

LIGHT. PRECISION. ANALYTICS.



Nitrogen Laser MNL 100 / MNL X00

Operating Manual

LTB Lasertechnik Berlin GmbH
Am Studio 2c, 12489 Berlin, Germany
Phone: +49 30 912075-100
Fax: +49 30 912075-199
info@ltb-berlin.de
www.ltb-berlin.de

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Dear customers

With the purchase of an OEM laser from the MNL 100 / MNL X00 series, you have selected a state-of-the-art Nitrogen Laser.

This laser satisfies the sophisticated needs and demanding goals of various applications within the industry. The following properties reveal the advantages of the MNL 100 / MNL X00.

- High pulse power
- Minimal beam divergence
- Minimal time jitter
- Pulse halfwidths in the sub- and nanosecond range
- Long lifetime
- Low operating costs

These properties make this laser attractive for applications where high quality, stable output and cost-effectiveness are required.

The MNL is mainly used in

- MALDI-TOF-Mass spectroscopy
- Laser-induced fluorescence spectroscopy
- Time-resolved spectroscopy
- laser-induced plasma spectroscopy
- Laser ablation
- Micro-structuring
- Cell dissection under the microscope
- Laser acoustics
- Calibration of fast sensors
- Pump source of dye lasers
- Amplification of ultra-short laser pulses
- Technological processes like laser-induced bonding, hardening and cleaning
- Special applications in the environment and biotechnology

The laser operates on the principle of transversal excitation. The energy is stored in a capacitor arrangement at about 12 kV. A fast high-current discharge is triggered by means of a solid-state high-voltage switch, thus generating laser radiation. All laser functions are controlled and monitored by an internal laser controller.

Your laser has been carefully tested for all operating states with LTB's end test program, and has left the factory in optimal condition.

LTB wishes you much success in working with the laser on your projects. If this operation manual does not answer all your questions, please do not hesitate to contact us.

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1 About this Operating Manual



For safe and proper use of the product, read this manual carefully before use and act accordingly. Keep this manual for future reference. This document is available as print media / pdf on request.

1.1 Contact manufacturer, Imprint, Copyright

Manufacturer	LTB Lasertechnik Berlin GmbH Am Studio 2c 12489 Berlin Germany Phone: +49 30 912075-100 Fax: +49 30 912075-199 info@ltb-berlin.de www.ltb-berlin.de
Imprint	LTB Lasertechnik Berlin GmbH Am Studio 2c 12489 Berlin Germany
Copyright	© LTB Lasertechnik Berlin GmbH, 2021, All rights reserved.

2 Safety precautions

Please note: the laser source is an OEM device which is used for integration only.

MNL Lasers are 3B class lasers (IEC 60825-1)

Improper treatment and operation of the laser can cause damage to your health.

Please follow carefully all the instructions in this manual.

The safety and information labels and their position are shown in the appendix (see chapters 9.13 and 9.14).

2.1 Invisible laser radiation

The laser emits intensive invisible laser radiation in the UV range.

Do not look into the laser beam!

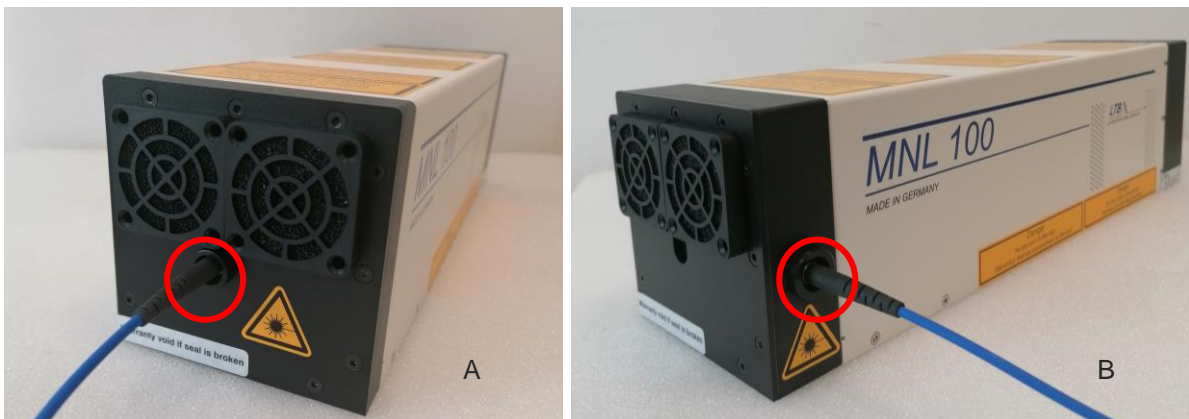


Figure 1: Positions of the laser beam output (here with optical fiber attached)

Depending on your configuration the laser beam output is located at position A or B (see Figure 1 above) or – for lasers with optical fiber – at the end of the fiber. The aperture label 4.2 (see chapter 9.13) warns of laser radiation emission.

Please always wear laser safety goggles appropriate to the wavelength of 337 nm and ensure that all persons in the vicinity of the laser also wear laser goggles during laser operation.

For MNL lasers, you need **class L6 laser goggles**.

Always close the beam shutter when the laser is not in operation.

Please observe that there are no reflecting materials in the beam path by which the laser beam could unintentionally be directed towards persons or sensitive materials.

Always use beam shutters made of non-inflammable materials in your set-up.

Always follow the safety regulations.

The laser safety parameters according to IEC 60825-1 depending on the configuration of the laser:

Model	MNL103PD / MNL106PD, MNLX03PD / MNLX06PD without optical fibre	MNL103LD / MNL106LD, MNLX03LD / MNLX06LD without optical fibre	MNL103PD / MNL106PD MNLX03PD / MNLX06PD with optical fibre attached
Ocular MPE*	1 J / cm ²	1 J / cm ²	1 J / cm ²
NOHD*	300 meter	2000 meter	1.2 meter**

* Specifications for the exposure time of 30000 seconds.

** Usually the customer connects a follow-up optic, which can lead to much higher energy densities and thus to higher NOHD.

2.2 High voltage up to 12 kV

A high voltage of up to 12 kV is generated in the laser. Perilously high energy amounts are also accumulated in the capacitors of the laser. Therefore, observe the protected earth connection of the mains. The earth conductor connection from the laser housing to the input of the LTB power supply of the laser is ensured.

Do not open the laser due to occurring dangerous high voltages in the interior of the laser!

Because of high voltage circuits, the laser should never be opened nor should any objects be put into the laser casing openings.

2.3 Dangerous gases

The high-energetic UV radiation causes ozone. No noxious gases are used in the laser. The cartridge has a pressure-safe sealing.

Please observe that the laser operating room is sufficiently ventilated.

2.4 Liability, Replacement parts

Any modification of the laser, replacement of components or adjustment of the laser must be done by authorized service staff.

Only components tested by LTB must be used.

Any liability and warranty lapses with the opening of the laser or any modifications without LTB's explicit written consent.

3 System requirements

3.1 Place and way of installation



Figure 2: MNL laser

The laser is intended for indoor use. The laser must be operated and stored in a dry, dust-poor and well-ventilated area.

Operation temperature	°C	+15...+38
Storage temperature	°C	-10...+60
Max. rel. humidity	%	85
Pollution degree	-	2
Air pressure	mbar	750...1300
Altitude	meters above sea level	-428...2000

Please make sure that the laser is not placed near any heat sources.

Moreover please observe that the air inlet is on the side of the beam output of the laser and must not be blocked. We recommend replacing the air inlet filters of the laser every 6 to 18 months depending on the dust concentration of the cooling air (see also 9.3 Inspection and maintenance, page 39).

The air outlet openings on both sides of the laser cover must be kept clear of any obstructions.

Mounting the laser may be realized via the base plate with the red-marked threaded holes. (See 9.9 Dimensions and interfaces, page 46)

The laser may either be used in a standing position, or hanging with the beam output downwards. Other positions can be checked on request.

3.2 Electric requirements

The laser is supplied with a low voltage of 24 V DC, 2.4 A. A power supply unit providing the low voltage from the mains is part of the delivery as standard.

The mains connection values are: 100 to 240 V, 47/63 Hz, 1.1 A (see type label).

Connect the laser power supply unit only to a mains that corresponds to the values stated on the type.

The laser power supply unit has an earthed conductor connection that is connected to the laser housing via the connection cable. The low voltage is off-earth, the minus line is connected to the frame ground.

The laser power supply fulfills the requirements of the standard, 61000-6-3, 61000-6-2, 61000-3-2 and 61000-3-3 regarding mains supply voltage fluctuations, interruptions and voltage dips for industrial environment.

Using another power supply requires the written consent of LTB Lasertechnik Berlin.

Please observe: only a mains that provides an earthed conductor is to be used.

The cross section area should be at least 0.75 mm² respectively AWG 18, voltage rating 300 V.

Unless otherwise specified (OEM contracts), a suitable power cord is included.

US / Canadian customers: Power cord (if being used) has to be UL / CSA compliant.

3.3 Fuses

The laser is equipped with resettable fuses. Their replacement is not necessary in case of an error.

3.4 Laser control, computer

Using a RS 232 interface connected to a PC or Notebook, the laser can be operated with all functions and settings. The last settings are stored when the laser is switched off, and are provided again as basic settings when the laser is switched on again.

The laser comes with an optic-electronic interface converter for the connection between laser and PC.

PC requirements: No special requirements.

For integrating the MNL 100 / MNL X00 in a system control, the interfaces of the MNL 100 / MNL X00 are described in detail in the Interface Manual.

Alternatively to the operation via the optical PC interface, the lasers of the MNL 100 / MNL X00 series can be operated without computer (see 7 OEM – Applications).

