Closes the connection to the device.

Menu > Firmware Update

Opens the Firmware Update window.

**Figure 15** TOPAS FemtoFiber smart Firmware Update window**NOTE !** Please refer to section 6.6 for a detailed description of the firmware update procedure.

Serial Port	Displays the USB Serial Port where the device is connected to.
Select	Choose the firmware file (*.elf) to be installed. The selected firmware file is displayed in the display field.
Start	Starts the firmware update.
Abort	Aborts the firmware update.
Log window	Displays details on the process of the firmware update.
Close	Closes the Firmware Update window.

Menu > Log	Adds the Log window to the bottom section of the screen.
Menu > Communication	Adds the Communication window to the bottom section of the screen.

NOTE ! When you display **Log** and **Communication** windows at the same time, you can display one window at full size in the front for better viewing. Do this by picking the window at the title bar and pulling it in the center of the screen area.
Each display window may also be moved to any screen position when picked at the title bar.

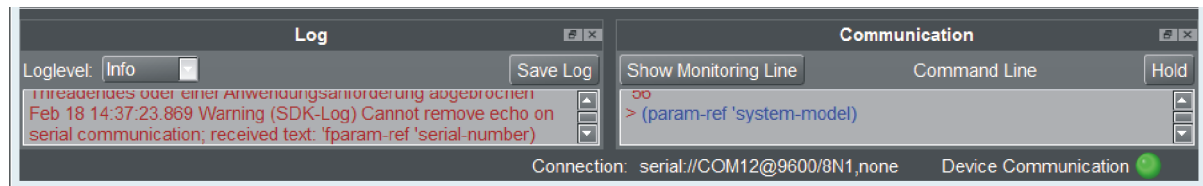


Figure 16 TOPAS FemtoFiber smart Log and Communication window

Log Window	The Log Window shows TOPAS FemtoFiber smart internal debug messages.
LogLevel	Selection of the LogLevel displayed in the Log Window Error Only Error messages are displayed. Warning Error and Warning messages are displayed. Info Error and Warning messages as well as additional detailed information on the system operation are displayed.
Save Log	The currently displayed log is saved.
Communications Window	The Communications Window shows the communication between TOPAS FemtoFiber smart and the FemtoFiber smart.
Show Monitoring Line/ Show Command Line	Click to toggle between display of communication on the monitoring or the command line.

NOTE ! Communication on monitoring line is not active with FemtoFiber smart lasers.

Hold	Freezes the display of the communication. Click Hold again to continue the display.
Monitoring Line/ Command Line	Display area for communication between TOPAS FemtoFiber smart and the FemtoFiber smart.

Menu > About	The About window opens, which provides information about the manufacturer, contact details, software version, etc.
Menu > Exit	Closes the TOPAS FemtoFiber smart software.

5.1.4 Help

Clicking opens a pdf version of the FemtoFiber smart manual.

5.2 Control Section

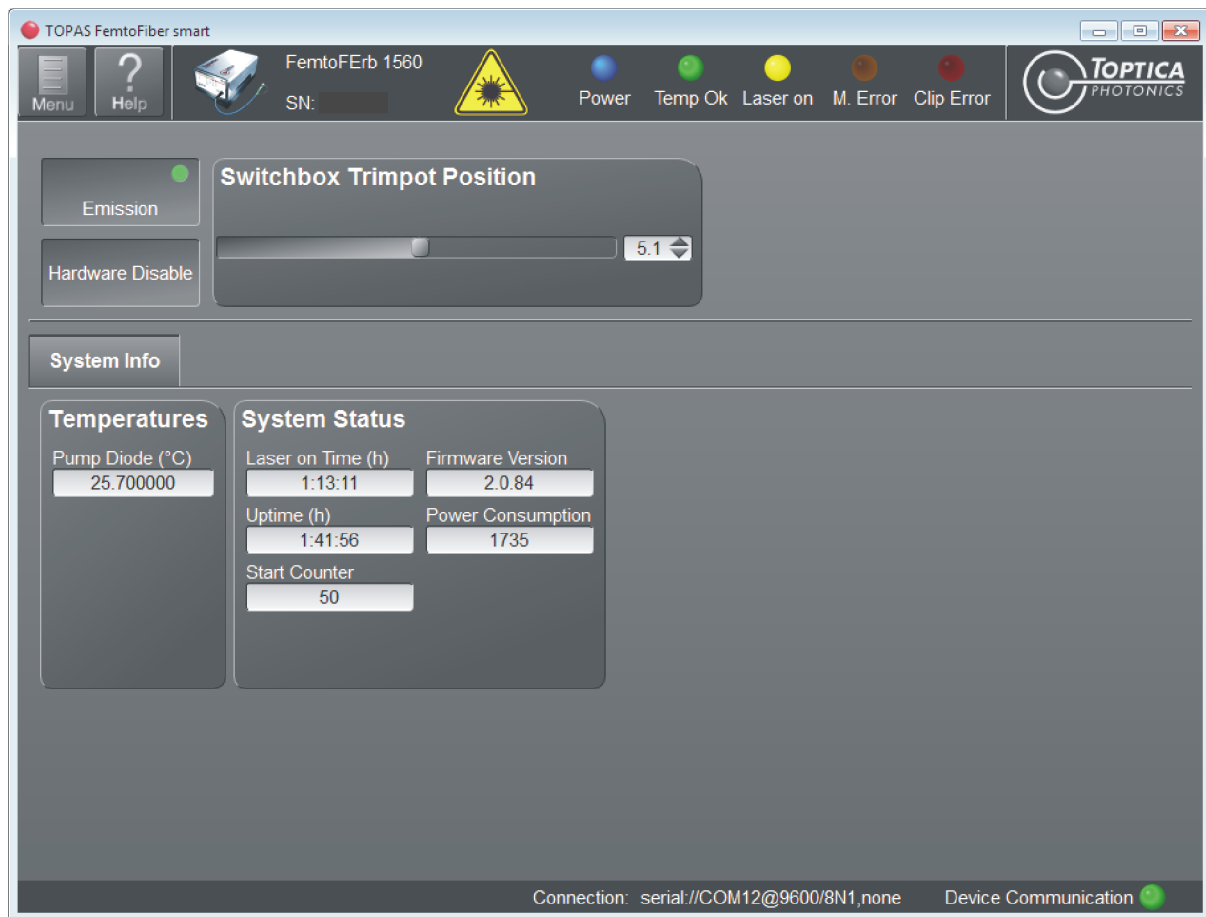


Figure 17 TOPAS FemtoFiber smart controls (Ferb system shown)

Emission

Indicates and controls the emission of the laser.

