Operating Manual
Tube Laser Marker TLM 864

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List of Abbreviations

1 Introduction

The Tube Laser Marker (TLM) is a tube-handling device, which can permanently mark tubes via a laser. Additionally, it offers the possibility to transfer tubes between, e. g., regular SBS format racks and high-density racks with the same footprint (pick & place) resulting in roughly a 40 % increase in the packaging density. The Tube Laser Marker can be connected to your Laboratory information management system (LIMS) and/or enterprise resource planning (ERP) system.

> **ⓘ** LIMS/ERP integration can only be performed after the agreement between the customer and the supplier.
> Integration into LIMS/ERP is resulting in additional customized effort which can be obtained separately.

1.1 Intended Use

The Tube Laser Marker is a precision instrument designed for the automation of routine laboratory tasks, in particular the marking tubes with desired information on the side (marking field) via an integrated laser marker. It can also perform pick & place operations from an SBS format rack to other SBS format racks with potentially higher packaging density racks for storage and further processing in laboratory environments.

The following LVL tube- and rack-types are allowed to be used within the device:

LVL Tube types	Suitable LVL rack types (SBS format)	
	Standard-density racks	High-density racks
SX 300	SX 300 SBS Rack 96	2D Rack SAFE® HD 138 für SX 300
MX 500	MX 500 SBS Rack 96	2D Rack SAFE® HD 138 für MX 500
LX 1000	LX 1000 SBS Rack 96	2D Rack SAFE® HD 138 für LX 1000
MI 500	MI 500 SBS Rack 96	
LI 1000	LI 1000 SBS Rack 96	
XLX 2000	XLX 2000 SBS Rack 48	
XXLX 2000	XXLX 2000 SBS Rack 24	
XXLX 4000	XXLX 4000 SBS Rack 24	
XXLX 6000	XXLX 6000 SBS Rack 24	
XXLX 8000 *	XXLX 8000 SBS Rack 24	

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* Only single-variety processing possible, must not be mixed with other tube-/rack-types

Table 1: Tubes & racks used

The Tube Laser Marker is intended for the following use:

- Laser-marking of tubes with the same information per batch
- Laser-marking of tubes with individual information
- Picking and placing of tubes between racks [re-formatting].

> ℹ️ The Tube Laser Marker is intended for commercial use.

> ℹ️ The instrument operator is responsible for the correct use of the Tube Laser Marker according to all local, state, and federal laws that may apply.

Both the hardware and software architecture of the Tube Laser Marker is based on a modular concept, that maximizes the flexibility of the device.

The Tube Laser Marker consists of the following hardware modules:

- Tube Handler module
- Rack Storage module
- Laser module

> ℹ️ Two or more hardware modules are integrated into a single module in the software application.

1.2   Purpose of this Operating Manual

This operating manual describes the installation, functioning, operation and basic maintenance of the Tube Laser Marker. In addition, it provides important information for the safe and efficient handling of the device.

> ℹ️
> - Only personnel that has successfully completed training provided by the manufacturer or distributor are permitted to use the Tube Laser Marker.
> - This manual is available as a PDF file upon request.

1.3   Disclaimer of this Operating Manual

This operating manual has been prepared with the greatest care. However, the manufacturer and distributor do not accept responsibility for any misuse made of it.

The reprinting of this operating manual, even in parts, is only permitted with the prior consent of the manufacturer and distributor.

The manufacturer and the distributor reserve the right to change the layout as well as the contents to improve clarity at any time and without prior notice.

2 Safety Information

This chapter contains information to ensure the safe operation of the Tube Laser Marker. Detailed instructions regarding safety are provided throughout this manual, marked with warning and caution symbols as described in chapter 2.2.

All safety instructions in the manual must be strictly followed. Please ensure that this safety information is accessible to all users/operators of the Tube Laser Marker.

2.1 Safety Regulations

This chapter is intended for operators to protect personnel and laboratory equipment. All precautions must be taken to ensure the safe operation of the Tube Laser Marker.

The Tube Laser Marker may only be operated under the operating conditions as described in this manual (see chapters 3.3 and 11). Daily maintenance work must be carried out before using the device. If you do not operate the Tube Laser Marker according to the instructions in this manual, functional problems may occur, possibly followed by incorrect results.

2.1.1 Improper Usage

Liability does not apply if the Tube Laser Marker is operated or serviced by untrained personnel or other than described in this manual.

All applications that deviate from the intended use are considered to be inadmissible use, including the following:

- Use as a climbing aid
- Use outside the allowed technical operating limits
- Bridging/manipulation of safety devices
- Removal of protective coverings
- Use of non-approved tubes
- Use of non-approved racks

In the event of safety-related defects in the system or the associated documentation, all operators are obliged to immediately inform the manufacturer or distributor.

2.1.2 Modification or Changes

Any liability and warranty by the manufacturer will be voided in the event of unauthorized conversions and modifications to the system. The electromagnetic behavior of the device may be affected by additions or modifications of an abrasive nature. Therefore, do not make any changes or additions to the device without consulting the manufacturer and obtaining his written consent.

2.2 Safety Symbols

The following is an illustrated glossary of the symbols that are used on the Tube Laser Marker and within this manual. Wherever these symbols appear, the interpretation reads as follows:

WARNING!

Indicates an immediately hazardous situation which, if not avoided, will result in death or serious injury to the operator or serious equipment damage. Consult this manual for further instructions and proceed with extreme caution.

WARNING!

Warning of laser radiation

Exposure to laser radiation can result in serious injuries to the operator. Consult the manual for further instructions and proceed with extreme caution.
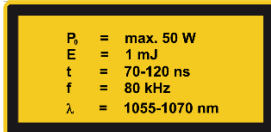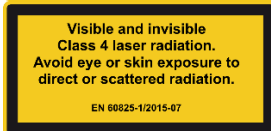
Laser class 4

This laser radiation is very dangerous for the eyes and skin. Even diffuse, scattered beams can be dangerous. This class of laser can cause fire- and explosion-hazards.

Adhere to all safety standards of laser class 4.

Pilot laser class 2

This laser radiation is not dangerous for short exposure times (up to 0.25 s) even for the eyes.

However, it is still highly recommended to never look directly into the laser beam.

ATTENTION!

Indicates the risk of loss of life or severe injury as well as damage to the system operator due to interference of moving parts of the Tube Laser Marker. Consult this manual for further instructions and proceed with caution.

ATTENTION!

Indicates the risk of loss of life or severe injury as well as damage to the system operator due to high voltage. Consult the manual for further instructions and proceed with caution.

DANGER!

Indicates the risk of loss of life or severe injury as well as damage to the system due to potentially dangerous chemical or biological material. Consult this manual for further instructions and proceed with caution.

CAUTION!

Indicates the risk of equipment damage or loss of data if instructions in this manual are not followed precisely. It is therefore strongly recommended that the system operator consults the corresponding chapters in related documentation or contact the manufacturer or distributor for further assistance.

Information about the correct use of the device and remarks where possible operator errors may occur.

ATTENTION!

- Capped tubes only!

Only capped tubes can be operated in the Tube Laser Marker. Tubes without caps might not be picked up straight which may result in distortions of the typeface and potential collisions. Additionally, uncapped tubes contain the risk of spilling inside the device, which can lead to damage to the equipment.

- No hazardous substances in vials!

The Tube Laser Marker is not suitable for marking tubes containing hazardous substances.
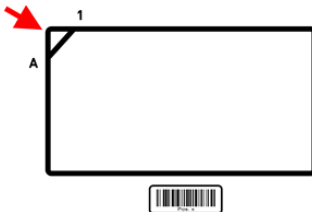
ATTENTION!

- Pay attention to the rack orientation!

Each tube might have individual information lasered. If the rack is not oriented properly, the intended information might not be written on the corresponding tube. For the correct orientation, always position the rack such that coordinate A01 sits on the top left corner of the rack holder.

2.3 Safety Instructions

Incorrect handling or lack of maintenance of the Tube Laser Marker bear risks in the form of mechanical, electrical, chemical, and biological hazards. Strictly adhere to the operator guidelines in this manual to avert incidents resulting in personal injury or instrument damage.

2.3.1 Mechanical Hazards

The Tube Laser Marker is an automation device that operates under computer control. Like for any robotic device, there is a potential for injury from moving mechanical components whenever the instrument is in operation. The device is designed for hands-off operation only.

However, the safety system of the device, including housing, doors and sensors, protects the operator from accidental contact with moving components. All doors of the housing must be closed at all times during normal operation.

Please be particularly aware of the following mechanical hazards:

WARNING!

- Risk of serious injury, when using the device despite malfunctions or faults.
- Do not use the device in case of malfunction.
- Switch off the device immediately if unusual noises or strong vibrations occur. Contact your service representative.
- The device must be closed at initialization (all moving parts move to the zero position) and at start-up.

ATTENTION!

- Risk of injury from moving parts.
- Hands can be pinched, pulled in, or otherwise injured.
- Do not reach into the device during operation! Keep all housing doors closed at all times during normal operation!
- The Screw Capping Head of the Tube Handler can exert enough force to cause injury during motion.
- The tube clamping can cause serious hand injury.

2.3.2 Electrical Hazards

Standard electrical safety precautions must be applied at all times. Only qualified personnel are permitted to perform electrical servicing. Static electricity can lead to damaging the installed sensitive equipment during operating tasks.

Please be particularly aware of the following electrical hazards:

ATTENTION!

Risk of electrical shock

- Make sure that there is no danger of electrical shock.
- Do not operate the device in a damp environment. Do not attempt to modify or intentionally disable the safety features of this device.
- If the power cord is cracked, frayed, broken or otherwise damaged, it must be replaced immediately by an equivalent cord from the manufacturer.
- After switching off the device, remove the power supply plug from the socket.
- Never carry out any service and maintenance work without properly turning off the power of the device at the main switch and physically disconnecting the power cable.

CAUTION!

Risk of losing data

- Do not turn off the main switch before shutting down the touch panel. This may cause definitive data loss.
- Do not run a process if the power supply is unstable.
- Do not modify, cut or delete the application data available on the touch panel. This can cause malfunctions in the automation program.

2.3.3 Chemical and Biological Hazards

Potential hazards to personnel may exist when handling sensitive material in the instrument. The functional features of the Tube Laser Marker minimize the risk. However, the potential for hazardous exposure still exists.

DANGER!

- All liquid and solid waste material must be considered biohazardous and therefore must be handled using universal laboratory precautions.
- All clinical samples used in the process must be considered potentially infectious. Toxic/corrosive chemicals or radioactive substances may be present.
- Respect warning labels and follow safety instructions in the material safety data sheet (MSDS) provided by the reagent manufacturer.

2.4 Disposal

All electrical and electronic devices must be disposed of separately from household waste. Proper disposal of the device at the end of its lifetime prevents possible negative consequences for the environment and human health. Dispose of all parts of the Tube Laser Marker according to local regulations or via a specialized disposal company. Further information on environmentally friendly disposal can be obtained from your local authority.

3   Installation of the TLM

3.1   Transportation

The Tube Laser Marker can be lifted by the aluminium profiles of the main frame for safe transport to the final installation site (see the green marked area in Figure 1).
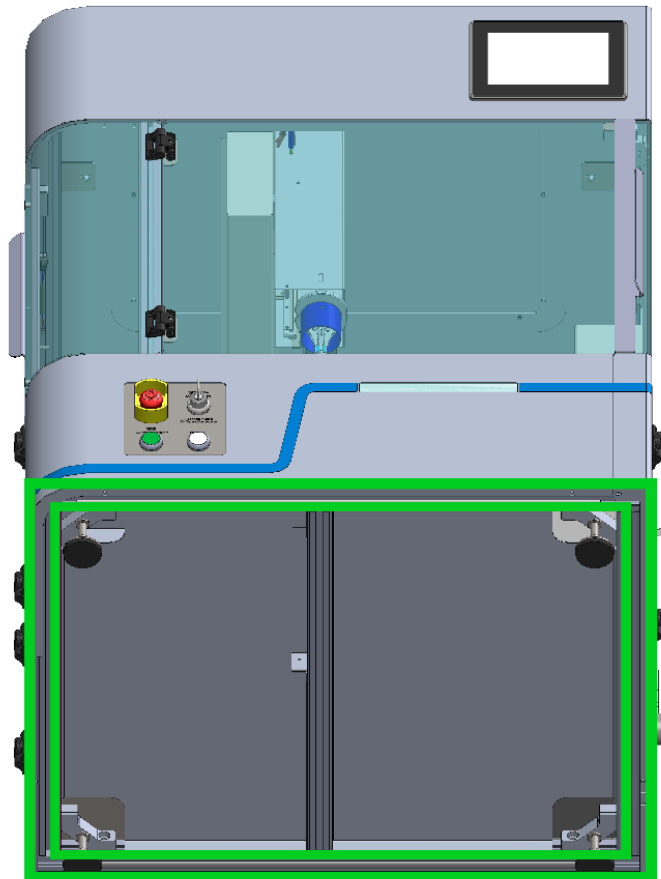
Figure 1: Transport

3.2   Transport Lock

The device has two transport locks, one for the X- and one for the Y-axis. Both transport locks must be removed before commissioning (see Figure 2). The transport locks can be stored within the electronic cabinet at the backside of the device for future use (see Figure 4).
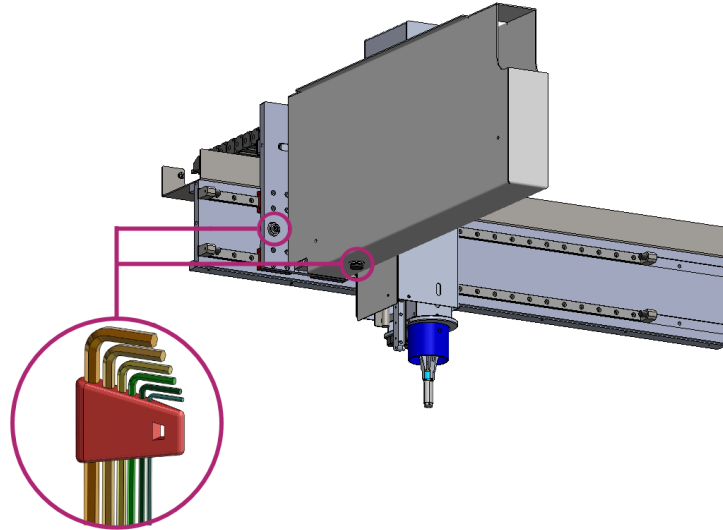
Figure 2: Positions of transport locks for X- and Y-axis.