4 Installation

- 1 - Device cord
- 2 - Power On LED (1 x green)
- 3 - Laser emission indicator LEDs (2 x red)
- 4 - Remote socket
- 5 - External trigger input, optical (HP OWG)
- 6 - RS 232 interface (optical, HP OWG, TX-grey, RX-blue)
- 7 - Sync Out (SMB) (optional)

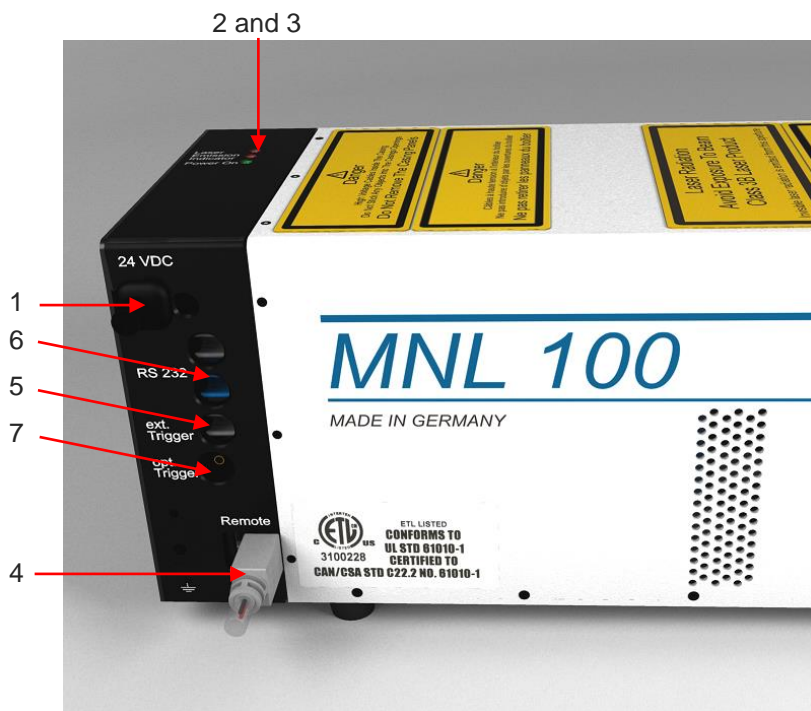


Figure 3: Connections of the MNL laser

4.1 Acclimatizing the laser

We recommend that the laser is acclimatized to its operating environment for one hour before it is switched on, especially if it was recently exposed to ambient temperatures outside the operating range.

4.2 Installing the connection between laser and computer

A Duplex-OWG (optical wave guide) is used to establish the connection between the laser and a computer or notebook.

The interface in the laser has already been integrated. Plug in and fix the interface adapter onto a free 9-pin serial port of your computer.

If you have only USB interfaces at your disposal, you will need an adapter USB-RS 232 (optionally available).

Turn on your PC. The transmitter line (blue connector) of the duplex cable must emit red light. Put the OWG connectors – blue below, grey above – in the sockets of the optical interface RS 232 at the laser. The PC and laser are now connected.



Figure 4: Duplex-OWG



Figure 5: USB-RS 232 adapter

4.3 Installation of the user program MarathonControl

1. The laser is operated and monitored via its serial interface. The program MarathonControl allows the convenient operation via PC or Laptop.

Download the “MarathonControl” software from the website <http://www.ltb-berlin.de/en/company/downloads/>

2. Unzip the zip file and execute the file **install.exe**.
3. The laser control software installation proceeds automatically.

4.4 Remote key and remote socket

The remote socket (see page 10, [4]) is provided for:

- Closing the external remote circuit with the remote key
- Integrating external applications in the remote circuit of the laser

The remote key prevents unauthorized use and provides additional safety during laser operation.

Always remove the remote key after switching off the laser and store it in a safe location.



Figure 6: Remote key

With an open remote circuit, the laser cannot be operated!

4.4.1 The external remote circuit

The external remote circuit is closed when the remote key is plugged into the remote socket (Mini-USB) of the laser.

4.4.2 Connecting external applications

For additional protection against laser radiation, the position switch of the laser beam guidance and the sample chambers of a laser application can be incorporated into the external remote circuit.

Thereby opening the beam guidance or sample chamber will automatically switch off the laser.

The necessary cables can be obtained from LTB.

5 Operating the laser

5.1 Preparing for operation

Connect the power supply unit with the mains via the device cord.

Connect the Mate-N-Lok connector to the laser.

The Power On LED (green) of the laser should start blinking. (please see 9.1 LED Codes)



Figure 7: Connecting the mains

5.1.1 Remote key

Plug the remote key or remote adapter in the remote socket of the laser. The green Power ON LED on the top of the laser should remain on.

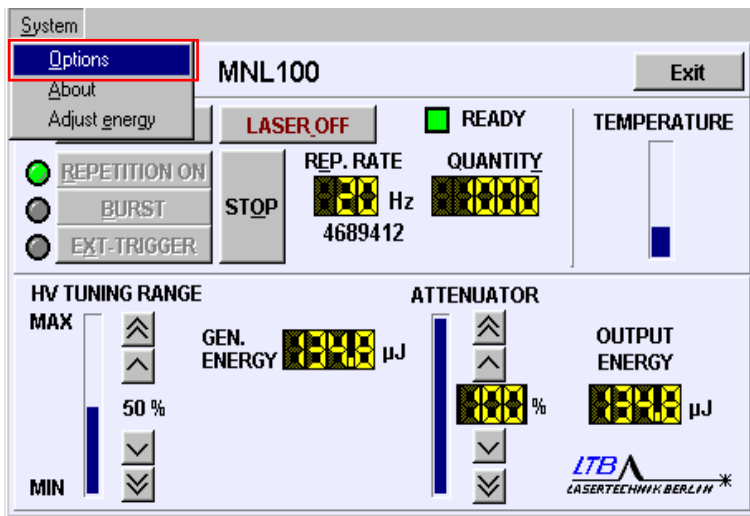
5.1.2 Connection establishment

Start the MarathonControl program.

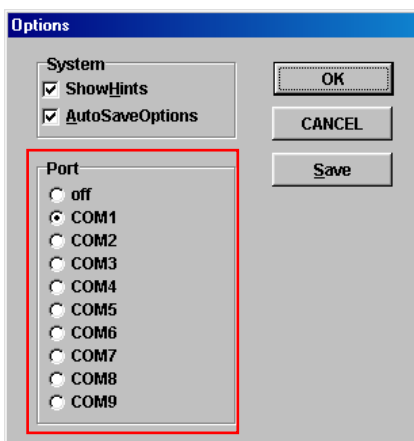
The laser controller automatically switches into ONLINE mode. Laser-computer-communication is electronically monitored. The laser and computer are properly connected if the blue and the green triangles in the MarathonControl user interface flash alternately.



If, however, NO CONNECTION flashes, the COM-port must be changed in the user interface.



Click **System** in the drop down menu and then go to **Options** or click directly on **COM**.



Choose the appropriate port (COM 1...9).

5.2 Starting laser operation

You can set all alterable parameters via a mouse click on the user interface or by using the respective underlined letters in the menu bar.

After the warm-up period is completed, you can begin laser operation.

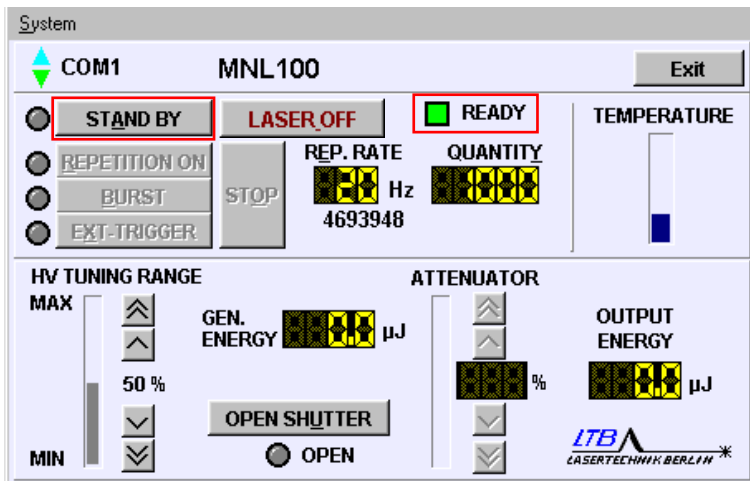
5.2.1 Enabling operation

By clicking the button



(or "A" on the keyboard)

you enable operation.



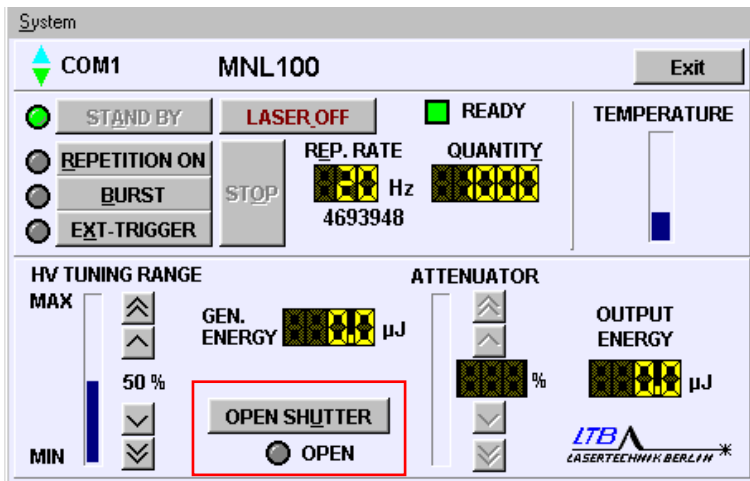
5.2.2 Beam Shutter

The laser is equipped with a motor-driven beam shutter which is activated via the laser interface.

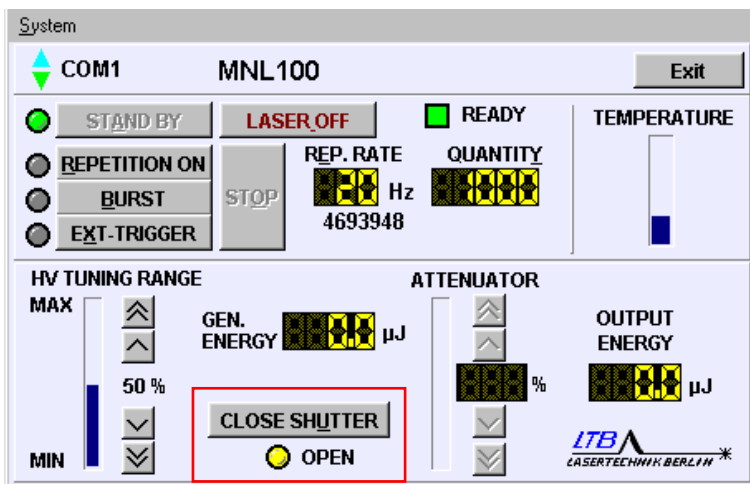
By default, the beam shutter is closed.

It can be opened by a software command and is automatically closed again if laser operation is interrupted.

When the laser is in the STAND BY mode, the shutter can be opened with the button **OPEN SHUTTER**.



When the shutter is open, the button changes to **CLOSE SHUTTER** and the display OPEN under the button gleams yellow.



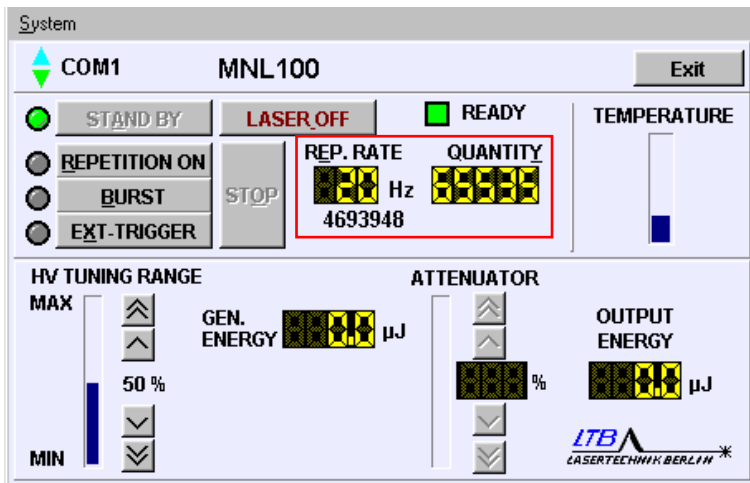
5.2.3 Set the repetition rate and the number of pulses

In the field **REP.RATE**

you see the current pulse repetition rate.