Indicator OFF: No laser emission.

Indicator green: Laser emission is turned on.

Click the **Emission** button to toggle the emission state.

Hardware Disable

Click the **Hardware Disable** button to toggle between GUI operation (hardware disabled) or e.g. Switch Box operation of the FemtoFiber smart. At software start, by default the button is set to hardware disabled.

When hardware is disabled, the Switch Box display and control elements are not active.

DANGER ! When the FemtoFiber smart is **remote controlled via TOPAS FemtoFiber smart**, the **Laser ON LED on the Switch Box does not show the actual status of the laser !**

Switchbox Trimpot Position

Enter a number or move the slider to change the laser power similar to a Laser Power trimpot adjustment on the Switch Box .
The adjustment can be used for fine tuning of the pulse characteristics.

NOTE ! The position of the Laser Power trimpot on the Switch Box is read out and displayed when the FemtoFiber smart is connected (**Menu > Connect**) to the TOPAS FemtoFiber smart software. Small deviations due to component tolerances are possible.

NOTE ! The system is checked and certified only for 100 % nominal output power. This is equal to Switch Box Trimpot position 5 (Ferb systems), or 10 (FYb systems). Please refer to the Production and Quality Control Test Data Sheet for specified values.
TOPTICA Photonics AG does not guarantee that the specifications of the laser are met at all other trimpot settings

5.2.1 System Info Tab

The System Info section (see Figure 17) provides detailed information on the FemtoFiber smart system set-up.

System Info Section**Temperatures****Pump Diode (°C)**

Displays the temperature of the pump diode.

System Status**Laser on Time (h)**

Displays the accumulated time where laser light was emitted.

Uptime (h)

Displays the accumulated system uptime.

Start Counter

Displays the number of emission ON cycles.

Firmware Version

Displays the current firmware version.

Power Consumption

Displays the internal power consumption index.

5.2.2 Micro Mover Tab (only FYb Systems)

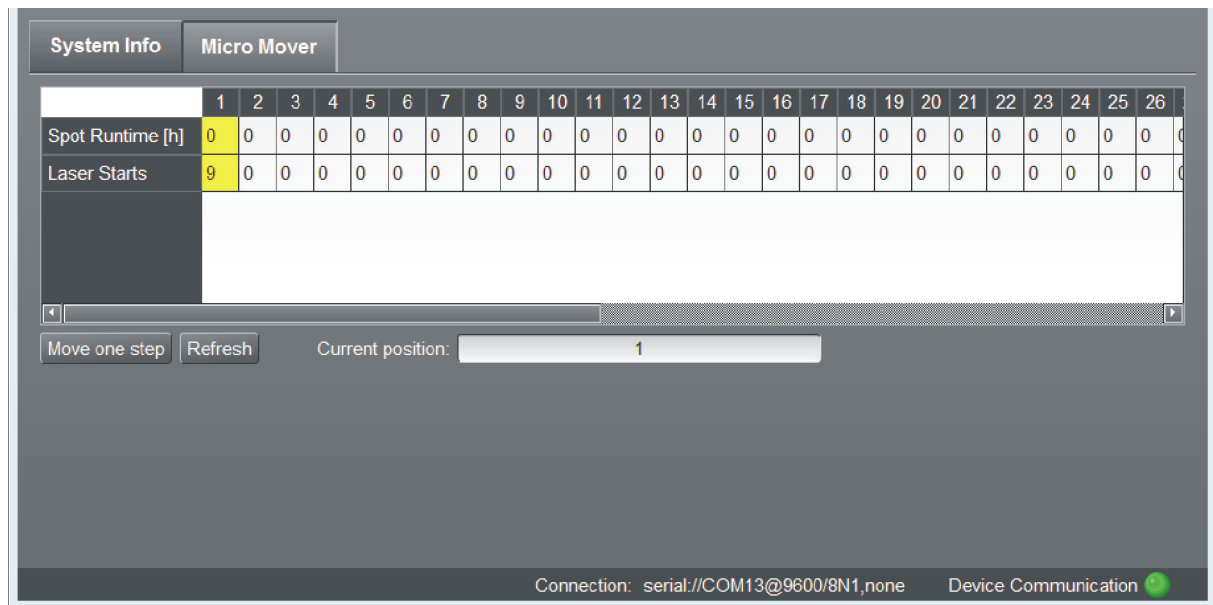


Figure 18 TOPAS FemtoFiber smart Micro Mover tab (only FYb systems)

Display	The current spot position is shown with a yellow background.
Spot Runtime (h)	Displays the accumulated operating time on the respective spot position.
Laser Starts	Displays the number of emission ON cycles on the respective spot position.
Move one step	A dialog windows opens. Select Execute to move the SAM to the next spot position by the micro mover.

NOTE ! Moving the SAM to the next spot position is only possible with the laser emission switched off !

Refresh	The content of the display is refreshed.
Current Position	Displays the current spot position.

6 Appendix

6.1 Specifications

For current specifications of the FemtoFiber smart systems please refer to the TOPTICA website and to the Production and Quality Control Data Sheet.

6.2 Pin Assignment D-Sub 9 Input/Output Connector

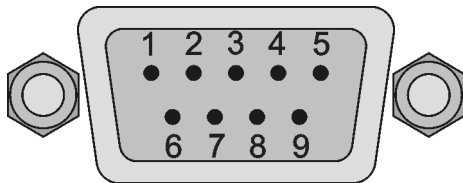


Figure 19 Input/output D-Sub 9 connector at FemtoFiber smart laser rear panel

Pin 1	12 ± 2 V DC filtered (supply)
Pin 2	GND (TTL)
Pin 3	TTL signal micro mover (optional)
Pin 4	GND (analog)
Pin 5	Analog Laser Power Control, Range 90 - 110 % (please refer to section 6.3 for details)
Pin 6	GND (supply)
Pin 7	TTL high (+ 2 V..+ 5 V) Laser ON, TTL low (0 V..+ 0.8 V) Laser OFF
Pin 8	Error low = error (monitor signal e.g. for external control)
Pin 9	Oscillator Power Monitoring, Output Voltage 0 .. 4.5 V for 0 .. 100 % (does not represent the laser output power exactly)

6.3 Operation without Switch Box (Control via TTL/Analog Pins)

If a FemtoFiber smart laser head is operated without Switch Box, the Pump Laser Power Adjustment trim-pot setting has to be replaced by the Analog Laser Power Control applied to pin 5 of the Input/Output D-Sub 9 connector.