To unscrew the X-axis transport lock, an Allen key is needed, which can be obtained from the electronic cabinet of the device. The maintenance door, which secures the electronic cabinet, can be opened by unlocking the sockets (see no. 2.1 & 2.2 in Figure 3) using the delivered service access key (see no. 1 in Figure 3).

Figure 3: Maintenance door access

Once the maintenance door on the back of the device is opened, the Allen key [no. 5 in Figure 4] can be accessed. Along with the set of Allen keys, a set of Torx keys [no. 4 in Figure 4] is also delivered.

5   4   3.1 / 3.2

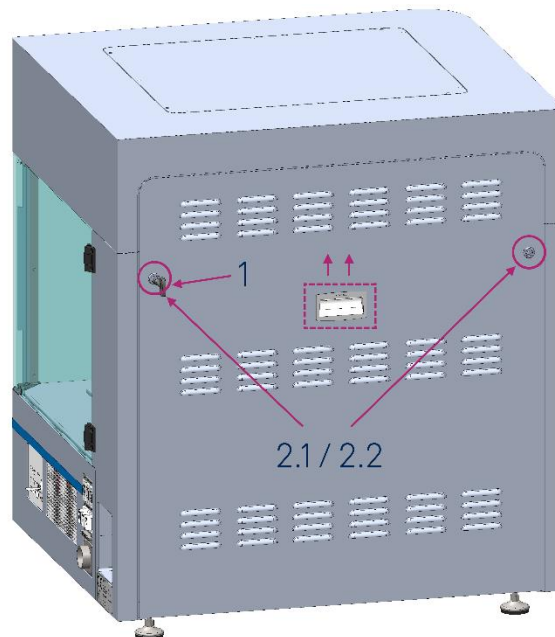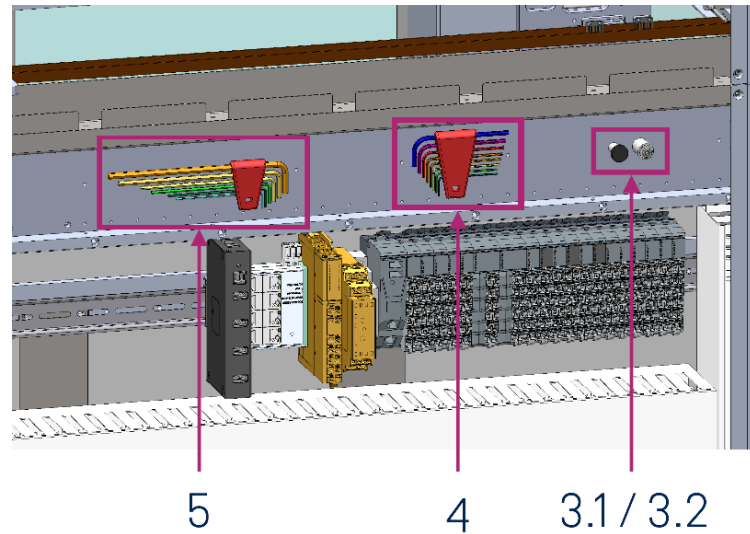Figure 4: Transport lock storage

Please safely store the two transport locks (see no. 3.1 & 3.2 in Figure 4) for potential future use.

ATTENTION!

The device may only be opened by qualified electricians and trained personnel service technicians from the manufacturer and distributor.

3.3 Environmental Conditions

The installation site must offer at least 50 cm of additional space on all sides of the device for operation, cleaning, repair, and maintenance. The system has to be placed on a firm and secure table or workbench. The system can be leveled by adjusting the height of the threaded feet at the bottom of the device. It has to be ensured, that the ventilation of the device is not restricted by interfering objects. See also chapter 11 for further information about the environmental conditions.

Connections for electricity and network access should be available at the installation site.

Before an operation, make sure that the extraction and filter system supplied with the device also has a firm and secure standing. Make sure to fix the safety locks of the swivel castors before switching on the system.

Generally, only one socket is required for the connection of the Tube Laser Marker. The extraction and filter system does not need an extra power socket, as it is connected directly to the Tube Laser Marker.

The nominal voltage of the device is 100-240 VAC, 50/60 Hz.

ATTENTION!

The device must not be operated in a damp environment.

The device must not be exposed to direct sunlight.

4 Functional Description of the TLM

4.1 Basis of the Tube Laser Marker

The device is used exclusively for processing the specified tubes and racks (see chapter 1.1).

> ℹ All tubes in a rack must be of the same type and must have been approved by the manufacturer or distributor, for the device to function properly.
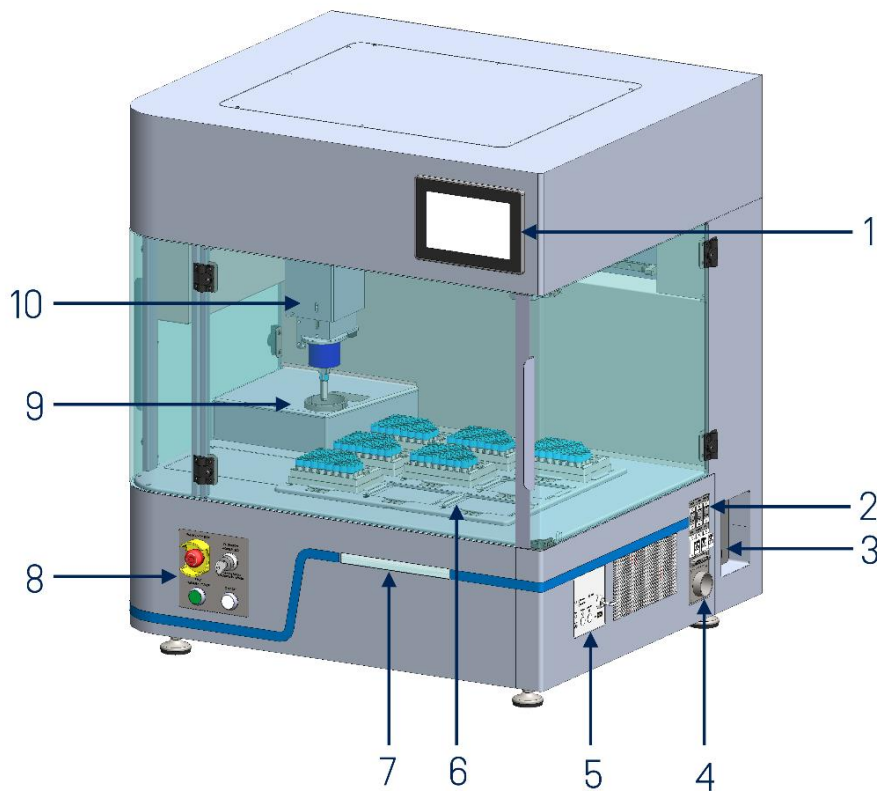
Figure 5: Device overview

No.	Explanation	No.	Explanation
1	Touch display	6	Rack module
2	User Interfaces	7	Signal bar
3	Power supply panel	8	Operating panel – device
4	Connection for extraction hose	9	Laser module
5	Control panel – laser	10	TubeHandler module

Table 2: Device overview – explanation

4.2 General Module and Components

4.2.1 Power Supply Panel

The main power supply is located on the right side of the device. The connections are explained in the following Figure 6.
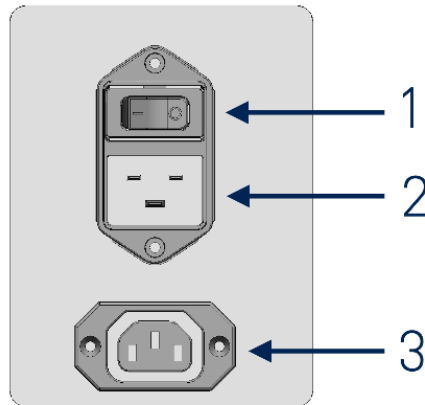
Figure 6: Main power supply

No.	Explanation
1	Main power switch
2	Power supply input of the device
3	Power supply output for extraction and filter system

Table 3: Main power supply - explanation

4.2.2 Operating Panel – Device

At the front left of the device, there is a control panel with buttons for performing and controlling various operations (Figure 7).

Figure 7: Operating panel – device

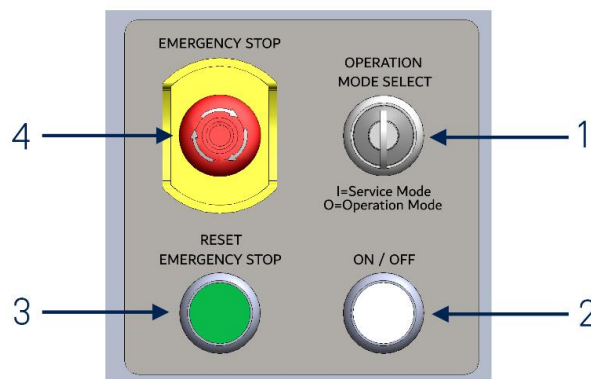| No.	Explanation
1	Operation mode select switch (switch between operation or service mode)
2	On/Off (switching the device on or off)
3	Reset emergency stop (resetting the emergency stop status)
4	Emergency stop

Table 4: Operating panel - explanation

Operation Mode Select [1]

If it is necessary, for example, to adjust the moving positions of the gripper, the operator must set the device to service mode. To do this, the Operation Mode Select switch must be set to the Service Mode position (I = service mode) using the operation mode selector switch key provided with the device (see chapter 13). In the service mode, the axes move at a reduced speed and the machine can be operated with open doors. After completion of the service work, the switch has to be returned to the initial position (0 = operation mode) using the selector key.

The Operation Mode Select switch may only be accessed by trained personnel or service technicians. In the service mode, all axes move slowly and the doors can be open for service and maintenance works.

ATTENTION!

Risk of injury due to moving parts

- Avoid placing hand/body parts inside the device, when the service mode is active and the door is open.

On/Off [2]

The On/Off button is used to start or stop the device. It can also be used to interrupt a running process. The button lights up white during normal operation.

If the On/Off button is not lit, then the control unit of the device will not have any power.

Reset Emergency Stop [3]

If the emergency stop button [4] is pressed, the Reset Emergency Stop button lights up green. The device is then put into idle mode. As soon as the problem has been resolved and the Emergency Stop pulled out, the Reset Emergency Stop button must be pressed. This ends the emergency stop state. The green light goes out and the device is ready for operation again.

> The Reset Emergency Stop button is always lit after starting the device. This button should be pressed to start the normal operation of the device. If the button is lit, the device will provide an error message to resolve this issue.

Emergency Stop [4]

The Emergency Stop button can be pressed in case a severe problem occurs, for example, damage to the access door or breakage of any hardware during a process. Pressing this button disconnects the device from the power supply. The running process is stopped and the operator can resolve the issue. After solving the problem, the Emergency Stop has to be pulled out and turned clockwise to lock the button in place. As the last step, the Reset Emergency Stop button has to be pressed.

> It is recommended to restart the GUI, to reconnect the control unit with the GUI after the Emergency Stop button is pressed and the issue has been resolved. Because the emergency stop will block even the information transformation between the control unit and the GUI.

4.2.3   User Interfaces

The user interfaces of the Tube Laser Marker are located on the right side of the device (Figure 8). The interfaces are explained in the following.
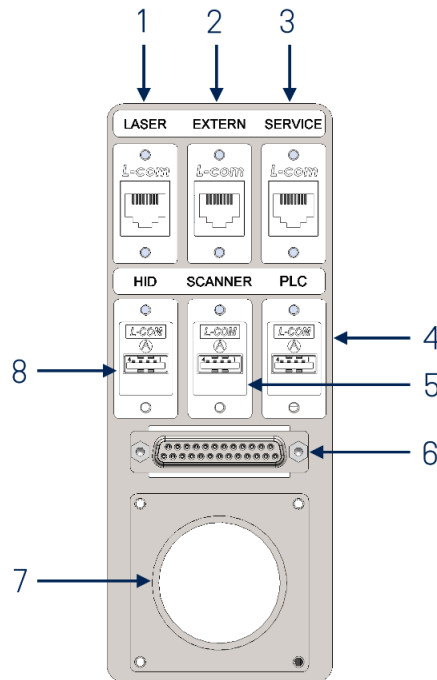
Figure 8: User interface

No.	Explanation
1	Laser connection (Ethernet port)
2	Internet connection for touch panel (Ethernet port)
3	Connection for PLC service (Ethernet port)
4	Connection for PLC update (USB A port)
5	Connection for handheld barcode scanner (USB A port)
6	I/O port for extraction and filter system system
7	Connection for extraction hose of extraction and filter system
8	Connection for HID (Human Interface Device) / peripheral devices (e.g. dongle for keypad, mouse, USB stick)

Table 5: User interface – explanation

CAUTION!

Risk of data loss

- The connection of the cables for the USB ports to the system should only be executed by service technicians or trained personnel.