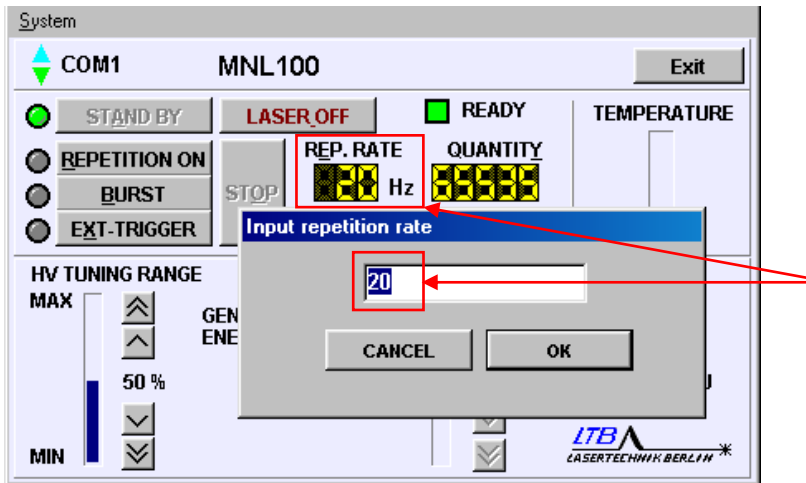
In the field **QUANTITY**

you see the current pulse number (refers to *Burst* mode only).



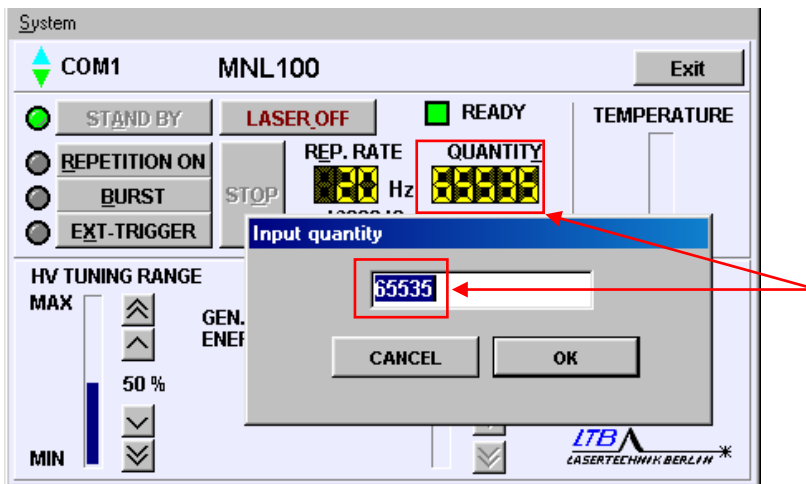
To change value of the repetition rate or pulse quantity, click the respective display:

The input window **INPUT REPETITION RATE** appears



OR

INPUT QUANTITY

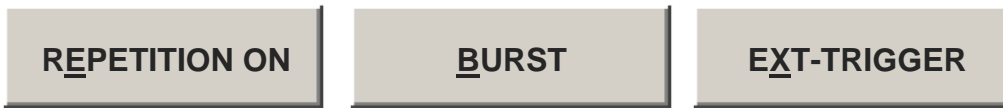


Key in your required values (in integers up to 65535) and confirm them.

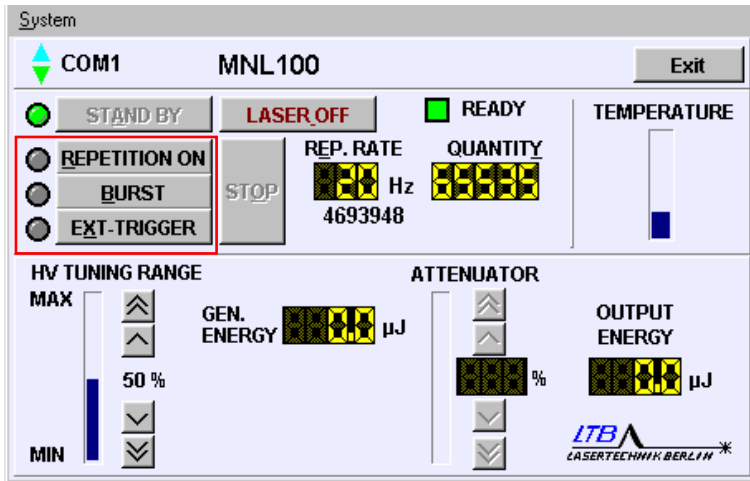
You can also call the input windows by entering "E" (for repetition rate) or "Y" (for quantity) on the keyboard.

5.2.4 Choosing your operation mode

Approximately ten seconds after you press the STAND BY button, the following buttons become active:



Here, you can choose the required operation mode.



After pushing one of these buttons, the high voltage is automatically switched on and the laser starts in the selected mode.

This can also be done by entering the respective underlined letter ("R", "B", "X") via the keyboard.

Please observe!

In EXT-TRIGGER mode the optical trigger input of the laser is active, and incident stray light can cause malfunctioning if no trigger cable is connected.

5.2.4.1 REPETITION ON

The laser runs continuously with the repetition rate between 1 and 60 Hz (depending on the laser type, internally limited) as set by you.

The required repetition rate can be modified while the laser is running.

5.2.4.2 BURST

In addition to the frequency, you can also choose the pulse quantity in this mode. Starting with the total number, the laser counts down the pulses to zero.

5.2.4.3 EXT TRIGGER

In EXT-TRIGGER mode the laser must be provided with an external optical trigger signal.

The respective input socket (Page 10; [5]) is positioned directly below the interface input. The trigger converter cable (electric – optic) converts electrical pulses into the corresponding trigger pulses (the cable is included in the utility bag)

If you use the trigger converter cable, please observe the following requirements:

Amplitude: 5 Volt (TTL, without OFFSET)
Driver current: ≥ 10 mA
Pulse width: 2-60 μ s

If you use your own optical trigger source, please observe:

The laser is equipped with a HP OWG receiver system for \varnothing 1 mm POF fibers and requires the following specifications:

- Pulse width of the light impulse 2-60 μ s
- Light power ≥ 100 μ W @ 660 nm

The maximum possible repetition rate of the laser is internally limited.

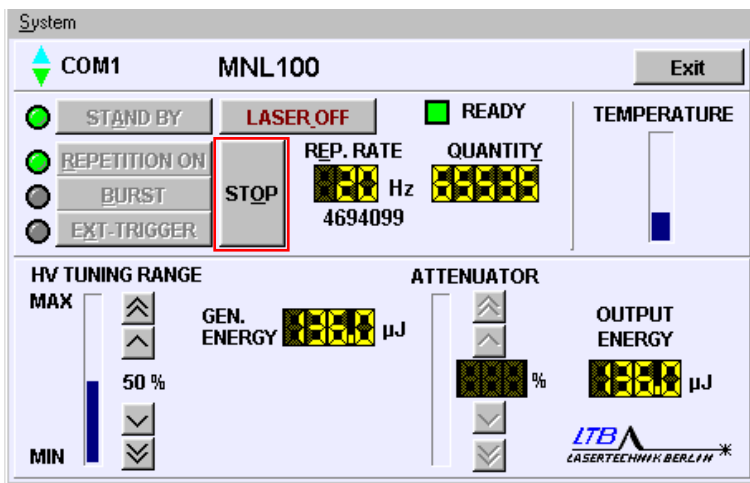
5.3 Switching off the laser

5.3.1 Stopping laser operation

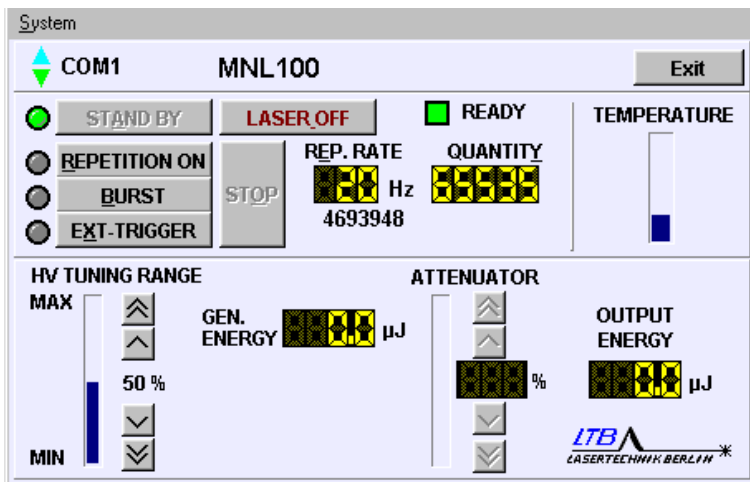
For a pause in operation, you can put it in the STAND BY mode by pushing the button



(or "O" on the keyboard).



Laser operation will be switched off but the laser remains in STAND BY mode. From this mode the laser operation can be reactivated at any time.

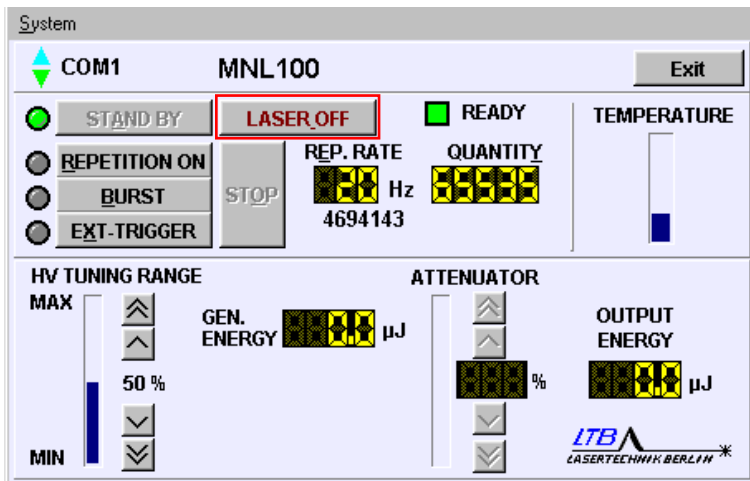


5.3.2 Switching off the laser

If you want to switch off the laser completely, press the button



(or the space key.)