NOTE ! This information is not valid for OEM integrators intending to use USB control and not TTL/ analog signals to control the laser.

FErb Systems: All FErb laser heads are specified at 100 % laser power with trimpot setting 5/mid position. To be within specification, 100 % laser power has to be adjusted by an external laser power control circuit when the Switch Box is not used.

FYb Systems: All FYb laser heads are specified at 100 % laser power with trimpot setting 10/end position. To be within specification, 100 % laser power has to be adjusted by an external laser power control circuit when the Switch Box is not used.

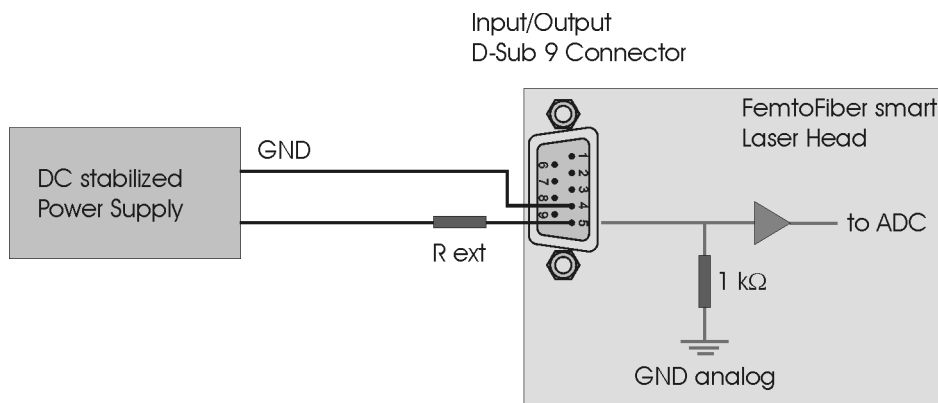


Figure 20 Setup for FemtoFiber smart operation without Switch Box

Examples for Analog Laser Power Control voltages applied to pin 5 of the Input/Output D-Sub 9 connector and the corresponding laser power are noted in the table below:

FErb System Laser Power	FYb System Laser Power	$R_{ext} = 1 \text{ k}\Omega$	$R_{ext} = 0$
90 %	90 %	0 V	0 V
100 %	95 %	5 V	2.5 V
110 %	100 %	10 V	5 V

6.4 Pin Assignment of Laser On Input Connector (Switch Box)

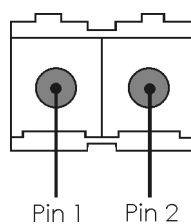


Figure 21 Tyco AMP 828549 connector

Pin 1: TTL high (+ 3.3 V..+ 5 V) Laser ON, TTL low (0 V..+ 0.8 V) Laser OFF

Pin 2: GND

6.5 Pin Assignment of Power Supply Connector (Switch Box)

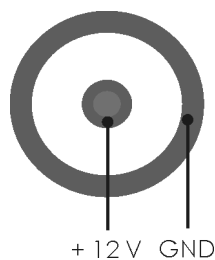


Figure 22 Power supply connector

6.6 Firmware Update

The file (*.elf) for updating the FemtoFiber smart firmware is provided by TOPTICA. Please follow the description below for updating the firmware.

Prerequisites:

- FTDI Driver installed on the control computer.
 - TOPAS FemtoFiber smart software installed on the control computer.
 - FemtoFiber smart laser head connected to the control computer.
 - FemtoFiber smart laser head switched off.
 - The firmware file (*.elf) is available on the control computer.
1. Run the TOPAS FemtoFiber smart software and select **Menu > Firmware Update**. The Firmware Update window appears (see also section 5.1.3).

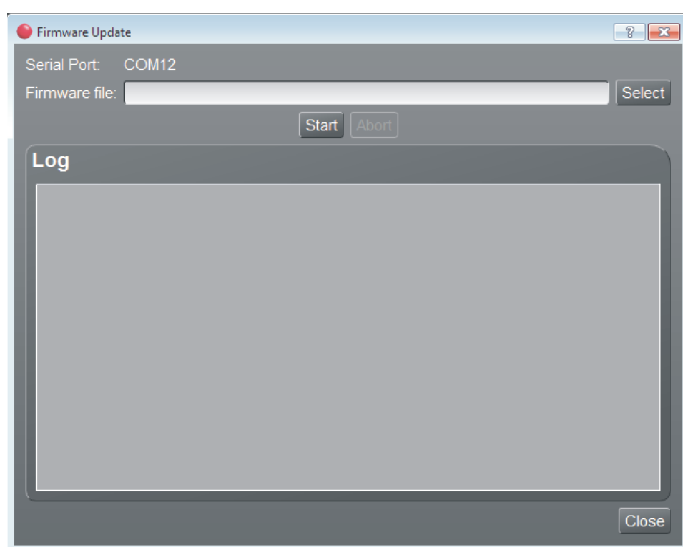


Figure 23 TOPAS FemtoFiber smart Firmware Update window

2. Click **Select** and choose the firmware file (*.elf) on the control computer.
3. Move the mouse pointer over the **Start** button **but do not click, yet**.
4. Switch off the FemtoFiber smart laser head.
5. Switch the FemtoFiber smart laser head back on. Now click the **Start** button in the TOPAS FemtoFiber smart Firmware Update window **within one second - otherwise the update will not take place**.
6. The firmware update takes about 2 minutes. A successful update is indicated by the message "Update successful". In case of an error, please repeat from step 3.
7. After a successful firmware update, please switch the FemtoFiber smart laser head off and back on. Establish a connection to TOPAS FemtoFiber smart.
8. The **Firmware Version** can be checked in the **System Info tab** (System Status section) of TOPAS FemtoFiber smart. Please note that the file name may be truncated.

6.7 USB Connection (Installation of FTDI CDM Drivers)

NOTE ! You will need to have administrator rights to run the setup. If you don't have logged in with such rights, you will need to logon as such first. As an alternative, you may also run setup.exe under a different user while using right-mouse-click and select "run as..."