4.2.4 Access Doors

The Tube Laser Marker has three large doors for the operator to access the device, e.g., placing or removing the racks. These doors must be closed during normal operation. The doors have a magnetic locking mechanism, which helps to prevent them from accidentally opening during a process. Furthermore, there are additional maintenance doors for access to the laser marking chamber and to the electronic cabinet of the device.
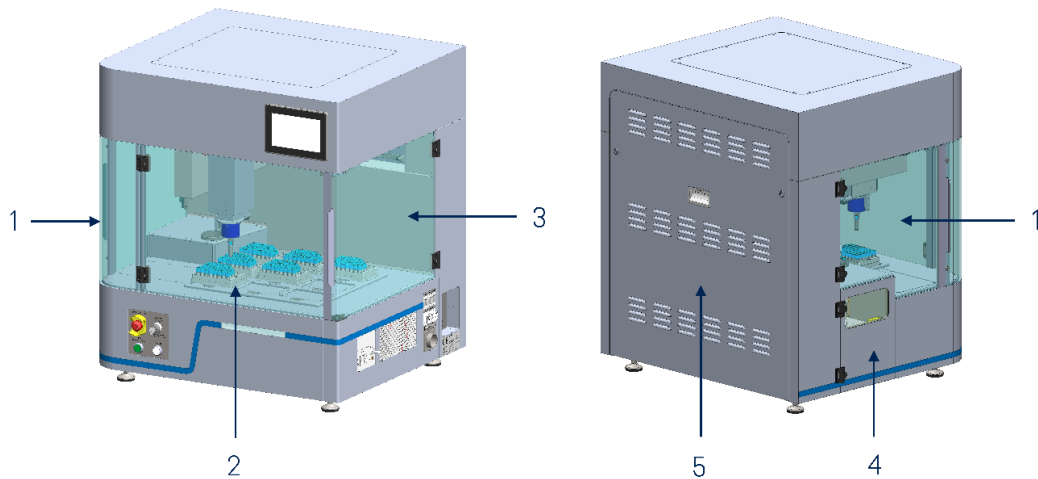

Figure 9: Access doors

No.	Explanation
1	Left Door
2	Front Door
3	Right Door
4	Laser Marking Chamber Access Door
5	Maintenance Door

Table 6: Access doors - explanation

- If the doors are opened during normal operation, the automation process stops to prevent the operator from potential danger.
- The process can be resumed once the doors are closed and the continue button in the touch panel is pressed.

WARNING!

Danger due to moving machine parts

- The doors must be closed during normal operation.
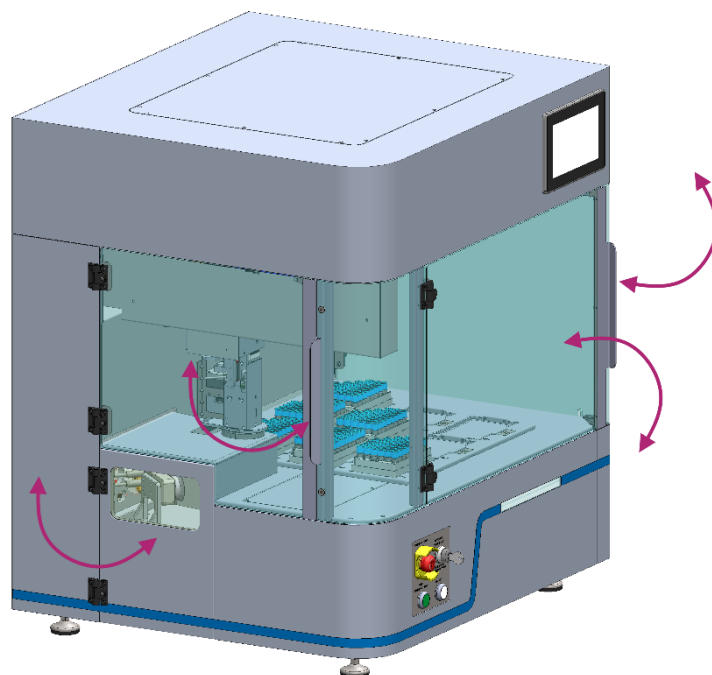- Bypassing safety devices or manipulation of any kind is not permitted.

Figure 10: Access openings

4.2.5 Maintenance Door

The access to the electronic cabinet, tools and transport locks is located on the backside of the device enclosed by the maintenance door. Refer to chapter 3.2 on how to access the maintenance door.

The device may only be opened by qualified electricians, trained personnel or service technicians.

> **WARNING!**
> Risk of electrical shock
> - Before opening the maintenance door, the device must be turned off and the power cord must be unplugged from the device.
> - The service access key for opening the maintenance door must be kept away from the device.

4.3 Tube Handler Module

The Tube Handler Module has several functions, which are explained below. The Tube Handler moves the tubes within the device along a Cartesian coordinate system. The Tube Handler module has two major axes, the XY-axis [2] and the Z-axis [1], as well as a supporting rotating axis in the gripper [3]. The gripper is passive and spring-loaded so that it cannot lose tubes in the event of a power failure. The Tube Handler moves the tubes between the racks and the laser marking position.
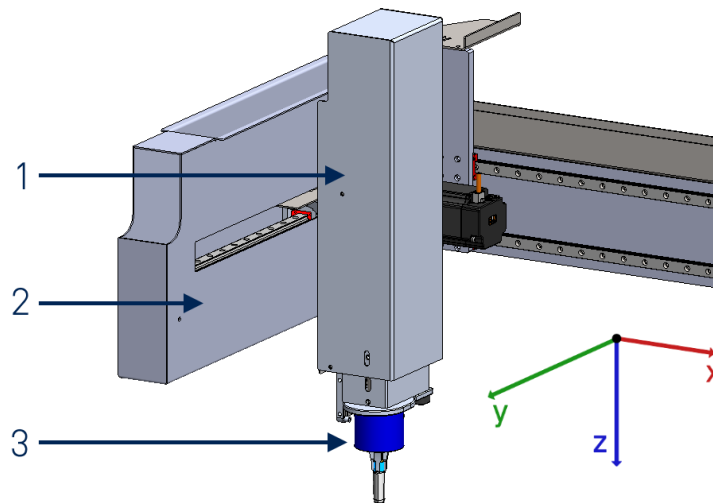

Figure 11: Tube Handler module

No.	Explanation
1	Z- axis
2	XY-axis
3	Gripper

Table 7: Tube Handler module - explanation

ATTENTION!

Risk of injury due to sharp grippers

- The gripper of the Tube Handler is spring-loaded. When manually removing the tubes from the gripper, pay attention not to get your fingers caught by the clamping mechanism.

4.4   Rack Module

The Tube Laser Marker can process a maximum of nine SBS Racks in a single run. The rack module can be accessed through the front door of the device. Each rack is determined by position number [1], which is engraved on the bottom of the rack position. In order to hold the rack in position, the right side and the bottom side of the rack position are equipped with positioning holders.

The position of the racks is validated during normal operation by the position barcode [2] placed below each rack.

Figure 12: Rack module
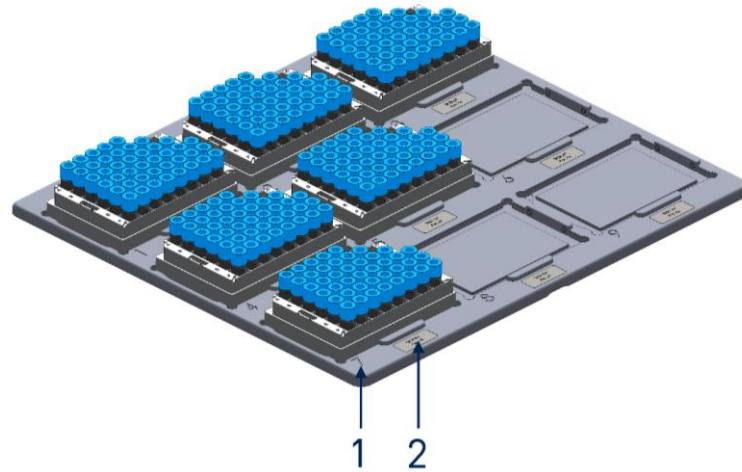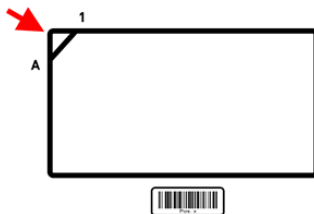
Pay attention to the rack orientation!

ATTENTION!

- Pay attention to the rack orientation!

Each tube might have individual information lasered. If the rack is not oriented properly, the intended information might not be written on the corresponding tube. For the correct orientation, always position the rack such that coordinate A01 sits on the top left corner of the rack holder.

4.5   Laser Module

The laser module in the Tube Laser Marker consists of two major units.

1.   Laser unit
2.   Extraction and filter system unit
3.   Handheld barcode scanner unit

4.5.1 Laser Unit

The Tube Laser Marker is equipped with an integrated laser unit (see Figure 13) for marking the tubes with individual information (e.g., number, text, logos, symbols, and barcodes). The laser is completely enclosed in a sensor-monitored marking chamber, additionally secured by two safety switches. The safety concept ensures that the laser can only emit light when all doors of the chamber are closed.
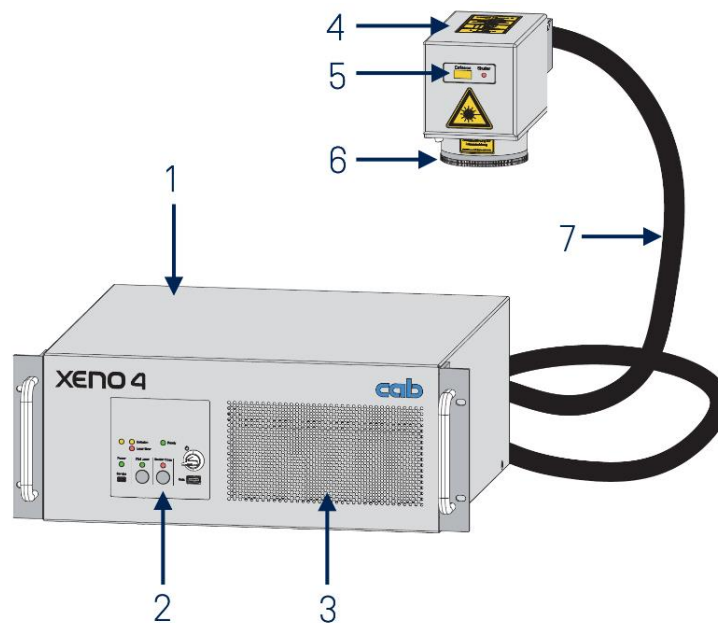
Figure 13: Integrated laser unit

No.	Explanation
1	Control unit
2	Control panel (see also Figure 15)
3	Ventilation grill air supply
4	Scan head
5	Status display
6	Lens
7	Connecting cable

Table 8: Integrated laser unit - explanation

> ℹ The laser marker XENO 4 is an external device integrated into the Tube Laser Marker manufactured and distributed by cab Produkttechnik GmbH & Co. KG (cab). Further information regarding operation and maintenance can be found in the cab user manual supplied.

The laser marking chamber can be accessed via a safety door (Figure 14). This access door is sensor-controlled, which means that the laser stops immediately when opening it.
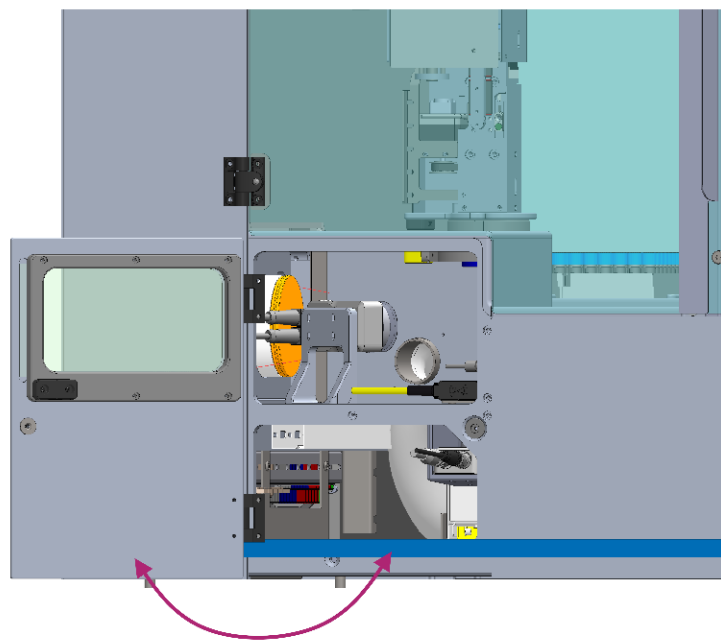
Figure 14: Laser module – safety access

Control Panel – Laser Unit

On the right side of the device is a control panel (Figure 15) for the integrated laser module.
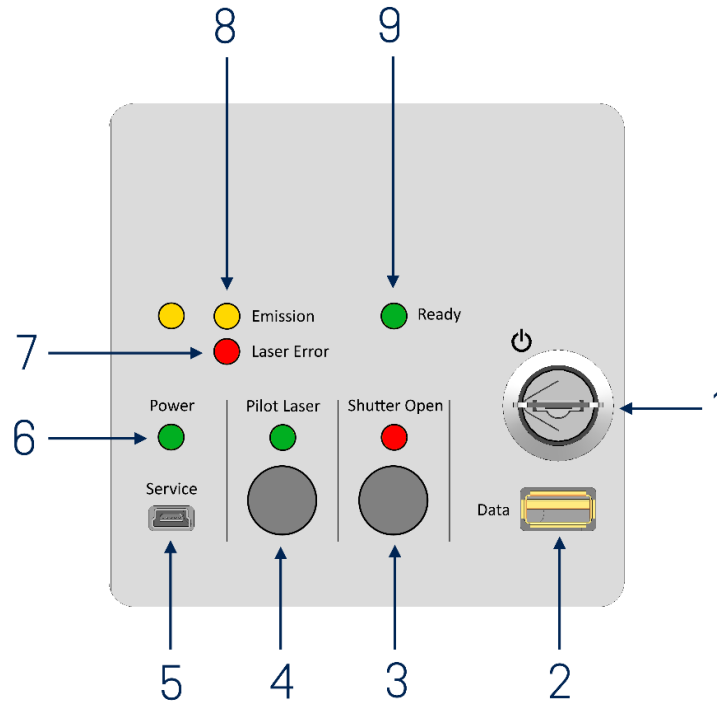
Figure 15: Control panel – laser unit

No.	Explanation
1	Switch key (switch laser source on and off)
2	Interface for removable media with marking layouts, used as an extension of the laser's internal memory.
3	Button to switch the mechanical safety lock in the laser's optical path on and off.
4	Button to switch the pilot laser on and off.
5	Service connection (interface for diagnosis via remote service).
6	LED shows if the main voltage is applied.
7	LED shows the error of the laser.
8	LED shows if the laser source is switched on.
9	LED shows if the laser is ready for marking.

Table 9: Control panel – explanation

- The laser marker has an integrated pilot laser for simulating the laser writing, e. g. for adjustment or validation purposes. This function in not needed during normal operation and can only be accessed via the touch panel through the service menu of the application.
- Only trained personnel or service technicians should operate the pilot laser.