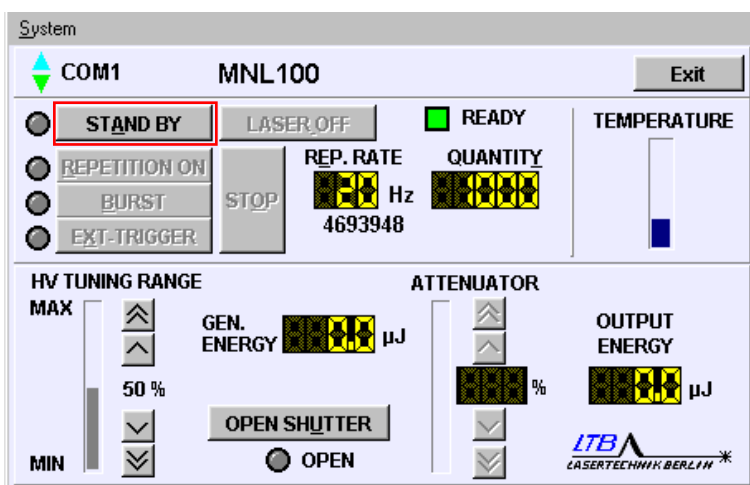


Now the laser is switched off.

If you wish to start the laser operation again set the laser in the ready-to-operate state again by pressing the button



The delay time between LASER OFF and STAND BY is approx. 10 s.



5.3.3 Break time automatic

The laser has two independent break timers (BT1 and BT2). After a pre-set time between 30 and 9999 seconds, the laser is switched back to STAND BY (BT1) and LASER OFF (BT2) mode, if no internal or external trigger signal is registered.

These reactions correspond to activating the STOP or LASER OFF button.

By pressing the respective button the laser will be set to the required operation mode again.

As standard the two timers are set as follows:

After a 5 minutes interval, the laser automatically switches to STAND BY mode. After another two hours, it switches to LASER OFF mode.

5.3.4 Closing the beam shutter

With the command LASER OFF, the beam path closes automatically, regardless of the chosen mode of operation.

5.3.5 Protecting the laser

If you remove the remote key from the remote connection after switching off the laser, the laser cannot be switched on again without the key.

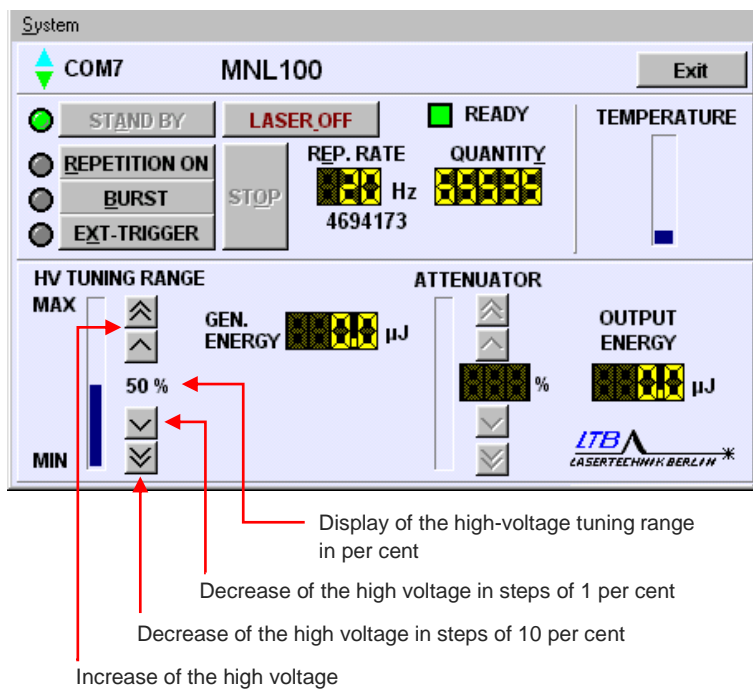
6 Optional Features

6.1 High voltage control

You can change the energy output by varying the high voltage within a range from 80-100 %.

The adjustment can be carried out through both the MarathonControl software panel and the interface.

In the MarathonControl window, you can change the high voltage in steps of one or ten percent (referring to the adjustment range) by clicking either the up or down pointing arrows.



6.2 Energy measurement

Optionally, the laser can be equipped with an energy monitor. By means of this monitor, the energy output can be displayed on your user interface. The energy measuring values are provided as 8-bit values at the laser interface.

The energy monitor is adjusted in the factory and should be checked after a maximum of one year and recalibrated if necessary. For this purpose, you need a calibrated energy measuring device for the wavelength 337.1 nm (e. g. the PEM of LTB).

6.2.1 Calibration of the energy monitor

Opens the adjust energy window

Available energy of the laser cartridge depending on the HV setting

Calculated energy value (after all optional features)

The calibration should be carried out at typical operating state temperature of the laser and at the frequency the laser is normally used.

First, click the **100% HV** button. The measured energy value is entered in the window and confirmed with the **CAL** button. Afterwards click the **0% HV** button, and enter currently measured value. Confirm with the **CAL** button as well.

Enter measured energy value

Confirm each value

Measurement at 0% and 100%

6.3 Attenuator module (in connection with energy monitor)

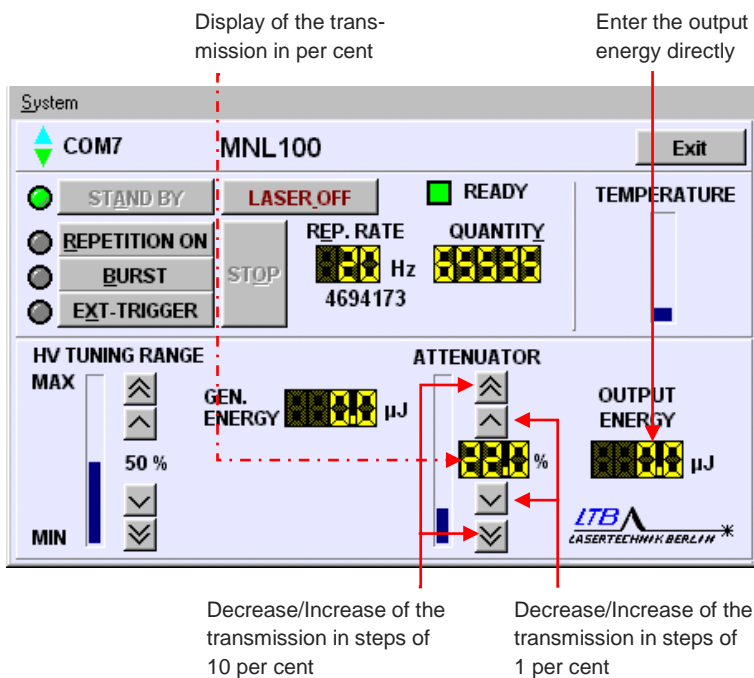
Via the attenuator module, the laser output energy can be adjusted continuously in a large range.

The attenuation is realized before the beam output and the coupling into a fiber. The adjustment can be carried out through both the MarathonControl software panel and the interface.

The transmission of the attenuator can be set with 1% resolution (via the arrow buttons), or the output energy can be entered directly with 0.5 μJ resolution via double click in the display field OUTPUT ENERGY.

When using the laser interface, the position of the attenuator can additionally be parameterized, so even better resolutions can be achieved. A special firmware module realizes the linearization and short response times.

With the energy monitor, you can directly enter the required output energy value. After switching on the supply voltage, the zero point of the filter is always determined and the transmission curve is provided from the laser controller memory.



Please observe:

Even when the attenuator is completely opened, it causes a transmission loss of 10% of the laser energy.

The integration of attenuator **and** beam shutter is not possible. As a protection against laser radiation, the attenuator is set to the range of lowest transmission by the firmware when the laser is switched on. The user has to sign an OEM agreement, since a residual risk exists. The regulations of IEC 60825-1(laser safety) are to be observed.

6.4 Fiber coupling

The generated laser light is coupled into a quartz fiber behind the shutter or attenuator. The fiber diameter is 200, 600 or 1000 μm . The numerical aperture NA is 0.22.

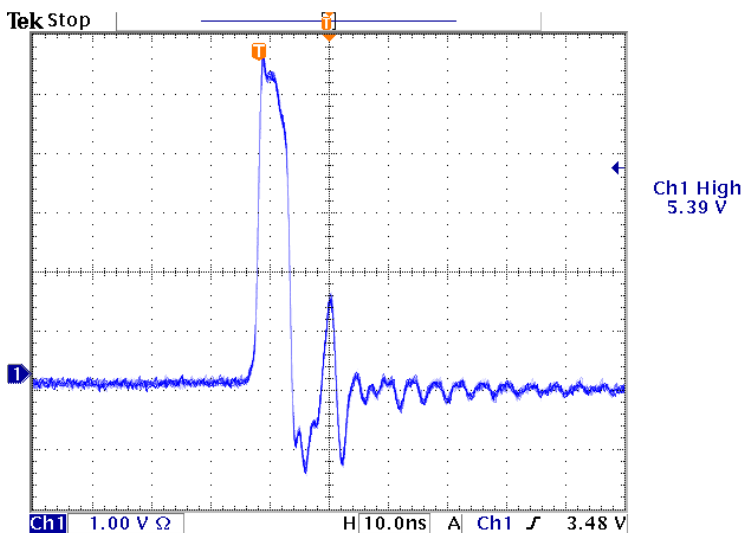
Fibers with a diameter smaller than 600 μm are non-detachable and can therefore not be replaced by the user.

The transmission of the fiber coupling is 70% (200 μm) and approx. 90% (1000 μm).

6.5 Optical trigger with electrical output

The current rise of the solid-state switch is analyzed and converted into an electrical trigger signal (SMB output).

Amplitude: 5.0...6.5 Volt (50 Ohm)
Delay: approx. 3.5 ns before the laser pulse
Jitter: < 0.2 ns (related to the laser pulse)
Rise time: < 800 ps
(incl. adapter cable SMB to BNC)



7 OEM – Applications

7.1 AUTOMODE operation

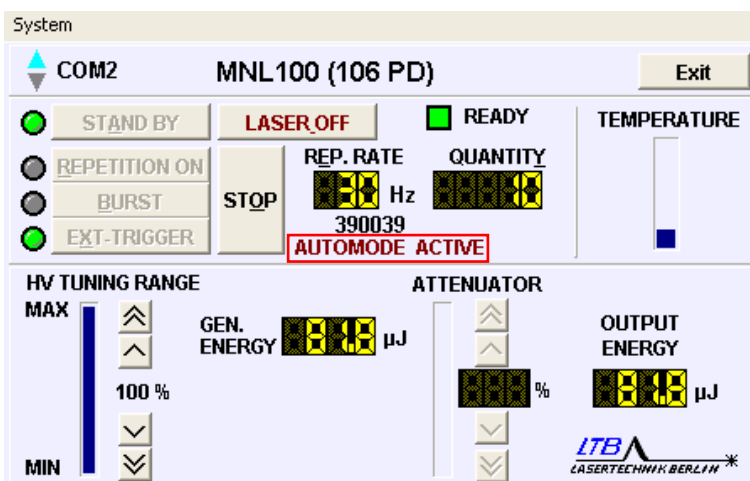
As an alternative to operation via the optical PC interface, the MNL 100 / MNL X00 series can be operated without a computer. In this case, the laser runs in the AUTOMODE using stored settings.