NOTE ! Since support of Windows XP has been terminated recently, TOPTICA no longer supports this or older operating systems. The following procedures are executed on a Windows 7 system, also including some special remarks on Windows 8. Operation with Windows 10 has been verified at time of issuing this manual.

NOTE ! Newest and latest FTDI drivers can always be found at the manufacturer's website: <http://www.ftdichip.com/Drivers/VCP.htm>

Insert the supplied USB flash drive to the control computer and select the folder *FemtoFiber-smart-USB-Driver_Windows* (Figure 24).

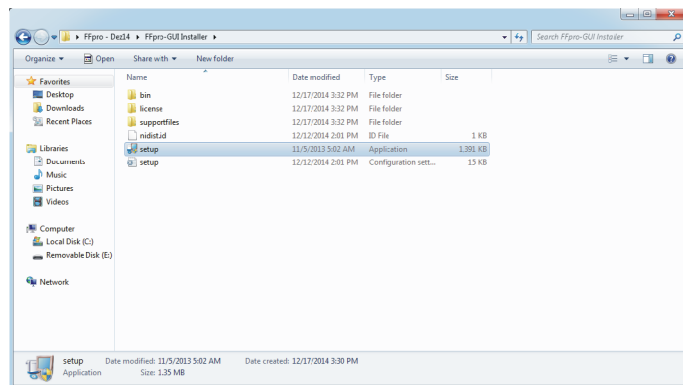


Figure 24

For USB driver installation, please insert the supplied USB flash drive to the control computer and start the installation wizard (CDM xxx.exe). The installation wizard will guide you through the installation process.

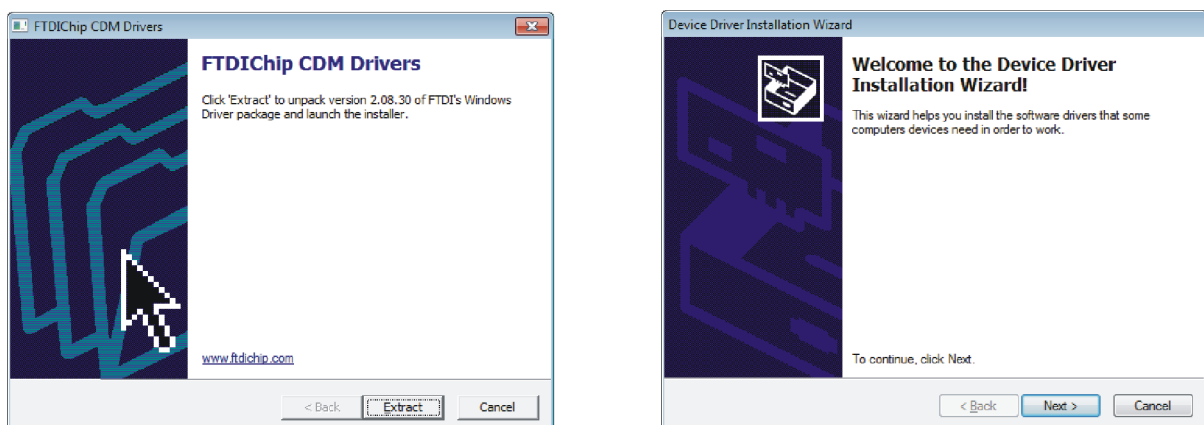


Figure 25 USB driver installation

Start the installation by clicking **Extract**. Continue to install by clicking **Next**.

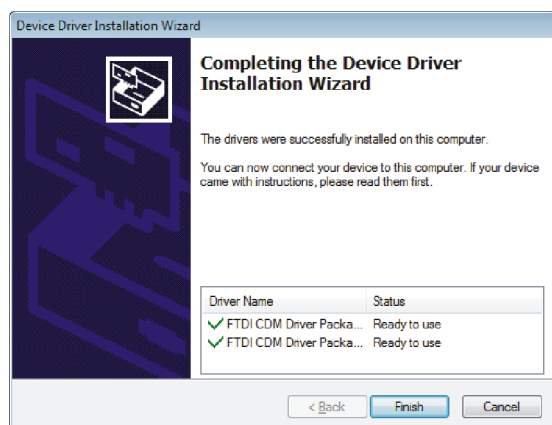


Figure 26 USB driver installation

Click **Finish** to complete the installation.

6.8 Precautions for Non-Condensing Operation Conditions

For FemtoFiber smart lasers, the typical temperature inside the housing is approximately 4 °C above the ambient temperature. This means, however, that especially in warm and humid surroundings, there could be condensation at relatively cold parts of the FemtoFiber smart – this is a condition that has to be prevented. Please refer to the dew point table below to see if the environmental conditions are appropriate for the operation of the FemtoFiber smart.

A safe operating condition for the FemtoFiber smart is reached when the dew point is below the typical temperature inside the housing. For safety reasons, there should be a small margin of 2 °C. Please check with the dew point table whether at your ambient conditions there may be a risk of condensation.

Ambient Temperature in °C	15	20	25	30	35	40	45
Ambient Temperature in °F	59	68	77	86	95	104	113
Relative Ambient Humidity	Dew Points at corresponding Ambient Conditions						
90%	13,4	18,3	23,2	28,2	33,1	38,0	43,0
85%	12,5	17,4	22,3	27,2	32,1	37,0	41,9
80%	11,6	16,4	21,3	26,2	31,0	35,9	40,7
75%	10,6	15,4	20,3	25,1	29,9	34,7	39,5
70%	9,6	14,4	19,1	23,9	28,7	33,5	38,2
65%	8,5	13,2	18,0	22,7	27,4	32,2	36,9
60%	7,3	12,0	16,7	21,4	26,1	30,7	35,4
55%	6,0	10,7	15,3	20,0	24,6	29,2	33,9
50%	4,7	9,3	13,9	18,4	23,0	27,6	32,2
45%	3,2	7,7	12,2	16,8	21,3	25,8	30,3
40%	1,5	6,0	10,5	14,9	19,4	23,8	28,3
35%	-0,3	4,1	8,5	12,9	17,3	21,6	26,0
30%	-2,4	1,9	6,2	10,5	14,8	19,1	23,4
25%	-4,9	-0,6	3,6	7,8	12,0	16,2	20,4
20%	-7,8	-3,7	0,5	4,6	8,7	12,8	16,8