The Laser module is controlled by the control unit of the device. Activating any options by pressing the buttons will be overridden by the control unit during normal operation.

WARNING!

Warning of laser radiation

Even though the laser marking chamber is designed to eliminate any kind of laser emission outside the chamber, pressing the pilot laser button will emit the CLASS 2 laser. So, avoid pressing the buttons on the control panel!
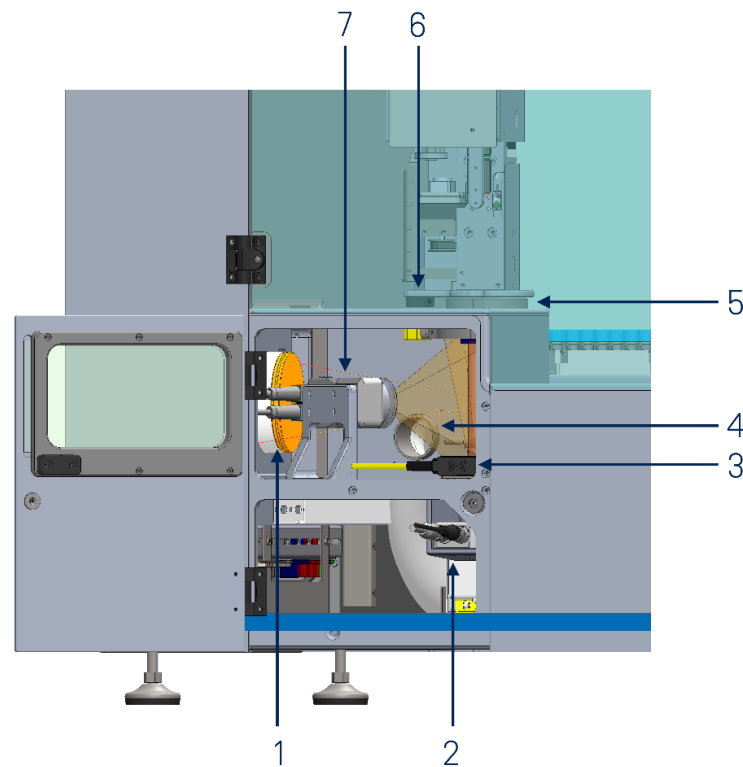
Lasering Process

Figure 16: Lasering process – safety concept

No.	Explanation
1	Laser scan head with lens
2	Barcode reader sensor
3	Door sensor – laser chamber
4	Opening for dust extraction
5	Opening for tube placement
6	Sensor – opening of tube placement
7	Marking field detection sensor

Table 10: Lasering process – safety concept - explanation

The entire laser process is accompanied by a comprehensive safety concept consisting of a separate laser chamber integrated into the device, as well as several sensors, to ensure the greatest possible protection for the operator. The process with the integrated safety equipment is described in the following

The tube handler picks up a tube from a rack and guides it through the opening to the laser position inside the laser chamber (see no. 5 in Figure 16). A sensor at the opening verifies that it is completely covered by the tube handler (see no. 6 in Figure 16). If the sensor detects that the opening is not completely closed, the process is stopped immediately. If the opening is completely closed, the barcode at the bottom of the tube is read using a barcode sensor (see no. 2 in Figure 16). A marking field detection sensor (see no. 7 in Figure 16) detects the area for the tube lasering. The tube is then lasered using a laser (see no. 1 in Figure 16), after which the tube handler transports the tube out of the laser chamber and back into the rack.

During the entire process, another sensor (see no. 3 in Figure 16) checks whether the door to the laser chamber access is closed. As soon as the door sensor notices that the door is opened, the process stops immediately.

In addition, the extraction and filter system is switched on and runs continuously during the process to extract dust and fumes generated during the laser processing from the laser chamber.

Lasering Safety

- If used properly with the laser chamber access door closed, this device meets the requirements for **laser class 1** in accordance with DIN EN 60825-1.
- The pilot laser emits **class 2 laser radiation** that is not shielded by the access door to the marking chamber. Since this radiation is dangerous to the eyes when looked at directly, wearing appropriate protective goggles is mandatory.
- Within the laser chamber, there is danger due to **class 4 laser radiation**. This radiation is very harmful to the eyes and harmful to the skin. Scattered or invisible radiation can also be harmful. Laser radiation can cause fire and explosion hazards.

- This device must not be operated if housing parts or covers are damaged.
- Users must not remove housing parts or covers under any circumstances. If the laser chamber access door is opened, the safety concept ensures, that no escape of class 4 laser radiation is possible.
- The operator of the laser equipment is responsible for the observance of the protection measures. Further information, accident prevention regulations, as well as operating instructions for all laser protection classes, can be found in the applicable directives.
- Depending on local regulations, a designated responsible person (e.g. laser safety officer) has to be appointed.

> To prevent eye or skin injuries to the operator, the laser stops immediately by closing the shutter when the laser chamber access door is opened during operation.

> **WARNING!**
>
> Depending on the material that is used for laser processing, hazardous dust or fumes that can harm the health of operators and the environment are released. These substances can cause cancer and lung damage.
>
> The hazardous substances are particulate (dust, fine dust) or gaseous (smoke, gases).
>
> - Only operate the device when the supplied extraction and filter system is attached and turned on.
> - Observe the operating manual for the extraction and filter system supplied.
> - Check the effectiveness of the extraction and filter system regularly.
> - Dispose the used filters properly.
> - Use only materials whose byproducts can be filtered with the connected extraction and filter system.
> - It is not permitted to bypass or manipulate the safety devices of the laser module, such as sensors or switches. This can lead to danger to the operating personnel.

Cleaning & Maintenance

The marking laser is a carefully developed device and offers almost maintenance-free components. However, errors may occur as a result of normal wear.

> **WARNING!**
>
> Depending on the material that is used for laser processing, hazardous dust or fumes that can harm the health of operators and the environment are released. These substances can cause cancer and lung damage.
>
> - When cleaning the marking chamber, wear disposable polypropylene gloves and a level 3 protective fine dust mask.
> - Ensure adequate ventilation in the room.

Cleaning the laser chamber:

- Turn the power of the control unit by pressing the On/Off button on the operating panel. See chapter 4.2.2.
- Open the laser marking access door.
- Cover the laser lens with the protection cap supplied with the device to protect the lens against damage.
- Disconnect the suction hose of the extraction and filter system from the user interface panel.
- Connect the provided nozzle to the open end of the suction hose.
- Turn the extraction and filter unit On using the control panel of the system.
- Clean the laser marking chamber. This will remove the contamination in the laser chamber.
- After cleaning, disconnect the nozzle from the suction hose.
- Reconnect the suction hose back to the user interface panel on the right side of the device.
- Remove the protection cap from the lens and close the laser chamber access door.
- Turn the power of the control unit on to start the normal operation.

> Before starting the operation of the device after cleaning the laser chamber with the extraction system, the device must be switched off at the main power supply switch, and then switched on again.

WARNING!

Risk of damage to the device and injury to the operator.

- After the cleaning of the laser chamber with the extraction and filter system, make sure that the extraction hose is re-attached to the device, before starting a laser process. Otherwise, the device will be contaminated with hazardous substances resulting from the laser processing.

WARNING!

- Never touch any glass surface in the marking chamber with bare fingers.
- Never clean glass surfaces using tools or hard objects.
- Never remove dust and dirt particles from the surface with compressed air.
- Never wipe any glass surface in the marking chamber using a dry cloth or paper.

Cleaning the lens protective glass:

- Remove dust using small bellows.
- To remove coarse dirt solely use lens cleaning paper together with isopropanol with an optical cleanliness of 99 %.
- Apply some drops of isopropanol on the lens cleaning paper, but do not touch the moistened side.
- Slowly move the lens cleaning paper towards one direction over the surface of the protective glass.
- Repeat this step using a new lens cleaning paper until the surface is completely cleaned.

Refer to chapter 10 for an overview of all cleaning and maintenance tasks.

> **WARNING!**
> - It is recommended that all kinds of repair and maintenance work be carried out by service technicians from the manufacturer or distributor or by authorized service personnel.
> - Tampering or modifications of any kind to the device by a third party will void all warranty claims.
> - Further information on the cleaning and maintenance of the laser module can be found in the supplied cab manual.

4.5.2 Extraction and Filter System Unit

The Tube Laser Marker is supplied together with an external extraction and filter system (see Figure 17). It is used to extract dust and fumes generated during material processing with the laser.

The extraction system protects the health of employees and prevents contamination of the laser chamber and the lens. It also ensures consistent laser efficiency. The air from the working area is extracted by a high-performance turbine through a flexible hose. Potentially hazardous substances are separated in the particulate air filter. Gaseous pollutants are absorbed by the activated carbon filter. The cleaned air is then returned to the environment.
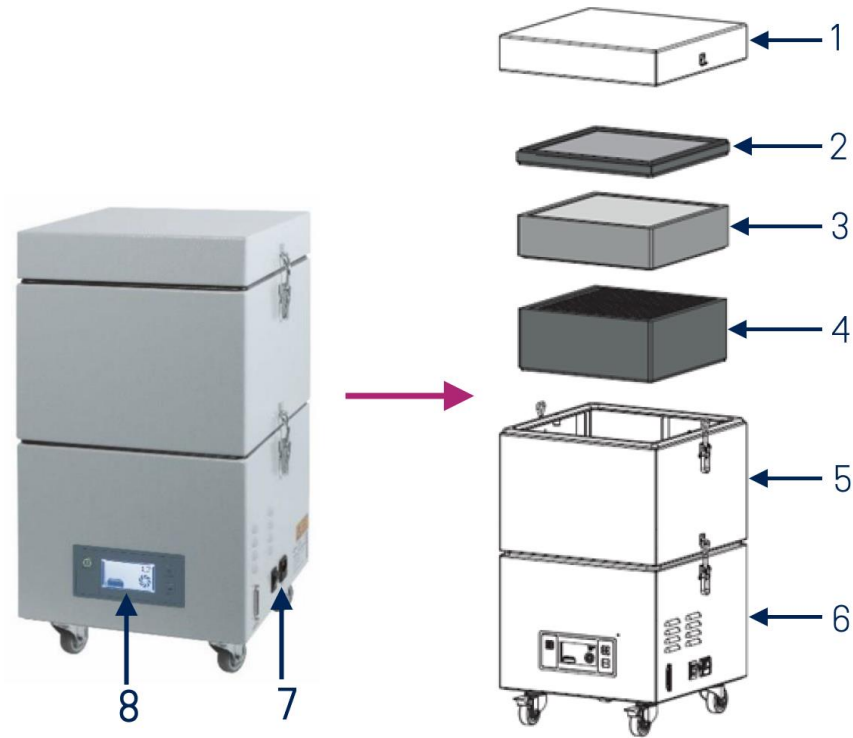
Figure 17: Extraction and filter system

No.	Explanation
1	Cover with extraction connector
2	Prefilter mat
3	Particulate air filter
4	Activated carbon/BAC filter
5	Module for the particulate air filter and activated carbon/BAC filter
6	Control/turbine housing
7	Power supply & switch
8	Control panel

Table 11: Extraction and filter system - explanation

The extraction and filter system must be switched on before operation. The suction hose must be properly connected on both ends to the opening on the right side of the Tube Laser Marker (see Figure 18) and the connection point at the extraction system. The extraction and filter system is controlled automatically or via the control panel on the Tube Laser Marker. It is only switched on when an automated tube marking process is running. It switches off automatically when the process is finished and is also turned off during a pick and place job.

> The main switch of the extraction and filter system must be on all the time during operation. The system then is automatically controlled by the device, depending on the status of the device or process selection.
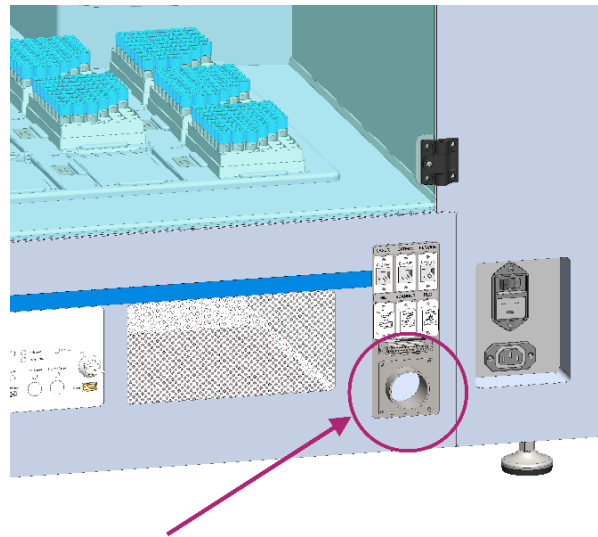

Figure 18: Opening for connection of hose

The following precautions must be observed for the safe and correct use of the extraction and filter system and to prevent damage to the system or injuries to the operating personnel:

- Use the device for the extraction of dust and fumes only.
- Do not use the device for the extraction of burning or glowing substances.
- Do not use the device to extract highly flammable or explosive gases.
- Do not use the device for the extraction of aggressive media or abrasive aluminium dust.
- Do not use the device to extract any kind of liquid.
- Protect the power cable against heat, moisture, oil and sharp edges.
- Observe the supply voltage specified on the type plate.
- Use genuine spare parts and replacement filters only.
- Do not use the device without an inserted filter.
- Unplug the device before opening it.
- The outlet on the back of the device must not be covered or blocked by any means.
- Make sure the device stands firm and safe.
- In case of technical problems, please contact the manufacturer or your specialist retailer.
- When extracting carcinogenic substances or welding fumes of materials containing nickel or chrome, the ventilation requirements specified by the Technical Rules for Hazardous Substances TRGS 560 "Air recirculation in connection with the treatment of carcinogenic hazardous materials" are to be met.
- Observe local work regulations for personal protective equipment (PPE), such as breathing protection, rubber gloves, or safety goggles. Depending on the dangerous goods class, a protective suit should be worn as well.

The settings and parameters of the extraction system are adjusted according to the specified use of the Tube Laser Marker (see chapter 1.1) and no further adjustment is necessary for normal operation. In case changes to the settings still have to be made, e.g. adjusting the extraction performance, please consult the manufacturer's user manual supplied.