Since the beam shutter does not fulfill the safety requirements of system redundancy, the customer must sign an OEM agreement. The user has a higher responsibility for the compliance with laser safety when using the AUTOMODE. The regulations of the IEC 60825-1 (laser safety) are to be observed.

The decision to operate the laser in the AUTOMODE must be made before dispatch. The settings can only be made at the factory.

Laser monitoring is also possible via the interface in this mode. *Automode* is indicated in the MarathonControl window. Only the shut-down functions (STOP und LASER OFF) are enabled.

If the shut-down functions are used during the Automode operation, the laser goes into a safe state. Only after a reset (separation from the mains for min. 30 s), can the laser be activated via a trigger signal again.



The two versions of AUTOMODE

7.1.1 AutoStandBy

After applying the operation voltage, the laser is in the **StandBy** mode.

The first external trigger pulse activates the **ext. trigger** mode after 8 milliseconds. All further trigger pulses generate laser pulses. Breaks between trigger signals longer than the time set in the break timer BT1 make the laser switch back to **StandBy**. BT2 is inactive.

7.1.2 TrgStandBy

After applying the operation voltage, the laser is in the **LaserOff** mode.

The first external trigger pulse activates the **StandBy** mode after 10 s. The second external trigger pulse activates the **ext. trigger** mode after 8 milliseconds. All further trigger pulses generate laser pulses. Breaks between trigger signals longer than the time set in the breaktimers BT1 and BT2 make the laser switch back to **LaserOff**.

The settings of the breaktimers should be set in a way that a switching back during operational intervals of measuring processes is prevented.

Description of the operation modes of the laser in AUTOMODE

If your measuring process requires longer intervals between measurements, we recommend TrgStandBy mode, since the running time of the laser ventilation has a major impact on the maintenance cycles (internal contamination).

sleeping mode operation voltage is on
(LaserOff) ventilation is off
high voltage is off

standby mode preionisation of laser channel is running
(StandBy) ventilation is on
high voltage is off

operation mode preionisation of laser channel is running
(Ext.Trigger) ventilation is on
high voltage is off
every trigger pulse generates a laser pulse

from	to	AutoStandby	TriggerStandby	delay
sleeping mode	standby mode	after switching on (operation voltage)	first trigger pulse	always 10 s
standby mode	sleeping mode	Hardware switch-off (safety key)	break timer BT2	no
standby mode	operation mode	first trigger pulse (next pulse triggers laser pulse)	first trigger pulse (next pulse triggers laser pulse)	no
operation mode	standby mode	after lapse of break timer BT1	after lapse of break timer BT1	no
sleeping mode	operation mode	impossible	impossible	-
operation mode	sleeping mode	Hardware switch-off (safety key) → only for emergency! Switching off the operation voltage → only for emergency!	Hardware switch-off (safety key) → only for emergency! Switching off the operation voltage → only for emergency!	no

The order **sleeping → standby → operation** is not changeable.

The shutdown of the laser should be done in the reversed order.

Quitting the operation mode by safety features (safety key etc.) or interrupting the operation voltage are emergency cutoffs and should be avoided.

7.2 Difference between AutoStandby and TriggerStandby

In **AutoStandby** operation the **standby mode** will be started directly after switching on the operation voltage and is active after 10 s switch-on delay. The laser remains in **standby mode** until switching off the operation voltage.

To activate the **operation mode** (high voltage ON) one trigger pulse is necessary. Each following trigger pulse will generate laser light. Breaks between the shots longer than BT1 will switch the laser back to **standby mode**.

Pro: only the first trigger pulse (of every burst) is necessary for starting, all the other pulses generate laser light

Con: preionisation of the laser cartridge is permanently running (stressing the laser gas)
ventilation is permanently running (increased contamination of the laser)

In **TriggerStandby** operation the **standby mode** will be activated by the first trigger pulse and will be reached after 10 s switch-on delay. The red laser warning LED's flash simultaneously in short intervals. If there are no following trigger pulses after reaching the **standby mode**, the laser remains in **standby mode** until the BT2 time is reached and switches back to sleeping mode then.

To activate the **operation mode** (high voltage ON), one trigger pulse is necessary. Each following trigger pulse will generate laser light. Breaks between the shots longer than BT1 will switch the laser back to **standby mode**.

Pro: preionisation and ventilation are only running if required

Con: trigger breaks longer than 60 s will switch off the **standby mode**
for returning to the **standby mode**, the 10 seconds switch-on delay when no laser light is generated must be considered

7.3 Description of the Break Timers BT1 und BT2

- automatic shutdown of the laser (to preserve the material)
- when using the laser in the AUTOMODE (without PC) only possibility to shut down the laser regularly
- also used in PC mode (laser controlling via interface), as additional safety function. Switching on and off is conducted via interface commands.

BT1 (AutoStandby and TriggerStandby mode)

- is active in operation mode
- can be preset from 30 to 60 s (PC mode up to 9999 s)
- monitors the time between the laser pulses and switches back to the standby mode when it is exceeded
- for return to operation mode, 1 Trigger pulse is necessary

BT2 (only for TriggerStandby operation)

- is active in the **standby mode**
- can be preset from 30 to 9999 s
- monitors the time between the laser is in the **standby mode** and switches back to the **sleeping mode** when it is exceeded
- for return to **standby mode** one trigger pulse is necessary (+ 10 s switch-on delay)

7.4 Description of the auto open and auto close functions

auto close

- When the laser is switched off (LASER_OFF), the shutter closes automatically, or the attenuator moves to the position of lowest transmission.
- Standard setting, can be disabled for OEM applications

auto open

- When the laser is switched into StandBy mode, the shutter opens automatically, or the attenuator moves to the position of the last set transmission value.
- only for OEM applications

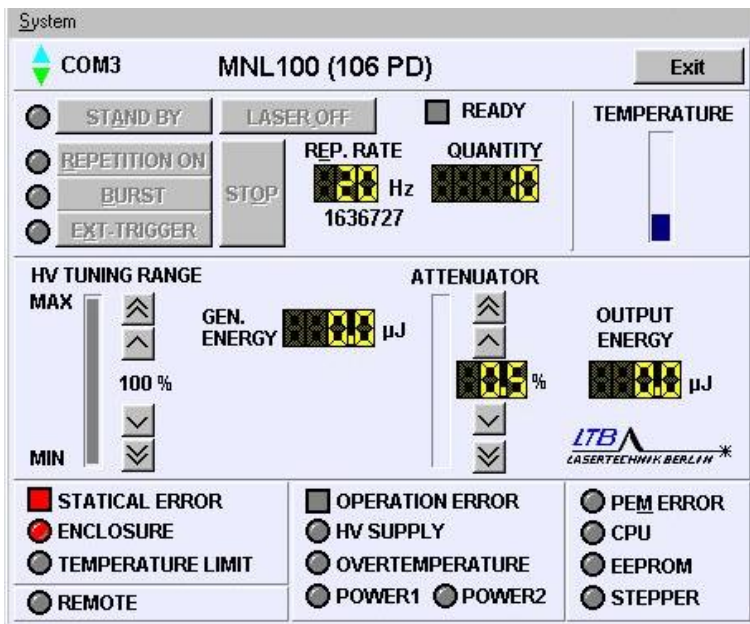
8 Safety functions

To ensure safe laser operation, a number of monitoring functions have been set up.

They comprise:

- External remote circuit (Remote)
- Supervision of the casing, protection against contact
- Temperature monitoring inside the laser (advance warning)
- Monitoring of the high-voltage circuit and HV generation
- Monitoring of the output energy

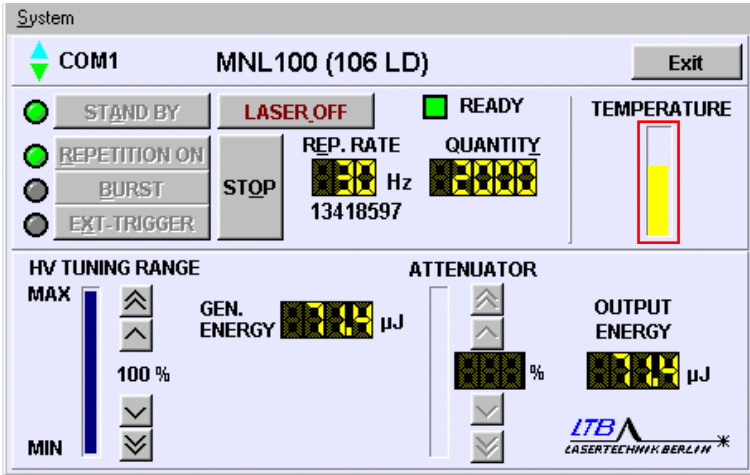
In case of an error, an additional window will appear on the MarathonControl user interface indicating the type and cause of the error. Errors are split into static errors and dynamic errors. With the exception of an EEPROM or PEM error, laser operation will cease.



8.1 Temperature monitoring

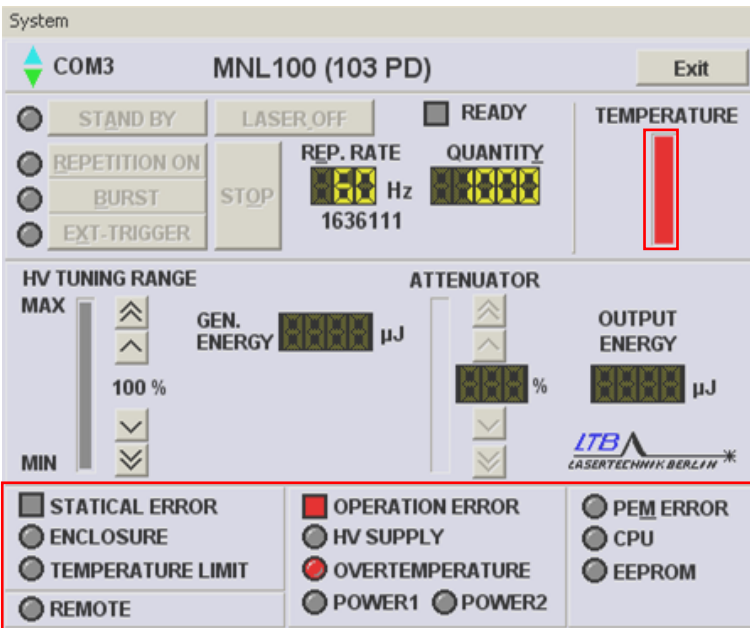
The temperature monitoring is depicted as a bar on the software control panel. If the internal laser temperature exceeds a limit value, the color of the bar will change to yellow.