Table 1 Dew point table

6.9 Declaration of CE Conformity

Konformitätserklärung			
Declaration of Conformity / Declaration de Conformité			
QM-Formular:	F-173	Stand Formular:	15.12.2016
Version Formular:	10	Seite:	1 von 1

Wir / We / Nous

TOPTICA Photonics AG

Anschrift / Address / Adresse

Lochhamer Schlag 19
82166 Graefelfing
Germany

erklären in alleiniger Verantwortung, daß das Produkt / declare under our sole responsibility, that the product / déclarons sous notre seule responsabilité, que le produit

Bezeichnung / Name / Nom

FemtoFiber smart

Artikelnr. / Article No. / No. d'Article

PicoFYb 1030, PicoFYb 1064, FemtoFYb 1030 -400/-800,
FemtoFerb 1560 + variants, FemtoFerb 780, FemtoFerb 1950

Beschreibung / Description / Description

Ytterbium- and Erbium-doped Fiber Lasers

mit den grundlegenden Anforderungen der Richtlinien / fulfills the requirements of the standard and regulations of the directives / satisfait aux exigences des normes et directives

**2014/30/EU (Elektromagnetische Verträglichkeit), 2014/35/EU (Niederspannungsrichtlinie)
2011/65/EU (RoHS-Richtlinie)**

übereinstimmt und damit den Bestimmungen entspricht. / and therefore corresponds to the regulations of the directive. / et, ainsi, correspond au règlements de la directive.

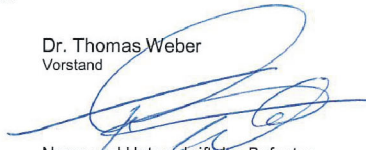
Angewendete harmonisierte Normen / Applied harmonized standards: / Normes harmonisées appliquées:

DIN EN 61326-1	VDE 0843-20-1:2013-07 Elektrische Mess-, Steuer-, Regel- und Laborgeräte - EMV-Anforderungen - Teil 1: Allgemeine Anforderungen (IEC 61326-1:2012); Deutsche Fassung EN 61326-1:2013 <i>Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements (IEC 61326-1:2012); German version EN 61326-1:2013</i>
DIN EN 61010-1	Sicherheitsbestimmungen für elektrische Mess-, Steuer-, Regel- und Laborgeräte - Teil 1: Allgemeine Anforderungen (IEC 61010-1:2010 + Cor.:2011); Deutsche Fassung EN 61010-1:2010 <i>Safety requirements for electrical equipment for measurement, control and laboratory use - Part 1: General requirements (IEC 61010-1:2010 + Cor.:2011); German version EN 61010-1:2010</i>
DIN EN 60825-1	Sicherheit von Lasereinrichtungen - Teil 1: Klassifizierung von Anlagen und Anforderungen (IEC 60825-1:2014); Deutsche Fassung EN 60825-1:2014 <i>Safety of laser products - Part 1: Equipment classification and requirements (IEC 60825-1:2014); German version EN 60825-1:2014</i>
DIN EN 50581	Technische Dokumentation zur Beurteilung von Elektro- und Elektronikgeräten hinsichtlich der Beschränkung gefährlicher Stoffe; Deutsche Fassung EN 50581:2012 <i>Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances; German version EN 50581:2012</i>

Durch nicht von uns autorisierte Änderungen am Produkt verliert diese Erklärung ihre Gültigkeit. / Non authorized changes at the product result in the invalidity of this declaration. / Changements au produit, qui ne sont pas autorisées par nous, ont pour conséquence l'invalidité de cette déclaration.

Graefelfing, den 29.08.2018

Dr. Thomas Weber
Vorstand



Ort und Datum der Ausstellung
Place and Date of Issue
Lieu et date d'établissement

Name und Unterschrift des Befugten
Name and Signature of authorized person
Nom et signature de la personne autorisée