> The extraction and filter system supplied with the Tube Laser Marker is an external device distributed by cab. Further information regarding operation and maintenance, e. g. filter changing, can be found in the user manual supplied by cab.

> **WARNING!**
> Before operating the extraction system, the safety instructions listed in the operating manual of the distributor cab must be carefully read and observed. Failure to do so may result in faults in the system or danger for the operator.

> **WARNING!**
> Do not use the extraction and filter system for any purpose other than specified in this manual. Any other use is not permitted and may result in the loss of warranty claims or damage to the system.

Cleaning & Maintenance of the Extraction System:

- Before cleaning the device, make sure that it is shut down and unplugged from the main power supply.
- The system housing is coated with a resilient varnish. It can easily be cleaned using a damp cloth and a common household cleaning agent. Do not use any solvents.
- Make sure no cleaning water leaks into electric components or into the ventilation slots.
- In case you loosen filter modules for cleaning, make sure not to damage the seals and ensure the proper fit of the seals before putting the device back into operation.
- Dry well with a dry cloth.
- Refer to chapter 10 for an overview of all cleaning and maintenance tasks.

> **WARNING!**
> - When cleaning the device, proper protection equipment is to be worn in order to prevent contamination with potentially harmful substances.
> - The replacement of turbines or electric components may only be performed by authorised specialists.

Filter Saturation Indicator and Filter Replacement:

- The individual filter stages are to be checked regularly (at least once a week).
- If required, the filters are to be replaced in order to ensure a consistent extraction performance and to prevent any damage to the system.
- During the filter replacement, the extraction process must be turned off and appropriate protective clothing must be worn.

WARNING!

- Do not clean air particle filters. They must be replaced in order to guarantee the consistent performance of the device.
- Activated carbon/BAC filters are to be checked and replaced regularly. They are not shown on the system's filter monitoring – it is recommended to replace them at least once a year.

WARNING!

Health and environmental hazards due to by-products of laser processing.

- Laser processing causes by-products harmful to both health and the environment, ranging from lung-irritating to carcinogenic effects.
- When working on filters, always wear disposable polypropylene gloves and a protection-level 3 FFP fine dust mask.
- Keep an air-tight and sealable polyethene bag ready for filter replacement.
- Do not clean the filter, but replace it with a new original one.
- Make sure that the room is properly ventilated.
- Dispose of as special waste according to the local regulations.

4.5.3 Handheld Barcode Scanner Unit

The Tube Laser Marker is equipped with a handheld barcode scanner to scan the barcodes of the racks and rack positions when setting up an automated process (see Figure 19). The scanning of the racks and rack positions is performed after the job selection via the touch panel (see also chapter 6.6.1).

Figure 19: Hand scanner

> ℹ️ The hand scanner GRYPHON from the manufacturer DATALOGIC is an external device supplied with the Tube Laser Marker. Further information regarding operation and maintenance can be found in the supplied user manual.

Before operating the hand scanner, ensure that the USB cable is plugged into the port named Scanner on the user interface on the right side of the device (see no. 5 in Figure 8).

The hand scanner is used to read the barcodes of the racks and rack positions in the Tube Laser Marker. It is recommended not to adjust the settings of the scanner.

> ℹ️ For changing the configuration (beep tone, volume, barcode, etc.,) of the scanner, please refer to the manufacturer's user manual supplied.

5 General Information of the TLM

5.1 Touch Display Overview

The Tube Laser Marker has a Linux operating system integrated into the touch panel for the stable running of the application. As default, the desktop of the touch panel is loaded with the following applications.
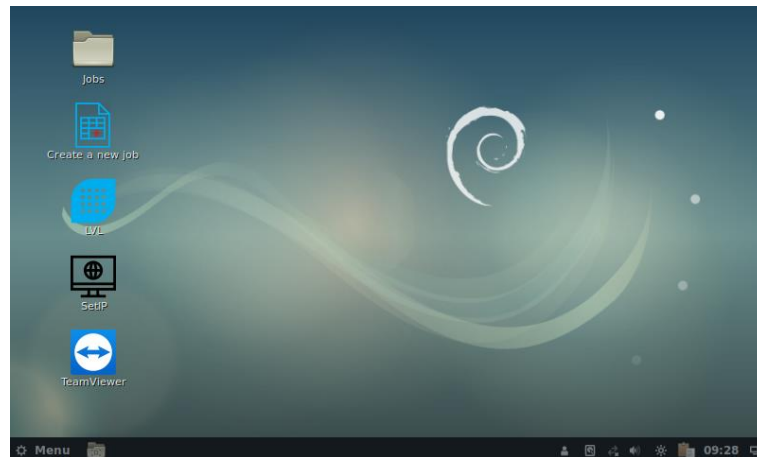

Figure 20: Touch display: desktop

> ℹ The arrangement of icons on the desktop may differ depending on the device.

5.1.1 Jobs Folder

The jobs folder on the desktop of the touch display has the job files, which are either processed or need to be processed. Those job files act as a validation document that refers to the processing status of the individual tube like the following.

- Bottom barcode (Tube identification)
- Processing status (processed or not processed)
- Processing state (OK or NOK)
- Lasered Information or Pick & Place Information

> ℹ If the REST Server has a different location (like an internal server on the customer site) after machine commissioning, then the location of the job files will be different.
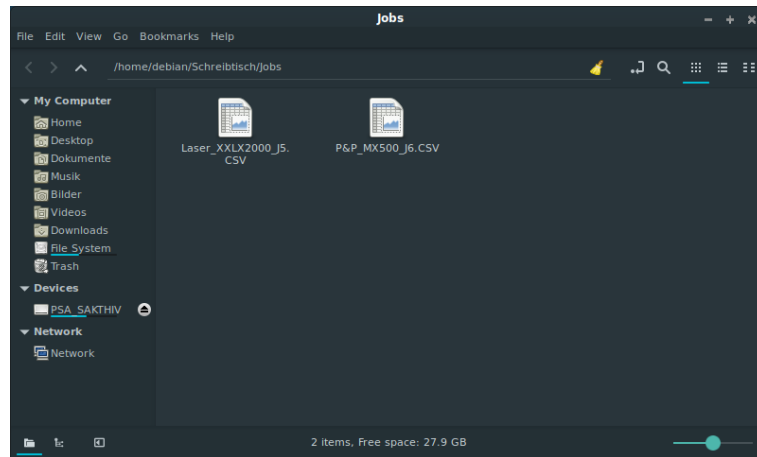
Figure 21: Jobs folder

In the example Figure 21, there are two different jobs. These two jobs will only be available for the automation process. New jobs can be added or the current ones can be modified or deleted depending on the requirement. If any changes have been made to the jobs, then the GUI must be refreshed using the Refresh Jobs button to update the changes to the jobs [see 5.2.2].

The jobs are always created or modified in a CSV format.

5.1.2 Create a new job Icon

The Create a new job icon on the desktop helps to create a job for the Tube Laser Marker. Clicking the icon opens up a terminal, where the user can create a new job.
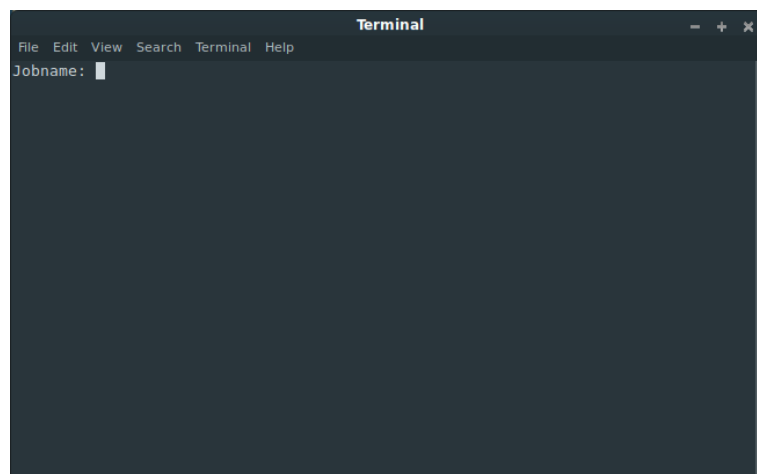
Figure 22: Create a new job terminal

New jobs can also be created directly from a CSV File.

For detailed information on creating a new job, see Chapter 6.4.

5.1.3 LVL Icon

Double-clicking the LVL icon (see Figure 20) will open the LVL GUI or the main GUI of the Tube Laser Marker (see Figure 25).

5.1.4 SetIP Icon

The SetIP icon opens the application to setup the internet protocol connection between the device and the customer network. The customer can connect the device either through a DHCP connection or a static IP connection.
For the Static IP connection, the following is needed.

- IP Address
- Netmask
- Gateway
- Nameserver

The connection enables the device to access the job file if the job files are stored in the customer database. This connection can also allow the customer to connect the device to the internet, so remote support for the customer can be provided through TeamViewer (see Chapter 5.1.5).
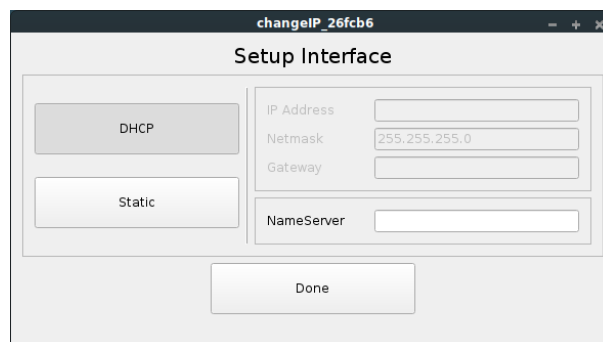
Figure 23: Setup interface

ℹ	As default, the DHCP protocol is enabled.

ℹ	The external network port on the user interface should be connected to the customer network through an ethernet cable to establish a connection between the device and device and the customer network.

5.1.5 TeamViewer Icon

Remote support for the Tube Laser Marker can be provided through TeamViewer, which is available on the desktop of the touch panel. The touch panel needs an internet connection to access Teamviewer. Once the touch panel has an internet connection (see Chapter 5.1.4), the TeamViewer can be opened after confirming the end-user license agreement.
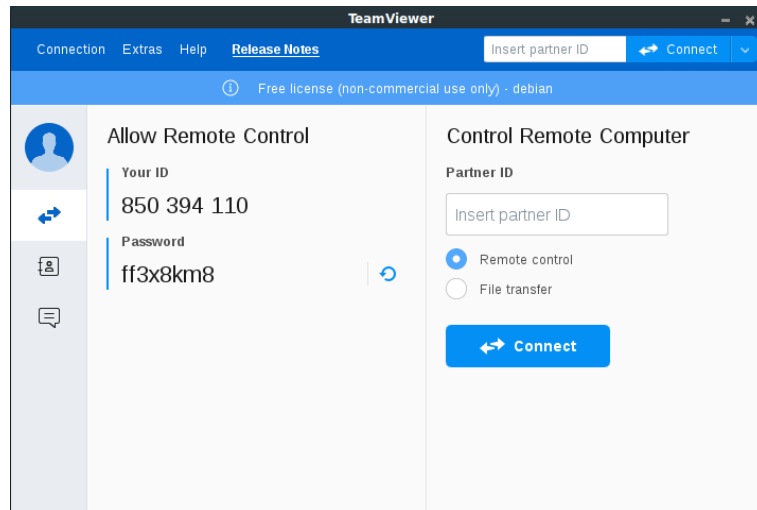

Figure 24: TeamViewer

- If the device has an internet connection and the firewall of the customer site does not block the TeamViewer, then the TeamViewer will be opened with an ID and a password as shown in Figure 24: TeamViewer.
- Each time when opening the TeamViewer, it might generate a different ID and password.

5.2 GUI Overview

The Tube Laser Marker runs on two-level graphical user interfaces.

1. Main GUI
2. Process GUI

5.2.1 Main GUI

The Main GUI is the base GUI, which runs the complete application of the device.

The Main GUI on the touch panel starts automatically after switching on the device. Only from this GUI, the user can access the Process GUI, X Tab, and the Service Tab.
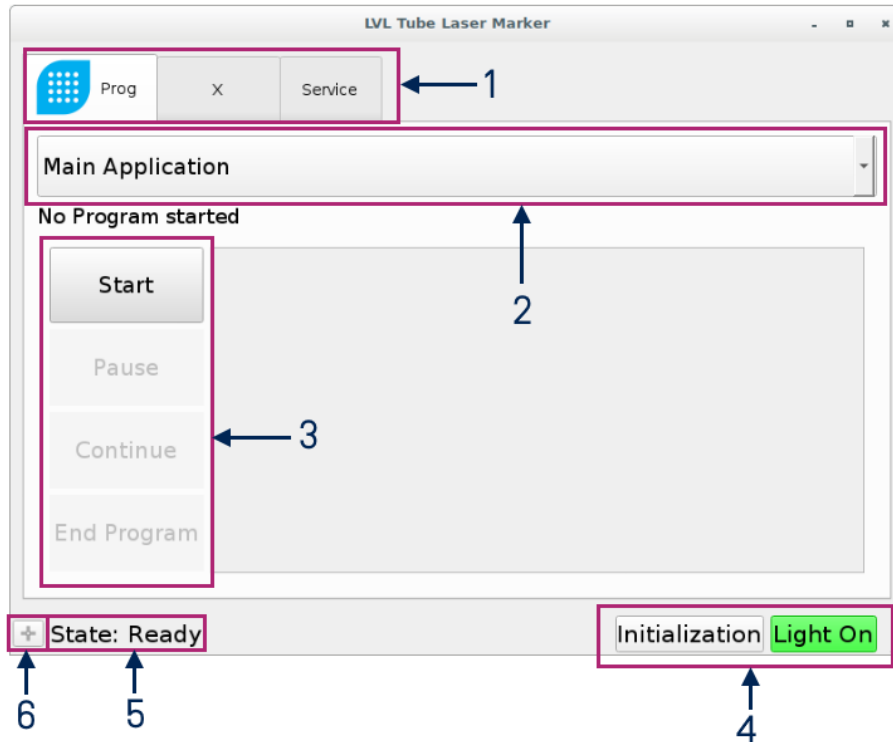
Figure 25: Main GUI overview

No.	Explanation
1	Main tabs (see chapters 5.2, 7 and 8)
2	Program selection drop-down menu
3	Action buttons: Start: starts a program or process Pause: pauses a running process Continue: continues the paused process End Program: aborts the running process
4	Quick Access Buttons: Initialization: Performs initialization of the entire device Light on/off toggle button: switching on/off the light in the process room of the device
5	Device status: Ready: the device is ready for input Running: the device is running a process Pause: the device is on pause during a process Error: an error occurred during a process
6	Toggle Button to maximize/minimize the GUI

Table 12: Main GUI overview – explanation

5.2.2 Process GUI

The process GUI is launched from the Main GUI, through the drop-down menu Main Application →
Start.