The laser and the surrounding temperature need to be checked.



If the temperature continues to rise, the colour of the bar changes to red and the laser will stop operating.

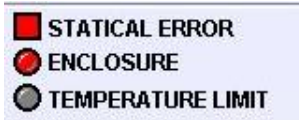
An additional window appears indicating the failure origin.



Window pops up in the case of an error

8.2 Error messages

8.2.1 Static errors



Indication "**No Connection**"

- The Laser-PC connection is unstable or interrupted
- (erratically blinking triangles)
- 30 seconds after missing or interrupted communication, the laser switches off automatically (Polling).
- USB-adapter usage in Windows XP (+higher): If the user logs out or the USB connection to the PC is cut, the used USB-port is disconnected from the PC as well and needs possibly to be set again via System\Options in the MarathonControl user interface after a new log-in.

Indication "**ENCLOSURE**"

- The laser casing is still open or the parts are not properly fastened.

Indication "**TEMPERATURE LIMIT**"

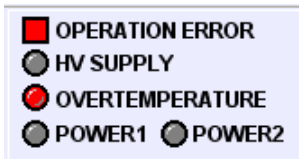
- Laser temperature is too high.

The laser remains in the stand-by mode and can be switched on immediately after removing the cause of the error.

Static errors are indicated by slow flashing green LED at the laser.

PC-connection errors are not indicated by the laser.

8.2.2 Dynamic errors (operation errors)



Dynamic errors indicate that the tolerance level of the monitored operating limits or components has been exceeded.

Indication "HV SUPPLY"

- The high voltage in the excitation circuit is too high or the recharging of the storage capacitors is taking too long).

Indication "OVERTEMPERATURE"

- The temperature in the laser head is too high

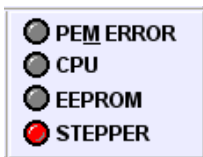
Indication "POWER1"

- Internal voltage monitoring

Indication "POWER2"

- Recurrent voltage drops below the operation voltage of 24 V (error in the external power supply)

8.2.3 Other messages



EEPROM, STEPPER, CPU and PEM errors are not signalled by indicator light at the laser.

Indication "PEM ERROR"

- Measuring error of the energy monitor

Indication "CPU"

- Firmware program error

Indication "EEPROM"

- Check sum or storage error (EEPROM)

Indication "STEPPER"

- Zero point determination of the attenuator failed

Indication "REMOTE"

- The external remote circuit is not closed

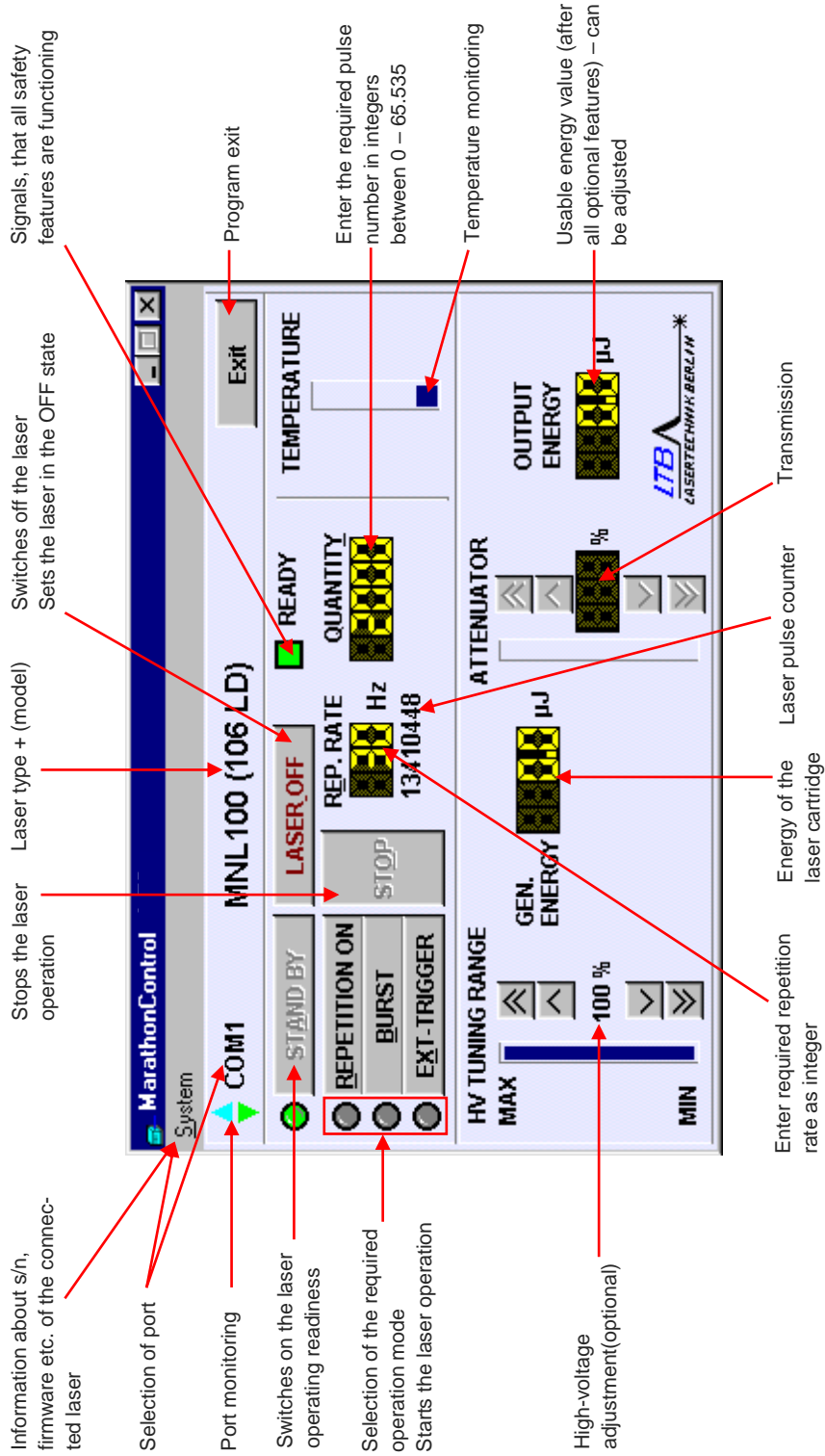
9 Appendix

9.1 LED Codes



	<p>Power on Laser OFF</p>
	<p>Power on statical error is displayed</p>
	<p>Power on operation error is displayed</p>
	<p>Power on Laser in AUTOMODE "TrgExtTrg" waits for a trigger für Stand By</p>
	<p>Power on Laser in Stand By (STOP) HV is OFF</p>
	<p>Power on OPERATION MODE HV is ON</p>

9.2 User interface of Marathon Control



9.3 Inspection and maintenance

The laser should be sent for inspection and cleaning to LTB Lasertechnik Berlin GmbH:

- MNL 100: after a runtime of 2 years or 60 million pulses
- MNL X00: after a runtime of 4 years or 400 million pulses

Depending on the dust concentration in the cooling air, the air inlet filters of the laser have to be replaced every 6 to 18 months (The filter mat dirties. The laser may indicate the error OVERTEMPERATURE).

1. Remove the covers



Figure 8: Remove covers

2. Replace the filter mats (Replacement fan filters can be obtained from LTB – component-number 3510751).



Figure 9: Replace filter mats

3. Affix and snap in the covers



Figure 10: Affix covers

9.4 Optional components

The following components and devices are optionally available with the MNL 100 / MNL X00:

- **Trigger converter cable**
[electrical (BNC female)/ optical (HP)]
Amplitude: 5 Volt (TTL, without OFFSET)
Driver current: ≥ 10 mA
Pulse width: 2 – 60 μ s
Low risetime in case of high jitter requirements
- **Energy meter μ -Joule Meter PEM 250 or PEM 500**
- **Remote adaptor (customized)**
- **USB-serial adaptor**

9.5 Warranty

The MNL 100 comes with a warranty of two years from the date of invoice or 6×10^7 pulses and the MNL X00 – with a customer warranty agreement.

The warranty includes all parts and labour to repair or replace defects in materials or workmanship.

Wear parts, consumables and maintenance items are excluded.

Check-up table on maintenance carried out

Date	Activities	Signature

9.6 OEM information

MNL Lasers are 3B class lasers (IEC 60825-1)

Improper treatment and operation of the laser can cause damage to your health. Please follow carefully the given instructions.

The laser was tested with regard to the laser safety by INTERTEK / SEMKO, however residual hazards exist.

Invisible laser radiation

The laser emits intensive invisible laser radiation in the UV range of the spectrum (up to 100 kW/pulse).

The laser beam must never directly or indirectly hit the eye of the user!

The beam output of the laser is closed by an integrated beam shutter or the attenuator in the lowest transmission position.

Independent of the switch-on command (operation mode), a command to release the laser beam is necessary (OPEN SHUTTER).

When switching off the laser, the beam output is closed again automatically.

In the end product, the beam path of the laser must be covered in a way that no radiation can escape. Please observe that there are no reflecting materials in the beam path by which the laser beam could unintentionally be directed towards persons or sensitive materials.

In service cases, always wear laser safety goggles appropriate to the laser wavelength (UV blocking filter for 337 nm) and ensure that all persons in the vicinity of the laser wear laser safety goggles as well.

For lasers of the series MNL you need laser goggles of the safety class L6.

Always follow the safety regulations that apply.