6.10 Main Dimensions of the FemtoFiber smart System Versions

6.10.1 FemtoFerb Free Beam

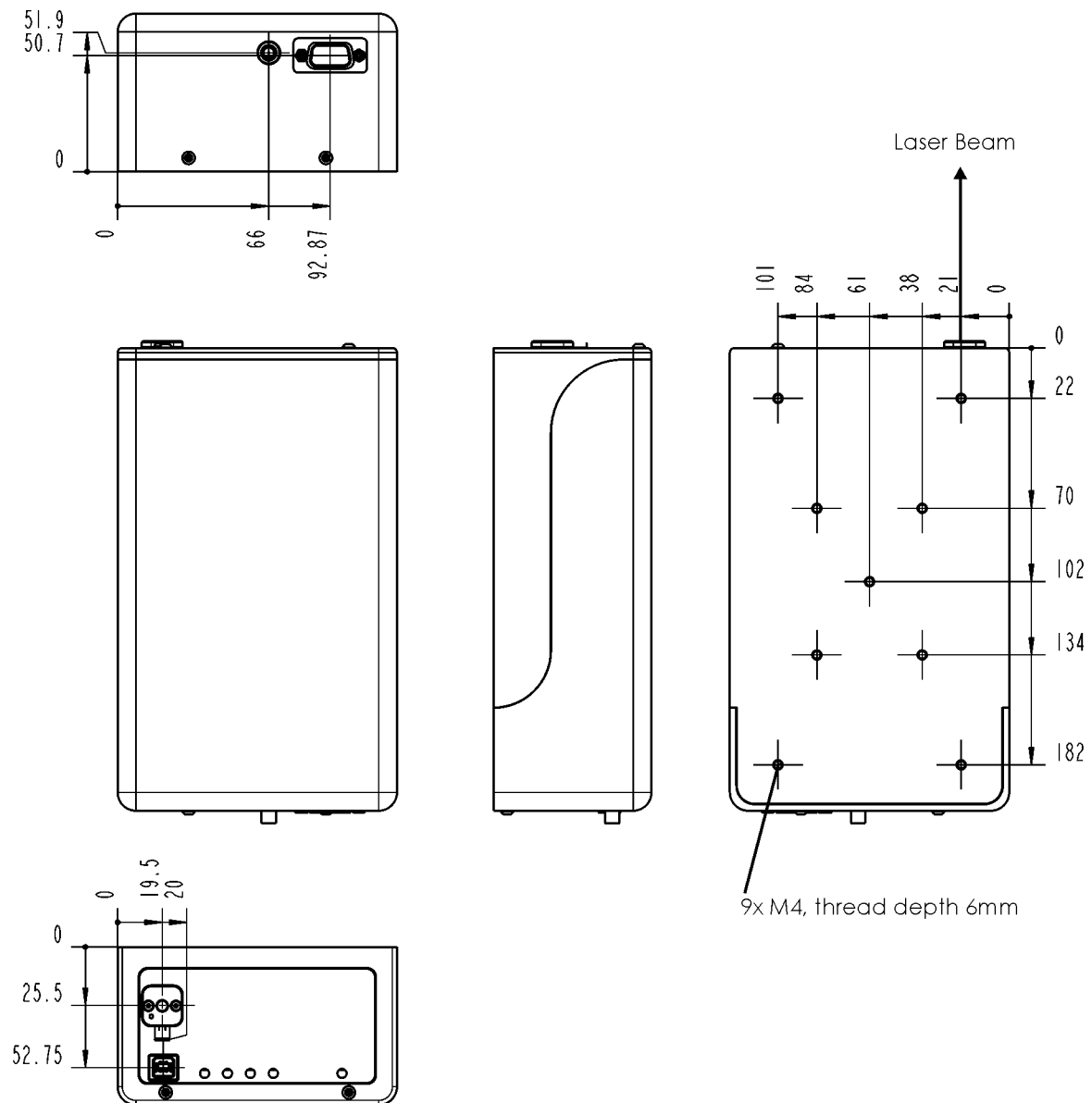


Figure 27 Main dimensions of FemtoFerb with free beam laser output

6.10.2 FemtoFerb with Fiber Pigtail

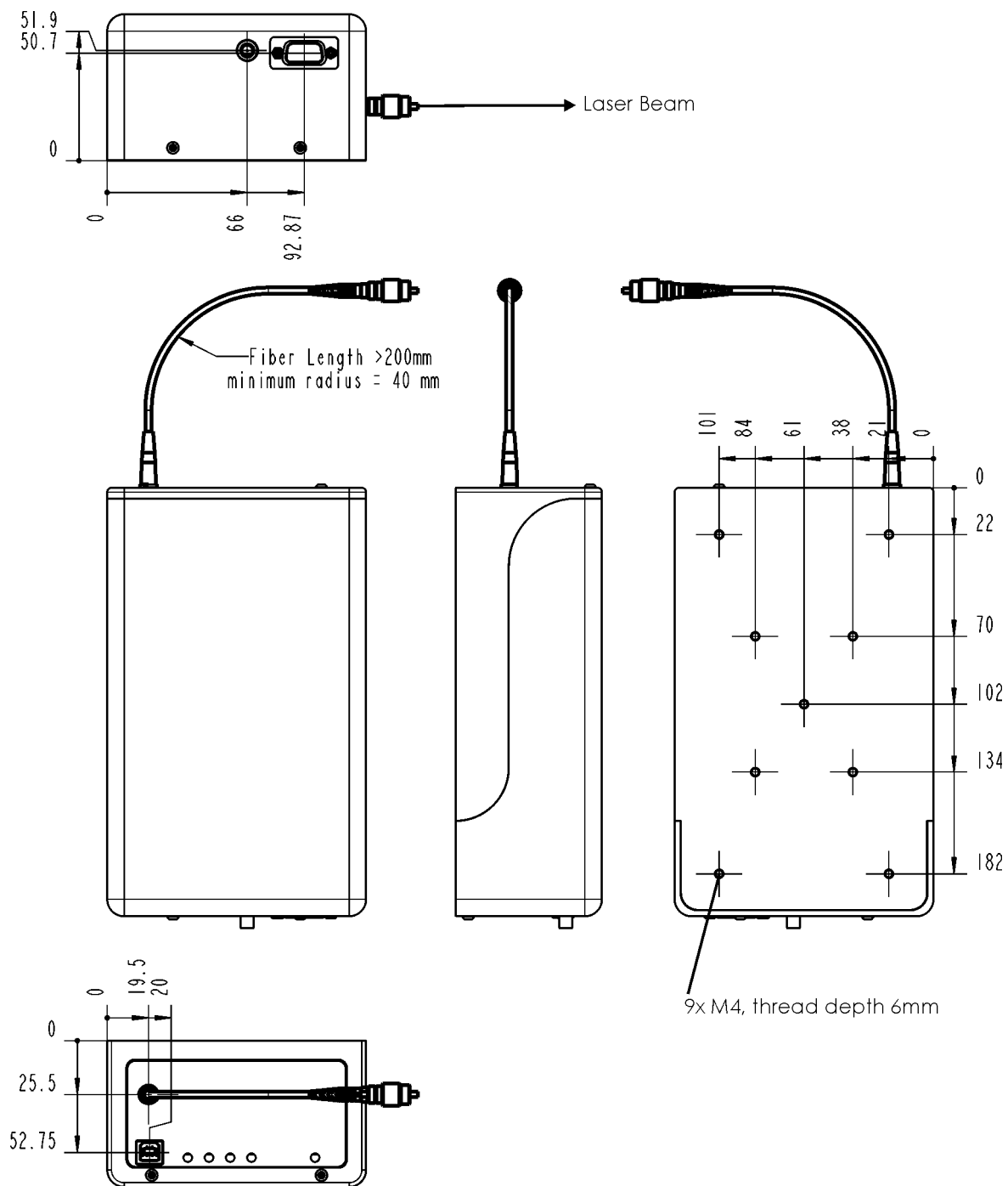


Figure 28 Main dimensions of the FemtoFerb with fiber pigtail

6.10.3 FemtoFerb with FC/APC Fiber Connector

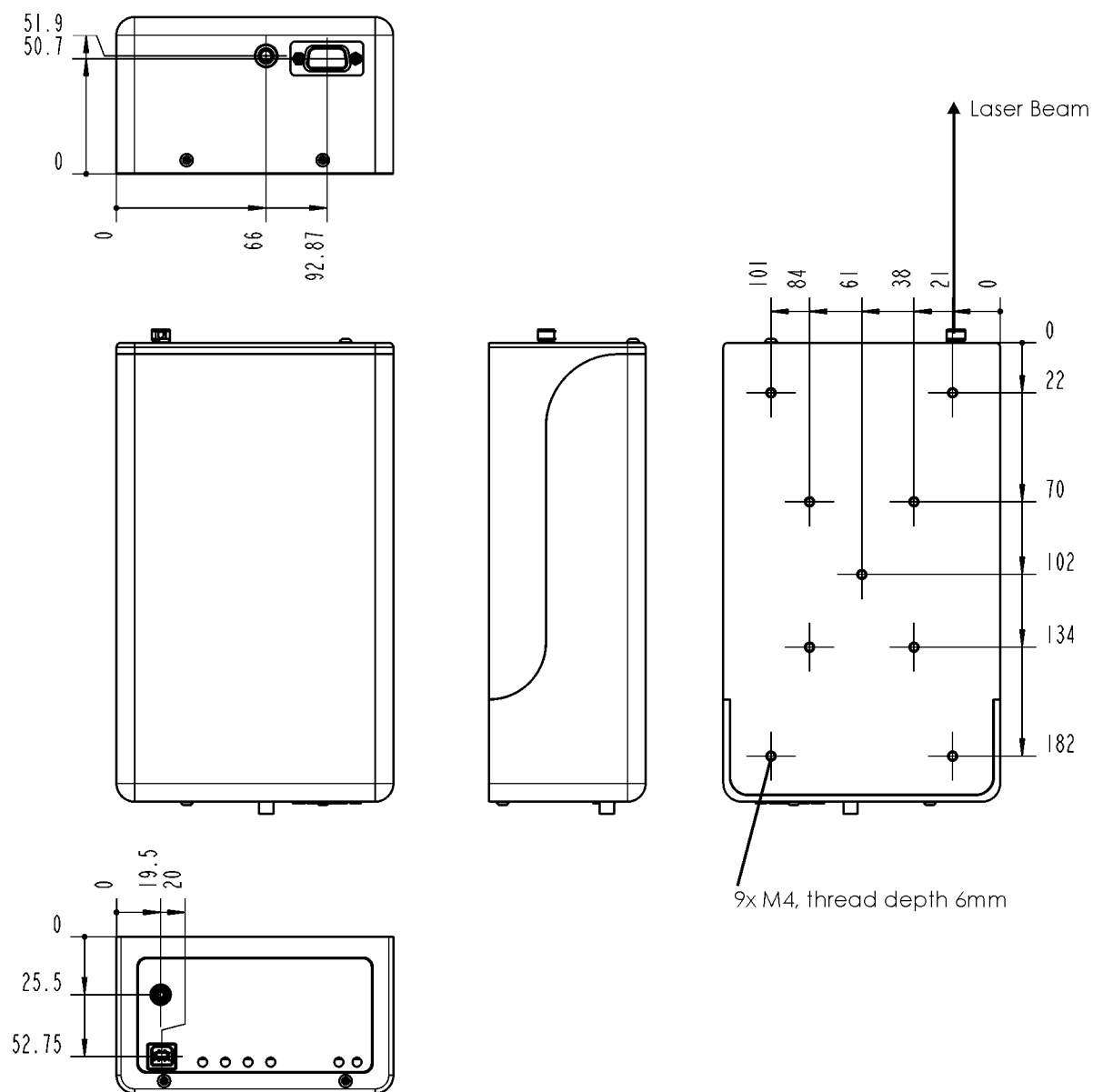


Figure 29 Main dimensions of the FemtoFerb with FC/APC fiber connector