The process GUI provides the visual interpretation of the normal operation.
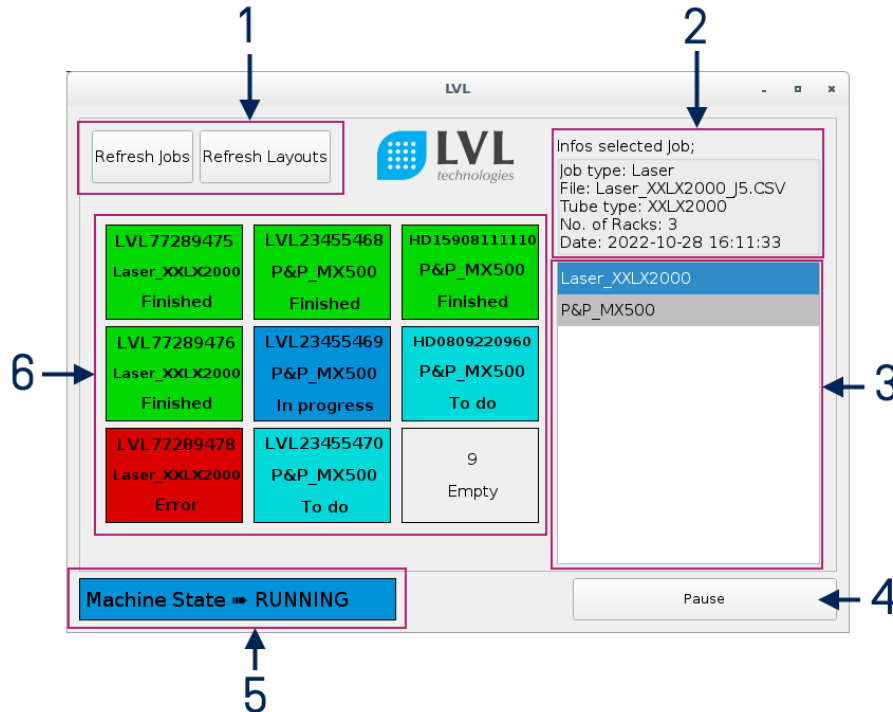
Figure 26: Process GUI overview

No.	Explanation
1	Refresh Buttons: Refresh Jobs: Refreshes the jobs in the REST server of the device to update the newly added or modified jobs with the current or old jobs in the job selection area. Refresh Layouts: Refreshes the laser layouts storage location to update the created or modified laser layouts.
2	Job Information Area: Provides the following information about the job. Job Type: Laser or pick & place File: Job name Tube Type: One of the permitted tube types No. of Racks: Number of racks processed in this job Date: Date & Time of job
3	Job selection Area: Lists out the jobs that are available in the REST server.
4	Pause Button: Pauses the current operation.

No.	Explanation
5	Machine State: READY: The device is ready for input RUNNING: The device is running state during a process PAUSE: The device is in a pause state during a process ERROR: The device is in an error state during a process
6	Rack Information Area: See Chapter 5.2.3

Table 13: Process GUI overview - explanation

5.2.3 Rack Information Area

The rack information area provides a pictorial representation of the status of the racks on the rack holder.
Here is the representation of the empty and occupied rack positions.

Empty Rack Position
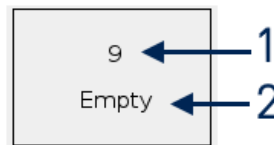
Figure 27: Empty rack position

No.	Explanation
1	Rack Position
2	Occupancy Status

Table 14: Empty rack position - explanation

The background color of the emptied rack position is always white.

Occupied Rack Position
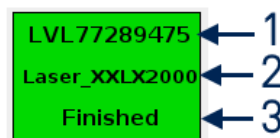
Figure 28: Occupied rack position

No.	Explanation
1	Rack Barcode
2	Job Name
3	Process Status (with color coding) Planned: The rack has a job defined to it, but the process has not been started. To do: The rack needs to be processed, but the process has been started for other racks. In Progress: The rack is in progress. Error in Progress: The rack is in progress, but there has been some error in the processed section of that rack. Error: The rack has been processed, but the rack has some errors. Finished: The rack has been finished.

Table 15: Occupied rack position - explanation

> The background color and the process status of the occupied rack position change automatically at the beginning and the end of the processing of the rack.

5.3   Changing Numbers

Various numerical values can be entered during the operation of the Tube Laser Marker. To change a specific number, click on it, and then a numeric keypad is displayed for entering a new number.
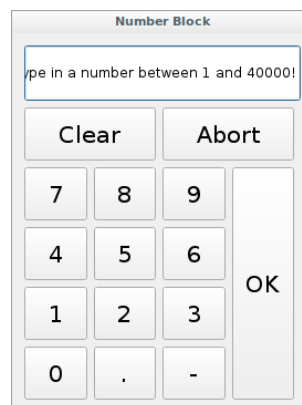
Figure 29: Numeric keypad

Command	Explanation
Clear	Clears the input field.
Abort	Cancels the input.
OK	Accepts the entered value.

Table 16: Numeric keypad - explanation

5.4 Error Handling

If an error occurs, the device stops, and a window with the error message is displayed.

- Read the message carefully and, if necessary, perform the actions mentioned in the message.
- Press Continue to continue the process or Cancel to abort the process.
  - o If the Continue button is pressed, initialization of the entire system is performed and the process continues after resolving the error (see Chapter 9).
  - o If the Cancel button is pressed, a new window appears asking for confirmation to abort the process.
- If the problem cannot be corrected or reoccurs, contact a service technician for additional support.

WARNING!

Risk of incorrect results or damage to machine parts

- Pressing Continue without understanding the displayed error and resolving it might interrupt the automation process and can cause damage to parts in the device.
- Improper acknowledgment of errors may cause undesired results.

See Chapter 9 for a detailed explanation.

5.5   Signal Bar – Color Coding

The Tube Laser Marker is equipped with a signal bar located at the front of the device (see no. 7 in Figure 5 in Chapter 4.1). It provides information about the status of the system.
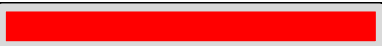
	Illuminated blue: device is in standby mode
	Illuminated green: device is running
	Flashing green: device is waiting for input
	Flashing red: error on the device

Table 17: Signal bar - explanation

> The frequency of the flashing LEDs can be adjusted in the service menu, in case the frequency of the flashing LEDs causes epilepsy or other symptoms to the operator.

6 Operating the TLM

6.1 Switching on the TLM

Start the Tube Laser Marker by turning ON the main switch [1] located at the power supply panel [see Figure 30]. This starts the touch panel and activates the power supply of the device. See also chapter 4.2.1.

By pressing the ON/OFF button [2] on the operating panel the PLC unit of the device is turned on. The device cannot be taken into automated operation without pressing the ON/OFF button.
Once the device is turned on, the Reset Emergency Stop button needs to be pressed once to confirm that the device is ready for normal operation.
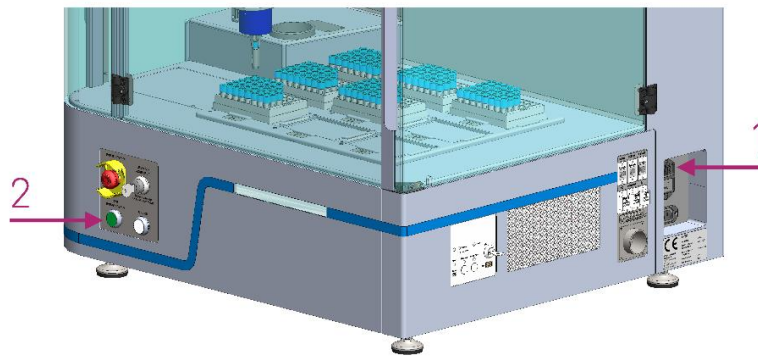
Figure 30: Switches

> ℹ The extraction and filter system attached to the instrument has a separate main switch to turn the power on or off. See chapter 4.5.2.

6.2 Switching off the TLM

The device is turned off by using the Shut Down button in the X Tab of the Program GUI [see also Chapter 7] and pressing the On/Off button at the operating panel of the device. Once the touch panel is shut down completely, the main switch cab is turned off to remove the power to the device. Alternatively, the application can be closed via the Close Application button in the X tab. Then the Linux operating system has to be shut down separately via the menu button on the desktop of the touch panel.

The extraction and filter system attached to the instrument has a separate main switch to turn the power on or off. See chapter 4.5.2.

CAUTION!

Risk of losing data

- Do not turn the main switch off before finishing the automation process and shutting down the touch panel properly.

6.3   Starting the GUI

Once the Tube Laser Marker is turned on, the GUI (see Figure 25) of the device pops up automatically.

If the GUI has been closed to create a new job or edit an existing job, the GUI can be reopened by double-clicking the LVL Application icon on the touch panel (see Figure 20).

The Prog tab (see Figure 25: Main GUI overview) in the main GUI includes all the required options for the normal operation of the Tube Laser Marker. The desired program from the drop-down menu is started by selection the option and pressing the Start button. The drop-down menu allows to select one of the following options:

- Main application (see chapter 6.6)
- Statistics (see chapter 6.7)

6.4 Creating Jobs

Jobs are an integral part of the automation process in the TLM. The jobs are created in CSV File format and those files act as the reference document in which the information of the racks, tubes, and the process status of those.

The jobs for the TLM can be created using two different methods.

1. Creating a new job
2. Modifying an existing job

6.4.1 Creating a new job

A new job is created using the Create a new job icon on the desktop in the touch panel (see Figure 22). Generally, the job is created on a Terminal window.

> **i** Create a new job icon can be accessed by closing the main GUI under the command
> X Tab → Close Application.

The terminal for creating new jobs is intuitive and easy. After providing the information asked to each command on the terminal, the jobs are created.

> **i** If the provided information to the respective command is not correct, then the terminal asks for suitable input.

Figure 31: Create a new job terminal

In the following table, the terminal is explained with the example (written in magenta) mentioned in Figure 31 along with some hints and tips (with # in front of the text) for a better understanding of the created jobs.

Command	Explanation
Jobname:	Provide a name for the creating job. There is no nomenclature for providing names for the jobs. #Providing some hints to differentiate between the laser job and the pick & place job in the job name will help to understand the job easily. # Providing some hints to differentiate the tube type in the job name will help to understand the job easily. In this example: Laser_XXLX2000
Job type:	Provide the job type, whether it is laser or pick & place job by typing either Laser or 1 or either PickPlace or 2 respectively. In this example: Laser
Tube type:	Provide the tube type by typing either one of the mentioned tube types or the corresponding number. In this example: XXLX2000
Number of tubes:	Provide the number of tubes to be processed. Depending on the number of tubes, the required number of racks is calculated automatically. # Providing an alphabet instead of numbers will not be accepted. # Providing tubes quantity more than the TLM can be accommodated will not be accepted. In this example: 72 (Equivalent: 3 x SBS Racks 24)
Are there two marking fields on the tube? [y / n]	Provide whether there are two marking fields (black area) on the tube. #Providing y or yes will be considered that the tube has two marking fields. #Providing n or no or anything apart from y or yes will be considered that the tube has only one marking field. In this example: y
Front laser layout:	Provide the desired laser layout name which has been intended for the tube. #Providing a laser layout name that is not available in the layouts will throw an error message during normal operation. The terminal cannot verify the available laser layout during the job creation process. #Available laser layouts can be seen in the Process GUI by pressing the Refresh Layouts button.

Command	Explanation
	In this example: C128_HR
No of objects in the front marking field:	Provide the no of objects which is in the previously mentioned laser layout. The number of objects used to create the laser layout will be required. # Providing an alphabet instead of numbers will not be accepted. #TLM generally recommends laser layouts with one object for smaller marking fields (in SX300, MX500, LX1000, etc.,) and two objects for a bigger marking field (in XLX2000, XLX4000, etc.,). In this example: 2 (Object no. 1 is C128 [Code 128 Barcode] and object no. 2 is HR [Human-readable text])
Front marking field Info 1:	Provide the lasering information that object 1 of the front laser layout marks on the tube. #Providing <%> will laser the bottom barcode of the tube to the corresponding object. #Providing <n> will create a new line in the corresponding object. #0nyl certain special characters are accepted. Verify it with the object of the laser layouts. In this example: <%> (The bottom barcode of the tube is lasered in the code 128 barcode format, as object 1 of the front laser layout is code 128.)
Front marking field Info 2:	Provide the lasering information that object 2 of the front laser layout marks on the tube. #Providing <%> will laser the bottom barcode of the tube to the corresponding object. #Providing <n> will create a new line in the corresponding object. #0nyl certain special characters are accepted. Verify it with the object of the laser layouts. In this example: Lot:121792 (This will be lasered without any format changes, as object 2 is human-readable. If <%> is provided here, the bottom barcode of the tube will be lasered as a human-readable text and numbers.)
Back laser layout:	Provide the desired laser layout name which has been intended for the tube. #Providing a laser layout name that is not available in the layouts will throw an error message during normal operation. The terminal cannot verify the available laser layout during the job creation process.