9.7 Declaration of Conformity

Declaration of Conformity	
Equipment name/type number:	Laser unit MNL 100 / MNL X00
Product description:	Light source for analytical and medical diagnostic systems
Manufacturer/Address:	LTB Lasertechnik Berlin GmbH Am Studio 2c 12489 Berlin / Germany Tel.: + 49-30-912075 100 Fax: + 49-30-912075 199 E-mail: info@ltb-berlin.de
European Representative:	LTB Lasertechnik Berlin GmbH
Applicable Directives:	Low voltage directive 2014/35/EC Radiated Disturbance and Immunity 2014/30/EC RoHS-Directive 2011/65/EC / 2015/863/EC
Applicable Standards:	Conformity of this product is based on European standards: Low voltage standard: EN 61010-1 / 07.2011 Radiated Disturbance and Immunity: EN 61000-3-2 / 03.2015 EN 61000-3-3 / 03.2014 EN 61000-6-2 / 02.2019 EN 61000-6-3 / 09.2011 Laser safety EN 60825-1 / 07.2015
We hereby declare that the equipment model series identified above conforms to the specified Directives and Standards. CE marking was first affixed during 2006.	
	 <hr style="width: 100px; margin: 0 auto;"/> Christian Scholz (CEO)

9.8 Specifications, Technical Data

General

MNL 100 / MNL X00		103-PD / 106-PD	103-LD / 106-LD
		X03-PD / X06-PD	X03-LD / X06-LD
Wavelength	nm	337.1	
Spectral bandwidth	nm	0.1	
Pulse halfwidth FWHM, typ. ¹	ns	3	
Guaranteed pulse energy (90 % after 60 mill.) ²	µJ	≥ 130 / ≥ 110	≥ 75 / ≥ 55
Typ. pulse energy (typ. 70 % after 100 mill.) ²	µJ	≥ 140 / ≥ 120	≥ 85 / ≥ 65
Pulse power, typ.	kW	47 / 40	28 / 22
Repetition rate ³	Hz	1...30 / 1...60	1...30 / 1...60
Energy stability SD/<E> (for all rep. rates)	%	≤ 2	≤ 2
Beam dimensions, vertical x horizontal, typ.	mm	3 x 4	4 x 2.5
Beam divergence, vertical x horizontal ⁴	mrad	≤ 3.5 x ≤ 3	≤ 0.5 x ≤ 0.3
Focus stability ⁵	µm	< 15	< 25
Beam exit angle, vertical / horizontal, typ.	grad	+0.5 (±0.2) / 0±0.1	0±0.1 / 0±0.1
Trigger In		Optical or electrical (TTL)	
Jitter: ext. trigger ↔ laser pulse	ns	± 2.5	
Pulse delay: ext. Trigger ↔ laser pulse	ns	1300 ± 10%	
Sync Out (optional):		Typ. 3.5 ns before the laser pulse (U>4V)	
Jitter: electr. Trigger exit ↔ laser pulse	ns	< 0.2	
Warm-up time	s	< 20	
Control		AUTOMODE or software (DLL) via integrated controller	
Certifications		CE, ETL (UL, CSA, VDE, Semco), FDA	
Laser class		3B / IIIb	

Electrical interface

Power supply ⁶	V DC	24
Power consumption	A	2.4
Maximum / (average) power consumption	VA	60 / 40

Environment and conditions of use

Operating temperature	°C	+15 ... +38
Storage temperature	°C	-10 ... +60
Max. relative humidity (non-condensing)	%	85
Air pressure	mbar	750 ... 1300
Dimensions of the laser (L x B x H) ⁷	mm	321 x 95 x 95
Weight of the laser	kg	3.5
Dimensions of the power supply (L x B x H)	mm	180 x 80 x 50
Weight of the power supply	kg	0.6
Degree of ingress protection (IEC 60529)		IP 20
IK code (IEC 62262)		IK08
Pollution degree of the intended environment		Class B (residential building environment) regarding radiated disturbances and conducted continuous disturbance at mains supply Class A (industrial environment) regarding harmonic current emissions in low-voltage supply systems

Warranty

MNL 100	60 million pulses or 2 years
MNL X00	Long life laser, customer agreement required

¹ reduction on request

² higher energies on request

³ higher repetition rates on request

⁴ at max. rep.rate; measuring at 5 m distance

⁵ based on focusing of 60 mm

⁶ via external wide-range power supply (100...240 V AC) (part of the delivery)

⁷ with attenuator module (335 x 95 x 95) mm

Additional components

Energy monitor

- display accuracy: $\pm 8 \%$
- with calibration function

Attenuator

- only in combination with an energy monitor
- transmission max. 90 %
- attenuation up to approx. 1 % of the laser output energy possible
- Please note modified external dimension
- no beam shutter possible (OEM agreement necessary)

Fiber coupling

- transmission approx. 90 %
- only for PD-type
- SMA-connector
- fibers with diameters $< 600 \mu\text{m}$ cannot be replaced by the user

Fiber 200 μm

- length: 150 cm
- transmission approx. 70 %

Fiber 600 μm

- length: 150 cm
- transmission approx. 90 %

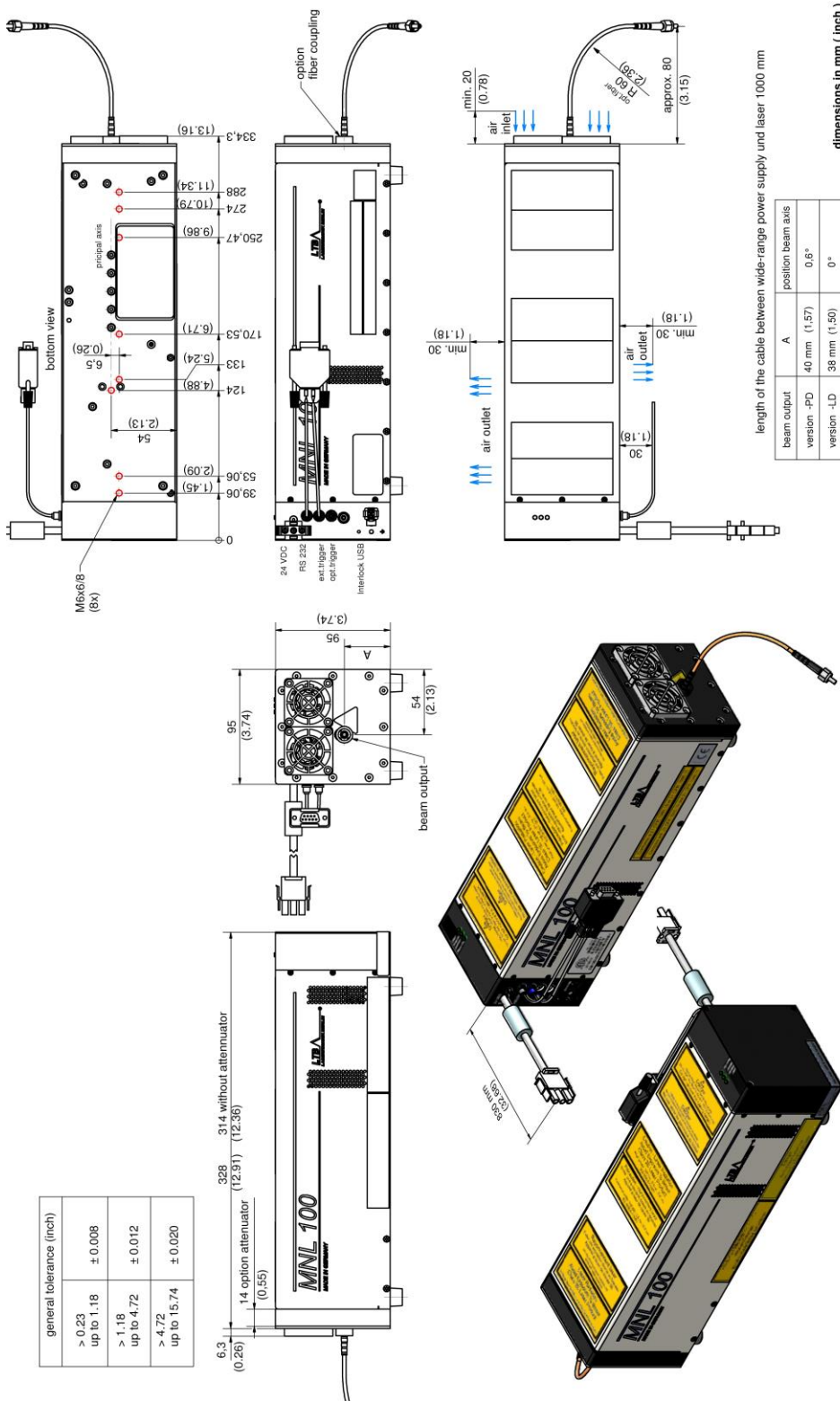
Fiber 1000 μm

- length: 150 cm
- transmission approx. 90 %

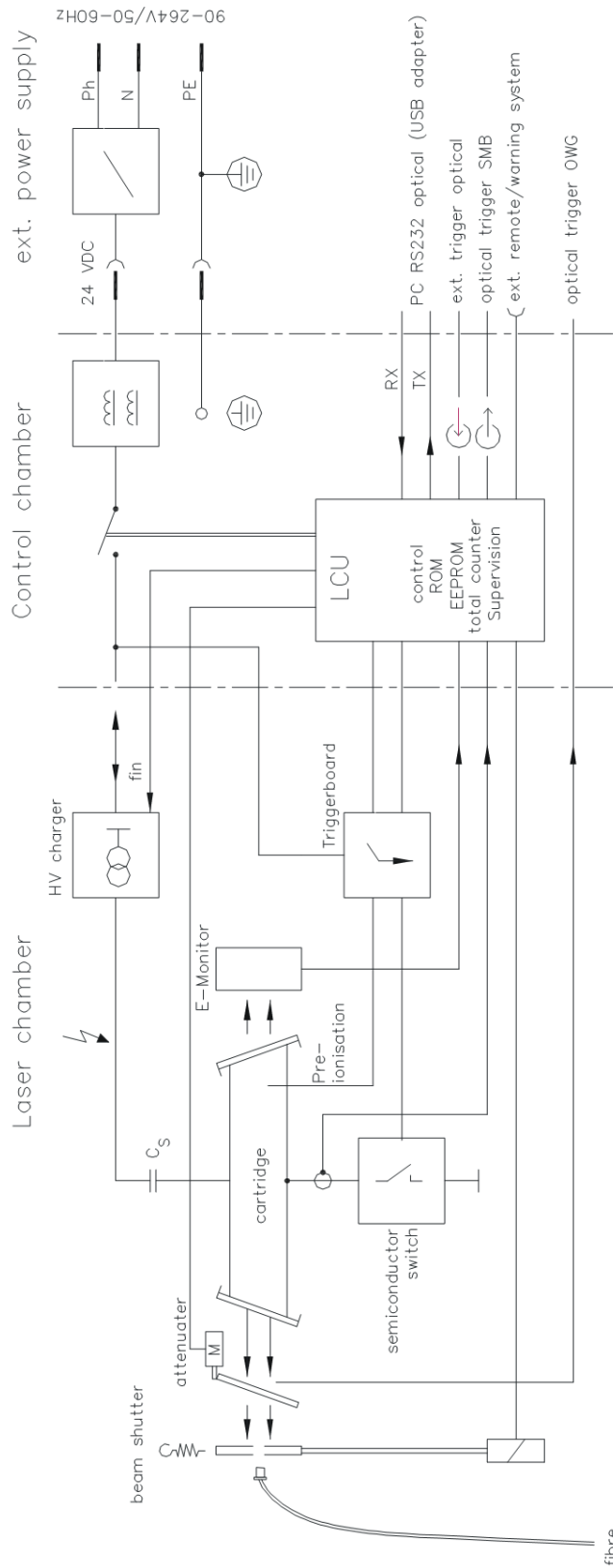
Optical trigger with electrical output

- pretrigger
- Delay: approx. 3.5 ns (electr. trigger output \leftrightarrow laser pulse)
- Amplitude: 5.0...6.5 Volt (50 Ohm)
- Jitter: $< 0.2 \text{ ns}$ (related to the laser pulse)
- Rise time: $< 800 \text{ ps FWHM}$
- incl. adapter cable SMB to BNC