6.10.4 Femto/PicoFYb with Fiber Pigtail

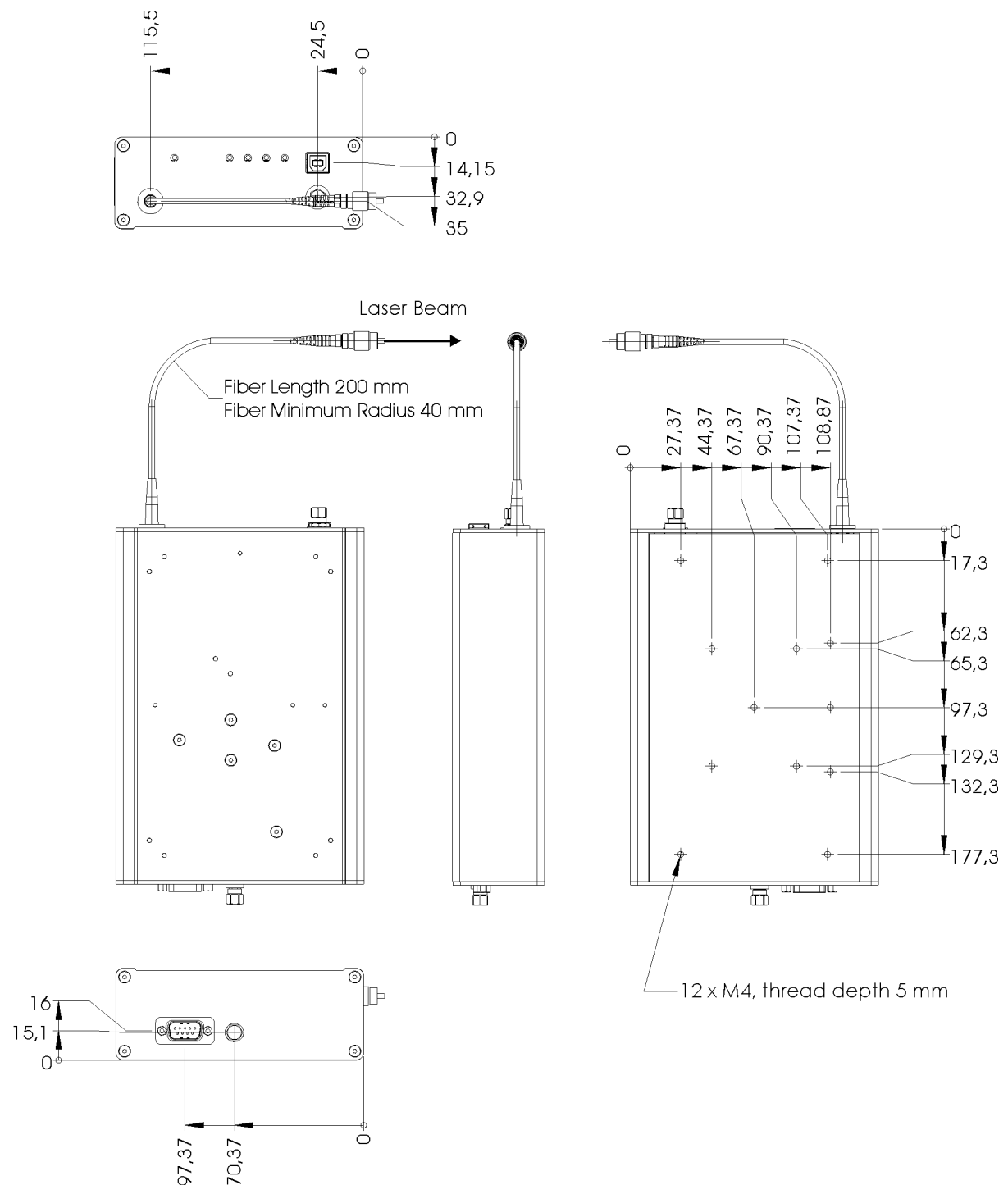


Figure 30 Main dimensions of the Femto/PicoFYb with fiber pigtail

6.11 License and Copyright Information associated with Third Party Software

This product incorporates certain third party software. The license and copyright information associated with this software is available in the folder Software License and Copyright Information on the supplied USB flash drive.