Command	Explanation
	#Available laser layouts can be seen in the Process GUI by pressing the Refresh Layouts button. In this example: C128_HR
No of objects in the back marking field:	Provide the no of objects which is in the previously mentioned laser layout. The number of objects used to create the laser layout will be required. # Providing an alphabet instead of numbers will not be accepted. #TLM generally recommends laser layouts with one object for smaller marking fields (in SX300, MX500, LX1000, etc.,) and two objects for a bigger marking field (in XLX2000, XLX4000, etc.,). In this example: 2 (Object no. 1 is C128 [Code 128 Barcode] and object no. 2 is HR [Human-readable text])
Back marking field Info 1:	Provide the lasering information that object 1 of the back laser layout marks on the tube. #Providing <%> will laser the bottom barcode of the tube to the corresponding object. #Providing <n> will create a new line in the corresponding object. #Onyl certain special characters are accepted. Verify it with the object of the laser layouts. In this example: <%> (The bottom barcode of the tube is lasered in the code 128 barcode format, as object 1 of the back laser layout is code 128.)
Back marking field Info 2:	Provide the lasering information that object 2 of the back laser layout marks on the tube. #Providing <%> will laser the bottom barcode of the tube to the corresponding object. #Providing <n> will create a new line in the corresponding object. #Onyl certain special characters are accepted. Verify it with the object of the laser layouts. In this example: Lot:121792 (This will be lasered without any format changes, as object 2 is human-readable. If <%> is provided here, the bottom barcode of the tube will be lasered as a human-readable text and numbers.)
Everything correct? [y / n]	Provide whether the provided information is correct by verifying with the displayed summary. #Providing y or yes will be considered that provided information is correct and a new job will be created in the job location and the terminal will close automatically.

Command	Explanation
	#Providing n or no or anything apart from y or yes will be considered that the provided information is not correct and the terminal starts the commands from the beginning.
	In this example: y (The provided information is correct and s job named Laser_XLXX2000 is created and the terminal will be closed)

Table 18: Create a new job terminal

The return key ↵ should be pressed in the terminal after providing the information. Without pressing the return key, the terminal does not get the input.

For a pick & place job, the same applies. except for the laser layout selection, the desired placing rack (standard rack or high-density rack) is asked in the terminal.

- Creating a new job is optimal when a new tube type or new process (laser or pick & place) is introduced to the working TLM.
- Creating a new job is more suitable where every job is totally different from the previous jobs.
- Modifying an existing job is optimal when the same process is repeated for a different batch of tubes with a slight change in the information.
- Modifying an existing job is more suitable where the current job is more or less similar to the previous jobs.

6.4.2 Modifying an existing job

Modifying an existing job is performed to the created job file in the respective location. This involves manually editing the CSV file to have a new job for the automation process.

An existing job icon can be modified by closing the main GUI under the command X Tab → Close Application and opening the Jobs folder on the desktop.

If the jobs are located in a different location, then the folder in the respective location is opened.

Modifying an existing job is easy. After making the respective changes to the CSV File, it should be saved in the CSV format to use the file.

It is recommended to create a copy of the file that needs to be modified, so the original file will be left unaffected by the changes that will be made during the modification.

Here is a sample CSV File after creating a job.

The below-shown sample file is created through the Create a new job icon. And it is the same file that has been created from Figure 31

Figure 32: CSV File: created job

The below figure is an example showing the CSV File of the above-mentioned processed job

Figure 33: CSV File: processed job

The table below explains each piece of information with the example (written in magenta).

No.	Explanation
1	Jobname (Desired) In this example: Laser_XXLX2000
2	Jobtype (Laser or Pick & Place) Laser
3	Tubetype (One of the LVL-approved tube types) In this example: XXLX2000
4	Laserlayout: on the front marking field (Available laser layout for the corresponding tube type) In this example: XXLX2000_C128_HR (Laser layout corresponding to the tube type XXLX2000 with two objects. Object 1. Code 128 barcode and Object 2. Human-readable information)
5	Laserlayout: on the back marking field (Available laser layout for the corresponding tube type) In this example: XXLX2000_C128_HR (Laser layout corresponding to the tube type XXLX2000 with two objects. Object 1. Code 128 barcode and Object 2. Human-readable information)
6	Rack (Rack holder position, where the rack has been placed or is to be placed) In this example: 1, 2 & 3 (2& 3 not visible in the image)
7	Position (Tube position in the respective rack) In this example: A1 -D6 of each rack (SBS Rack 24)
8	Field 1 Info 1 (Information needs to be lasered on the object no. 1 of the front marking field) In this example: <%> (Lasers the bottom barcode information of the tube as code 128 barcode format)
9	Field 1 Info 2 (Information needs to be lasered on the object no. 2 of the front marking field) In this example: Lot:121792 (Lasers the information Lot:121792 as human-readable format)
10	Field 2 Info 1 (Information needs to be lasered on the object no. 1 of the back marking field) In this example: <%> (Lasers the bottom barcode information of the tube as code 128 barcode format)
11	Field 2 Info 2 (Information needs to be lasered on the object no. 2 of the back marking field) In this example: Lot:121792 (Lasers the information Lot:121792 as human-readable format)
12	Rackbarcode (Scanned rack barcode using the handheld barcode scanner) In this example: LVL77289475 (TLM writes this rack barcode information in this area after when the operator scans the rack barcode)
13	2D-Barcode (Scanned bottom barcode during the process using the barcode reader in the laser marking chamber) In this example: LV430279161 (TLM writes this tube barcode after reading the barcode from the bottom of the tube)
14	Status (Status of the processed tube. Either OK or nOK.) In this example: OK (TLM write this status once the process of the tube is completed)

Table 19: CSV File explanation

- • If the tube has only one marking field, then options 5, 10, and 11 should be removed.
- • If the laser layout has only one object, then options 9 and 11 should be removed.

The below example shows the changes made to an existing CSV File to create a new job for different tube type.

Figure 34: CSV File: modified job

If the CSV files are created on another PC, those files should be saved with the following settings.

- • Character set: ISO 8859-1 / Latin-1 / Windows-1252
- • Field delimiter: , (comma)
- • Text qualifier: " (quotation mark)

6.5   Creating Laser Layouts

> **i** End users are not recommended to create laser layouts, as creating the laser layout is a tedious process and can access the root settings of the laser. So, it is recommended that the user should contact LVL for further laser layouts.

Eventhough the user will not be able to create or modify the laser layouts, this chapter provides an overview on laser layouts. In order to laser the tubes, desired laser layouts are needed. Those laser layouts are created using cabLase Editor 5 software. This software cab downloaded from the cab website. But TLM is generally equipped with sufficient default laser layouts that are needed for normal operation.

> **i** The cabLase software can be downloaded freely, but creating the laser layouts and accessing the XENO 4 Laser in the TLM needs a serial key. This serial key is available in the Laser Layout Access USB Key.
>
> The Laser Layout Access USB Key is not provided to the general user for safety purposes.
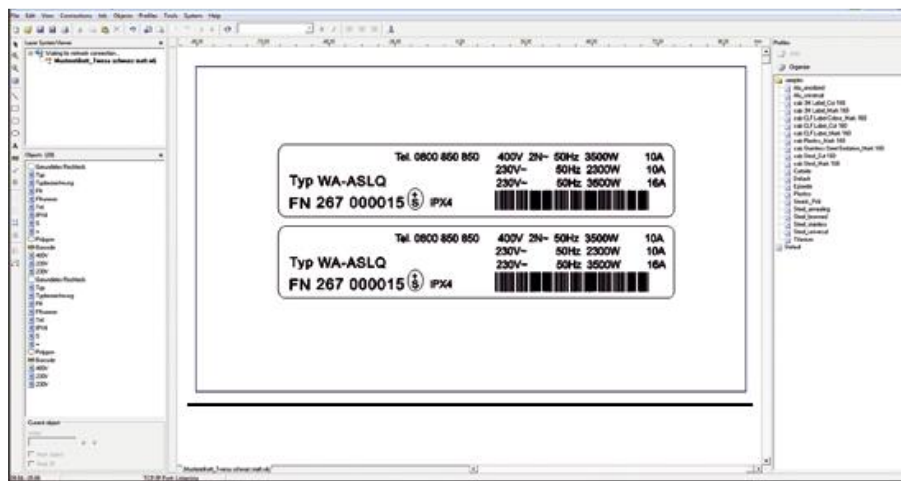

Figure 35: cabLase 5 software

> **i** Special laser layouts that are needed for the operation can be provided by the manufacturer or distributor upon request.

> **i** Further information regarding the creation of laser layouts can be found on the cab website. https://www.cab.de/en/marking/marking-laser/cablase/#uebersicht

Once the Layouts are created, those changes will be updated by pressing the Refresh Layouts in the Process GUI. This will opens the available layouts window and show the updated and available layouts in the system.
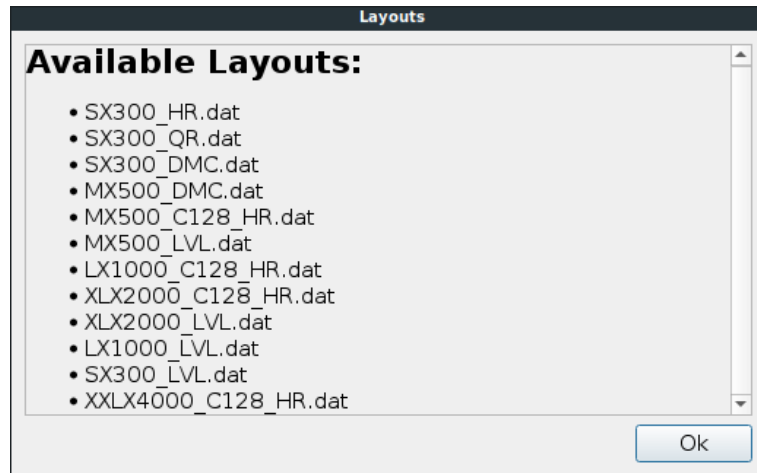
Figure 36: Available layouts

6.6 Main Application

By selecting Main Application and pressing the Start button, the Process GUI (see Figure 26) opens and allows to set up the automated process.
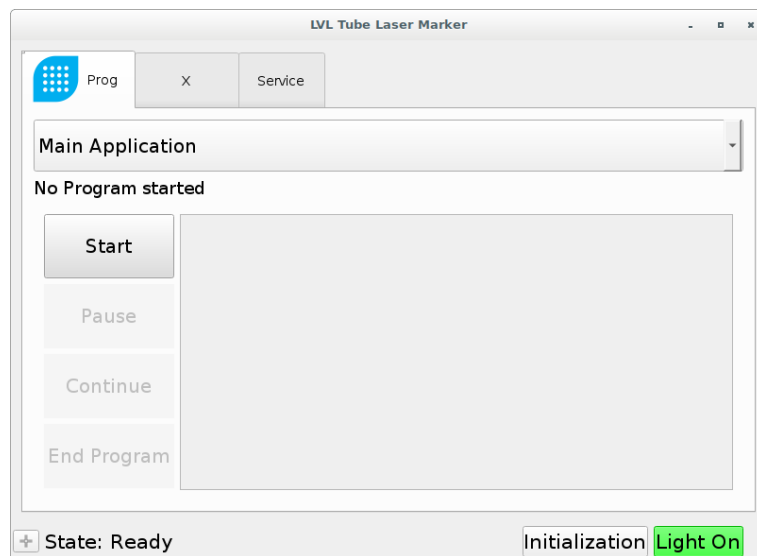

Figure 37: Main application starting window

A detailed description of the process GUI in explained in the Chapter.

6.6.1 Preparation of Job

The following chapter provides an overview of how to prepare the TLM for the created jobs.

> **i** For Job creation, see Chapter 6.4.

Job Selection

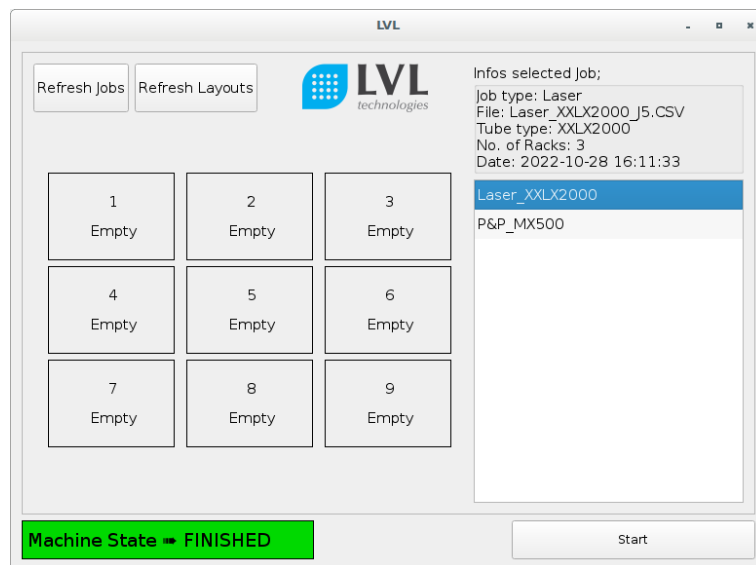Once jobs are created for the TLM, the jobs are available in the job selection area of the Process GUI.

Figure 38: Job selection

> **i** In this example, two jobs have been added to the process.
> 1. Lasering Job: Laser_XXLX2000
> 2. Pick & Place Job: P&P_MX500

> **i** • More than one job can be added to the jobs list at an instance.
> • Refresh Jobs button should be pressed if new jobs have been added to the list during the process.

Rack Selection

Once the respective job is clicked, a position job window appears. This request is for the desired rack that needs to be processed. The respective rack barcode needs to be scanned using the handheld barcode scanner. Once the barcode of the rack is scanned, the human-readable format of the barcode appears on the input field of the window.
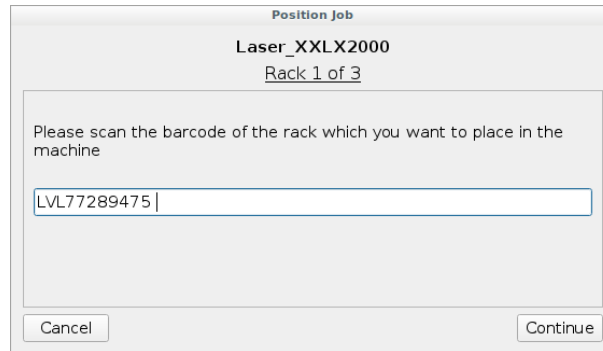
Figure 39: Rack selection

In this example,

- The name of the job Laser_XXLX2000 is displayed at the top.
- The number of tubes to be processed was provided as 72 in the job, which corresponds to three XXLX2000 SBS racks. So, the window is requesting the rack information of the first rack (Rack 1 of 3).
- The scanned barcode corresponds to the rack barcode number LVL77289475.