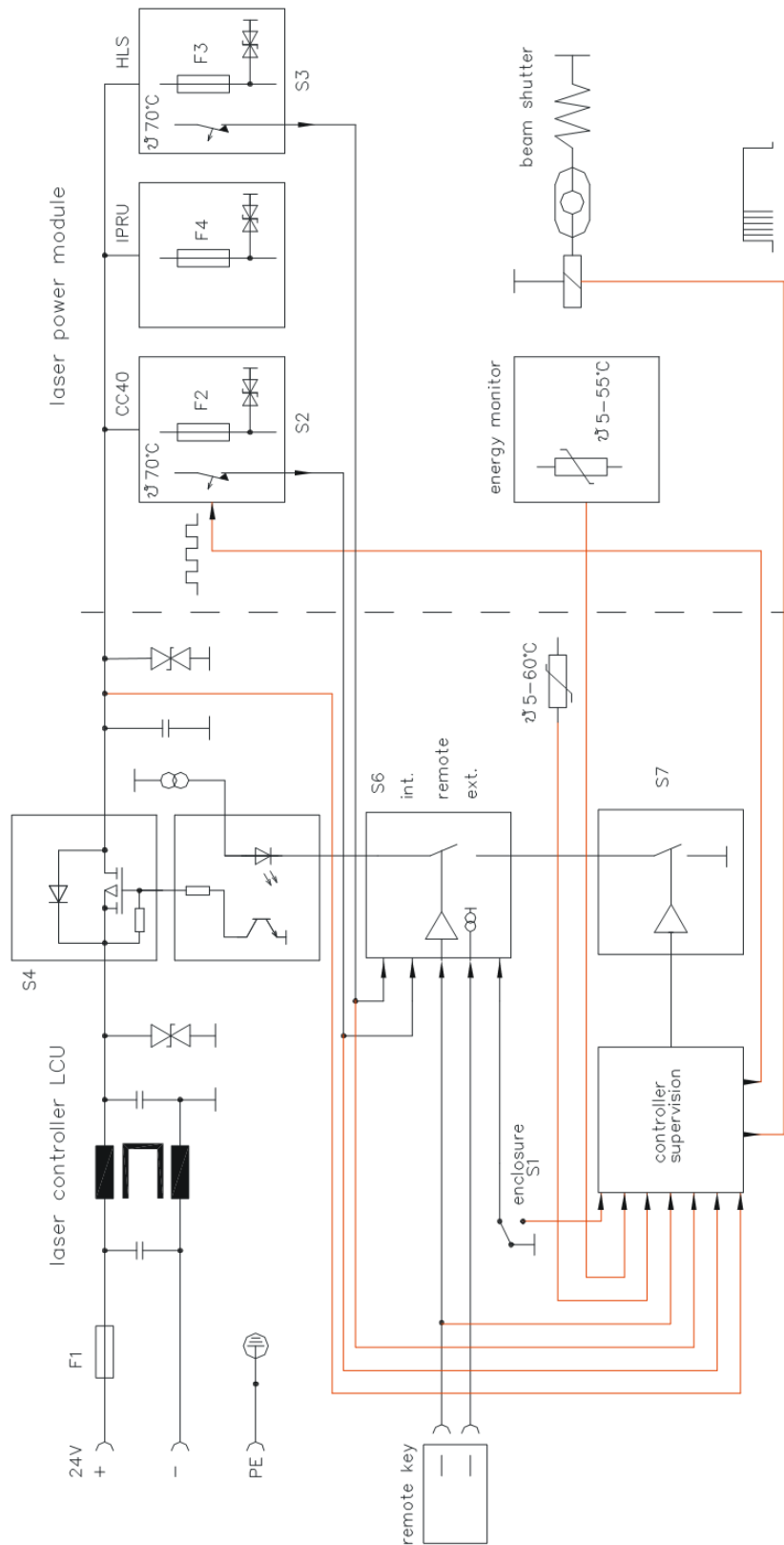
9.9 Dimensions and interfaces



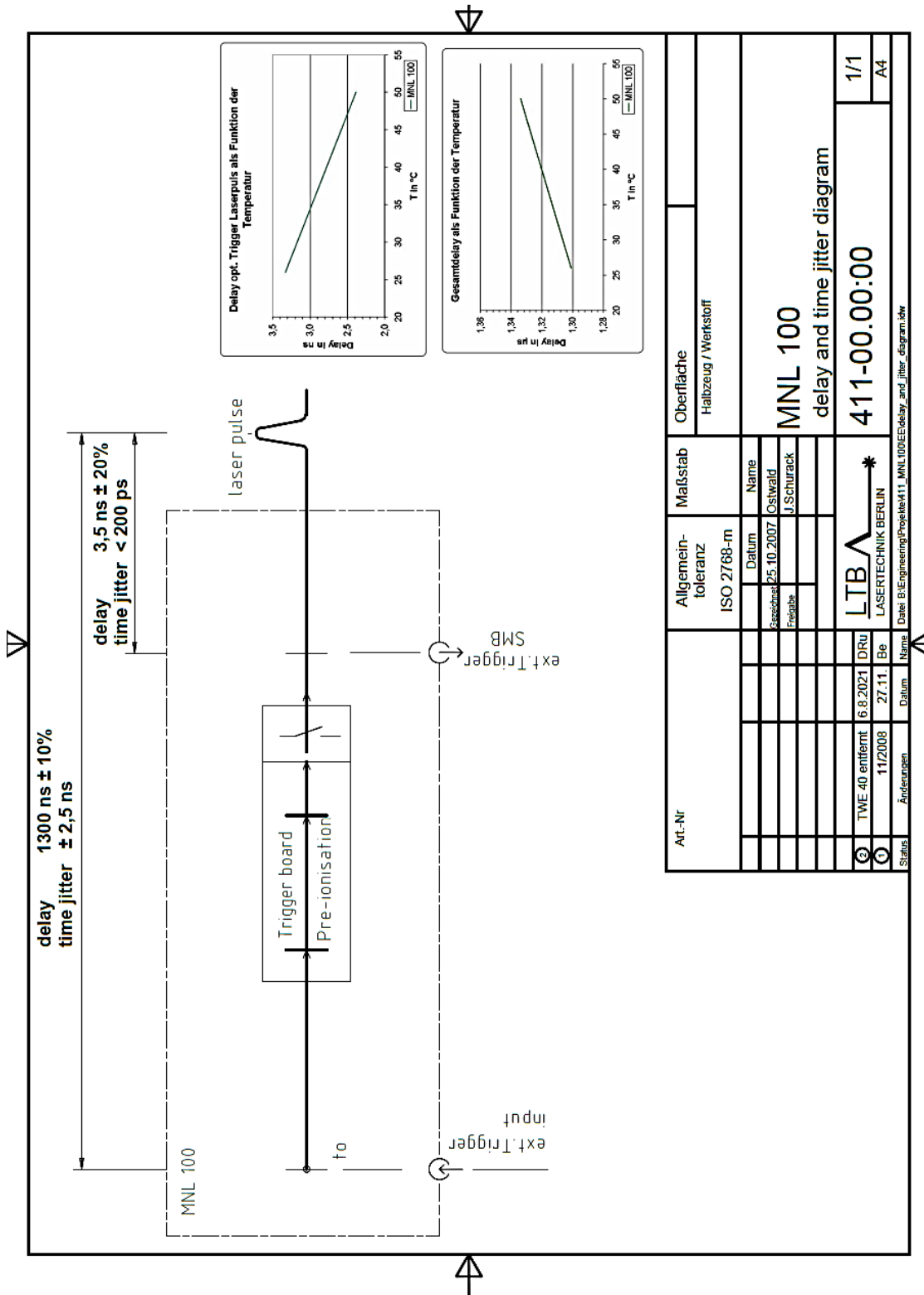
9.10 Functional block diagram



9.11 Safety functions










9.12 Delay and time jitter



9.13 Table of labels

	Label type	Label	Position
1.1	Certification label 1 - in English -		Hood: Side face down
1.1 F	Certification label 1 - in French -		Hood: Side face down
1.2	Certification label 2		Hood: Side face down
2.1	Identification label		Base plate: countersunk from the bottom
4.1	Aperture label 1 - in English -		Hood: Top, middle
4.1 F	Aperture label 1 - in French -		Hood: Top, middle
4.2	Aperture label 2		Side wall: Next to the beam exit

5.1	Warning label 1 - in English -		Hood: Sidewall bottom LCU side
5.1 F	Warning label 1 - in French -		Hood: Sidewall bottom LCU side
5.2	Warning label 2 - in English -		Hood: Top, LCU side
5.2 F	Warning label 2 - in French -		Hood: Top, LCU side
6.1	Power label - in English -		Hood: Top, beam exit side
6.1 F	Power label - in French -		Hood: Top, beam exit side
7.1	Warranty label		2x across the corner (bottom): Hood/sidewall Hood/controller housing

There is an alternative set of labels, which is pictured in Appendix A.

9.14 Position of the labels



2.1



1.1

1.1 F

1.2

4.1

4.1 F

7.1

6.1 F

6.1



5.2

5.2 F



4.2

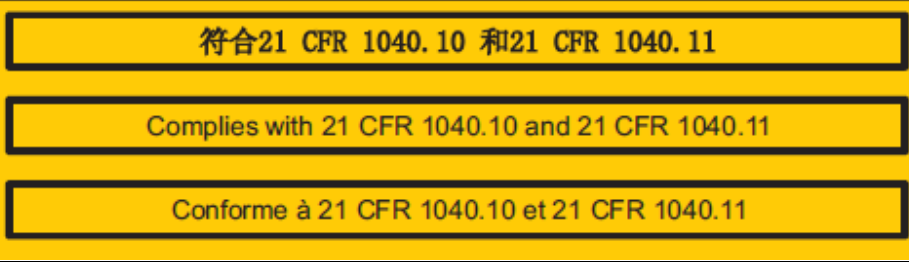
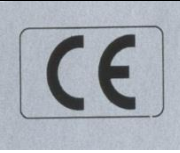


5.1




5.1 F




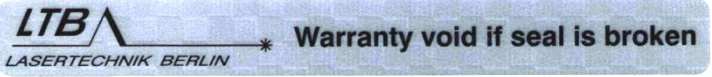

7.1

A Alternative Labels

All labels in Chinese are optional.

Label type	Label and symbol	Position
Certification		B
		CE Label
Identification		Laser ID Label
Laser power		F

Label type	Label and symbol	Position
Aperture		A
		Laser Label
		Laser Label

Label type	Label and symbol	Position
Warning		G
		C, D, E
		H
Warranty label		Warranty Label
Information label		Danger Label

A.1 Position of alternative Labels