Please address your request to TOPTICA Photonics AG, Head of Development, Lochhamer Schlag 19, 82166 Graefelfing, Germany. This offer is valid during a 3-years-period beginning at the purchase date.

6.12 EU Legislation for Electrical and Electronic Equipment (EEE)

Companies selling electrical and electronic goods in the European Union must conform to the EU legislation for electrical and electronic equipment (EEE), which includes the Waste Electrical and Electronic Equipment Directive (WEEE). Assigned duties affect product design of the equipment, disposal of used appliances as well as organizational responsibilities, i.e. product registration.

There are different requirements for household WEEE and that which is sold business to business (B2B). All equipment TOPTICA Photonics AG handles is classed as B2B. TOPTICA is registered at the Competent Authority (Stiftung Elektro-Altgeräte Register EAR) under No. DE70442884.

At end-of life return your product back to TOPTICA. TOPTICA will dispose used equipment in such a manner as to meet all relevant local, country and EU requirements and guideline.

To return products please mark them clearly with "intended for disposal". Contact TOPTICA prior to shipping and send them to the following address:

TOPTICA Photonics AG
Lochhamer Schlag 19

D-82166 Graefelfing

7 Guarantee and Service

On the following page you will find the **Guarantee Registration Form** in which the warranty conditions are defined. Please complete in the Guarantee Registration Form immediately after you receive your device and return it to TOPTICA Photonics AG by mail or fax.

As a first step towards obtaining technical support, please contact your local distributor or visit the support pages on our web site: <http://www.toptica.com/support/>.

In case you wish to return a product for diagnosis and/or repair, please contact us prior to sending it so we can issue a **Return Material Authorization** (RMA) number for you.

You can contact us in the following ways:

- Internet: service.toptica.com. In our support section you can find a list of frequently asked questions and a service contact form.
- Email: service@toptica.com
- Phone: +49-89-85837-150

Our customers in the USA and Canada may contact TOPTICA Photonics Inc.:

- Phone: +1-585-657-6663

Our customers in Japan may contact TOPTICA Photonics K.K.:

- Phone: +81-42-306-9906

Guarantee Registration Form



QM form: F-015	Status of form: 13.10.2015	Version of form: 02	Page: 1 of 1
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return to

sender:

TOPTICA Photonics AG
Customer Service
Lochhamer Schlag 19
D- 82166 Graefelfing/Munich
Germany

FAX: +49 89 85837-200

Guarantee Conditions

The products of TOPTICA Photonics AG are produced with the greatest possible care using high-quality components and are checked in detail before being delivered. Therefore, as the manufacturer, TOPTICA Photonics AG gives a guarantee of durability according to the following terms:

- TOPTICA Photonics AG guarantees the buyer that there will be no defects in the product based on defective material or processing, for a period of 12 months from first delivery (guarantee period).** Natural wear and tear as well as defects resulting from improper use or use contrary to the specifications, from failure to observe operating instructions, from insufficient maintenance and care or from modifications, interventions or attempted repairs that are neither carried out nor authorized by TOPTICA Photonics AG, are not covered by the guarantee.
- Unless expressly stated in the order acknowledgement or the invoice semiconductor light emitting devices like laser diodes, tapered amplifier chips, Terahertz transmitters and receivers etc. whether sold as single parts or integrated in systems are not covered by the guarantee.**
- If a defect covered by the guarantee arises during the guarantee period, TOPTICA Photonics AG shall rectify such defect within a reasonable period at its own discretion by repairing or replacing the product or the defective part.
- The guarantee period shall commence upon delivery of the product by TOPTICA Photonics AG or by a third party that obtained the product directly from TOPTICA Photonics AG for the purpose of selling it to the buyer. The claim under the guarantee shall be excluded if the defect is not notified to TOPTICA Photonics AG in writing immediately after having been discovered, and no later than one month after expiry of the guarantee period. For the purpose of rectifying a defect covered by the guarantee, the product or the relevant part shall be sent to TOPTICA Photonics AG at the expense and risk of the buyer. The product shall be returned at the expense and risk of TOPTICA Photonics AG.
- No claims may be derived from this guarantee other than claims for rectification of the defects falling within the scope hereof, in accordance with the present terms. In particular, the buyer is not entitled under this guarantee to claim damages or a reduction in price from TOPTICA Photonics AG, or to rescind the contract. Potential, more far-reaching claims of the buyer against its seller shall not be affected by this guarantee.
- Important!: The obligation of TOPTICA Photonics AG under this guarantee is subject to the condition that the buyer gives his/her express consent to them by sending the signed duplicate of this form to TOPTICA Photonics AG immediately after delivery, also truthfully indicating the model number, the serial number and the date on which the product was delivered.**
- The buyer may not assign claims under this guarantee to third parties without the prior written consent of TOPTICA Photonics AG.
- This guarantee is governed by substantive German law to the exclusion of the provisions of the UN-Convention on Contracts for the International Sale of Goods (CISG). The Regional Court [Landgericht] Munich I shall be the court of exclusive international, local and subject-matter jurisdiction for legal disputes arising under or in connection with this guarantee.

I request the above mentioned guarantee for the purchased products and herewith consent to the above mentioned Guarantee Conditions:

Model No.: _____ Date: _____

Serial No.: _____ Signature: _____

Date of Delivery: _____ Name/Title: _____

To be completed by the buyer and returned to TOPTICA Photonics AG by mail or fax (+49 - 89 - 85837 - 200).