The rack barcode number is saved in the job file once the rack barcode is scanned.

Position Selection

After scanning the rack barcode and pressing continue, the position job window for rack holder position pops up. In this window, the desired rack holder position barcode is scanned. Each rack holder position is identified using an individual position barcode, which is attached below the rack holder position (see Figure 12).
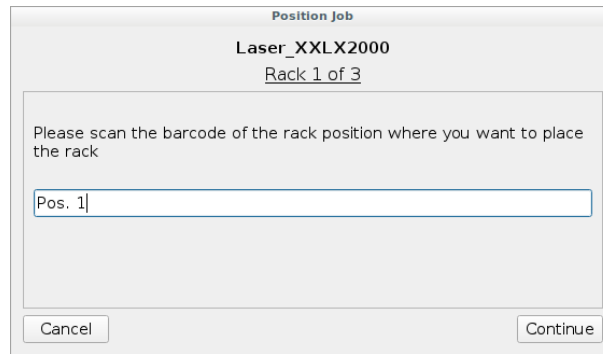
Figure 40: Rack position selection

In this example,

- The name of the job Laser_XXLX2000 is displayed at the top.
- The number of tubes to be processed was provided as 72 in the job, which corresponds to three XXLX2000 SBS racks. So, the window is requesting the rack position information of the first rack (Rack 1 of 3).
- The scanned rack is placed in rack holder position 1 (Pos. 1).

Step 6.4.2 and 6.4.3 is repeated till all three racks has been scanned and placed in the rack module

Once the desired number of racks (corresponding to the number of tubes provided during job creation) has been prepared for the process, the position job window pops up with an overview of the racks and the respective positions.
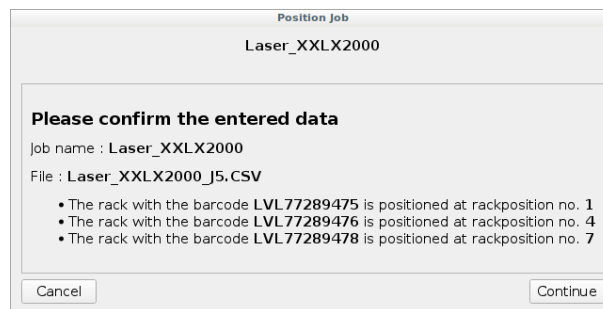

Figure 41: Racks and rack position overview

In this example,

- The name of the job Laser_XXLX2000 is displayed at the top.
- Along with the job name, the provided information (rack barcode and rack position) is stored in the job file (Laser_XXLX2000_J5.CSV)
- The number of tubes to be processed was provided as 72 in the job, which corresponds to three XXLX2000 SBS racks. So, the window is showing the information of the three scanned and placed racks (LVL77289475, LVL77289476, and LVL77289478) at positions 1, 4, and 7 respectively.

After pressing continue on the overview window, a rack orientation warning window pops up to provide an overview on how to orient the racks on the rack holder position.
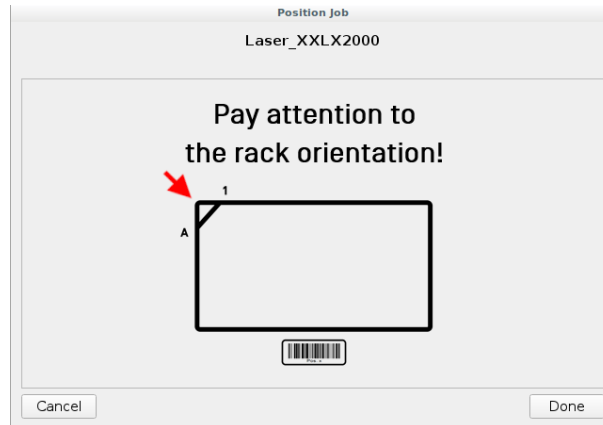

Figure 42: Rack orientation
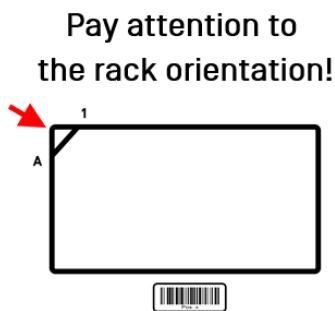
ATTENTION!

- Pay attention to the rack orientation!

Each tube might have individual information lasered. If the rack is not oriented properly, the intended information might not be written on the corresponding tube. For the correct orientation, always position the rack such that coordinate A01 sits on the top left corner of the rack holder.

Once the job selection is done, the Process GUI shows the pictorial representation of the position and the status of the picked racks.

Figure 43: Prepared job

In this example,

- The laser job is planned for the XXLX2000 tubes and the racks are placed in rack positions 1, 4, and 7.
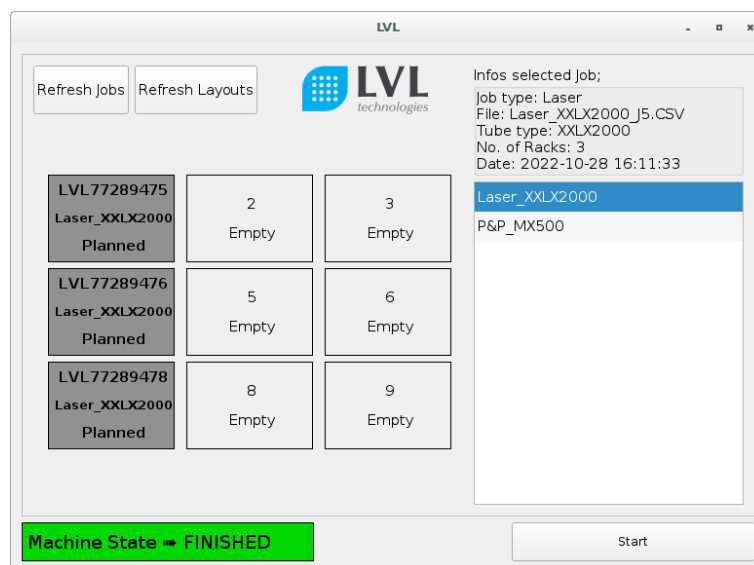- New jobs can be planned for the rest of the positions if needed.

The application of TLM uses the FIFO method to process the racks. This means the TLM process the racks according to their placement order.

For example, if the racks are placed in the rack position in the order 4, 7, and 1, then the TLM process the rack in position 4 first, followed by the rack in position 7, and then processes the rack in position 1.

6.6.2 Processing of Job

The jobs can be prepared for one or more rack positions (if needed) and then the automation process can be started to have a better walk-away time for the operator.

Once the jobs are prepared, Start button on the right bottom side of the Process GUI can be selected to start the automation process.
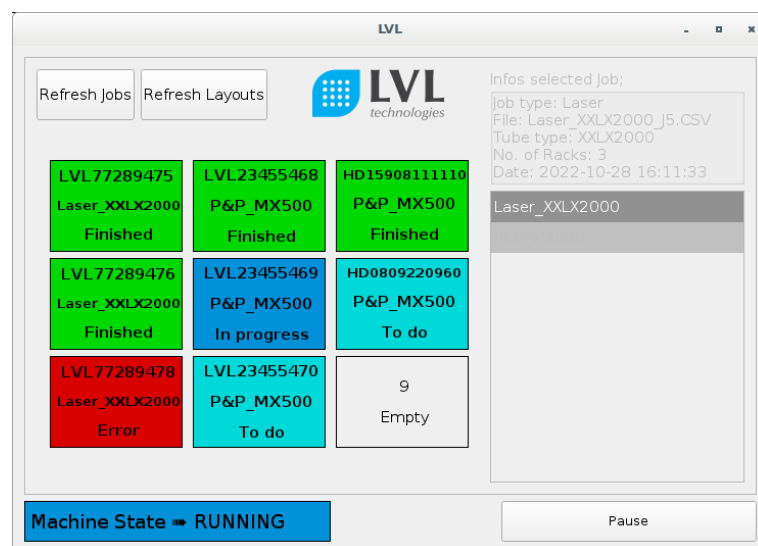

Figure 44: Job processing

In this example,

- Two jobs are prepared (Laser_XXLX2000 and P&P_MX500).
- Job Laser_XXLX2000 for three racks (Position 1, 4& 7) is finished. The Rack Position 7 has some errors during processing.
- Job P&P_MX500 pick & place job from the standard rack (Position 2, 5, and 8) to the high-density racks (Position 3 and 6) is in progress.
- Rack position 9 is empty.

6.6.3 Pausing of Process

The process can be paused in between using the Pause button on the right bottom of the Process GUI. Once the button is pressed, the pause window pops with the following option.
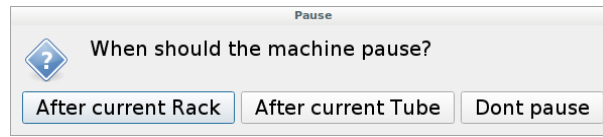
Figure 45: Pause window

Command	Explanation
After current Rack	Pauses the process after completing the current processing rack.
After current Tube	Pauses the process after completing the current processing tube.
Dont pause	Exits the pause window.

Table 20: Pause window

Figure 46: Pausing the process

The process might be paused for one of the following operations.
- To create a new job
- To prepare for new jobs
- To place new racks
- To remove processed racks
- To stop/cancel the current process

> **ℹ** If a job is paused for any one of the above-mentioned reasons and the Process GUI has been closed, the unfinished jobs can be continued by opening the Process GUI and pressing the Start button. This will start the process from the previously left tube position.

6.6.4 Removing the processed Jobs

Once the jobs are finished and if the jobs are no longer needed, the processed jobs can be removed by clicking the jobs in the job selection area of the Process GUI. Once the respective job is selected, the remove job window asks for confirmation of removing the job. Selecting Yes will remove the placed job.
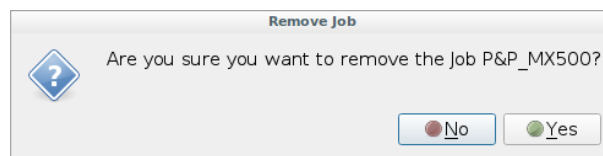

Figure 47: Remove job window

> **ℹ** In this example,
> - The job P&P_MX500 is removed.

> **ℹ** Removing the job will only remove the prepared job from the Process GUI. The Jobs will still be listed in the job selection area. Those jobs can only be removed from the job selection area by removing the job files from the job folder or the job file location.
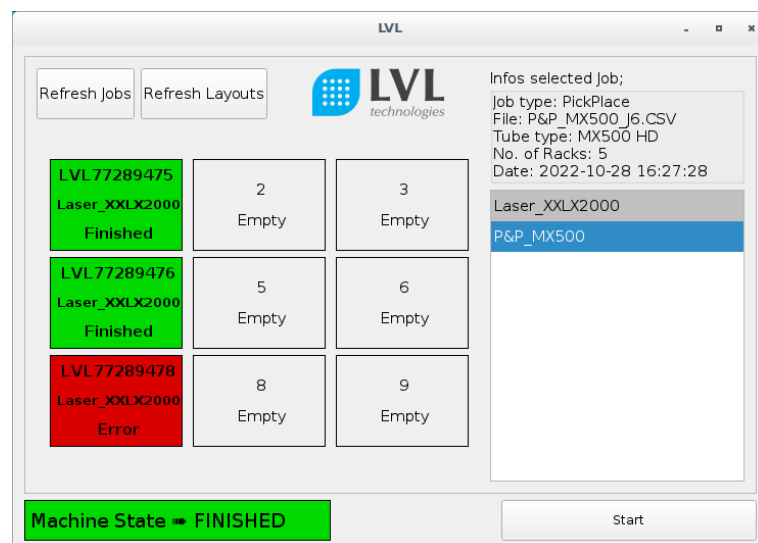
Figure 48: Removed prepared jobs

> The Process GUI can be closed by clicking the X icon on the top right corner of the window, followed by confirming the changes in the shutdown GUI window.
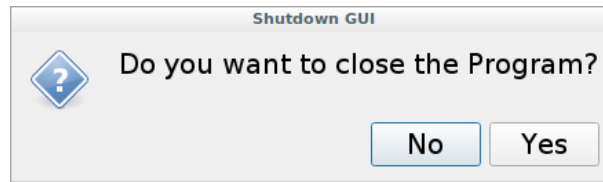
Figure 49: Shutdown GUI

6.7   Statistics

The Statistics window provides an overview of the number of tubes processed by the corresponding modules along with the respective process.
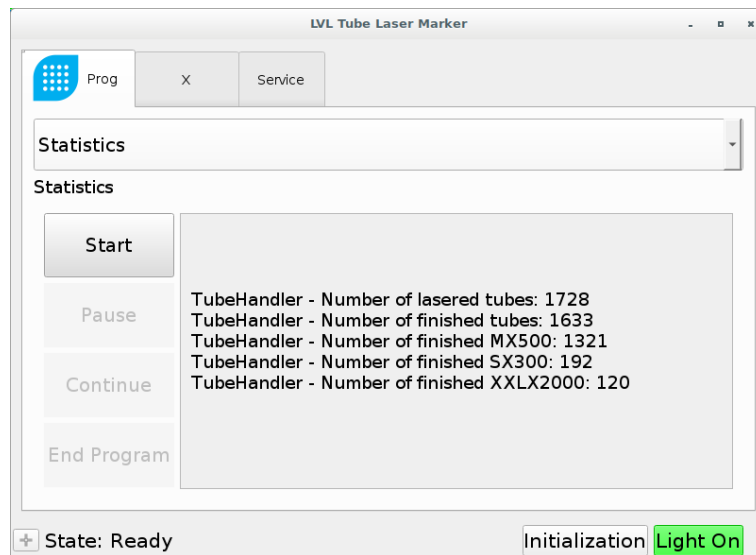
Figure 50: Statistics window

> The statistical information of the device at delivery does not correspond to the test runs performed on the device. The values are reset before shipment.

7 X Tab of the TLM

The X tab window offers two options.
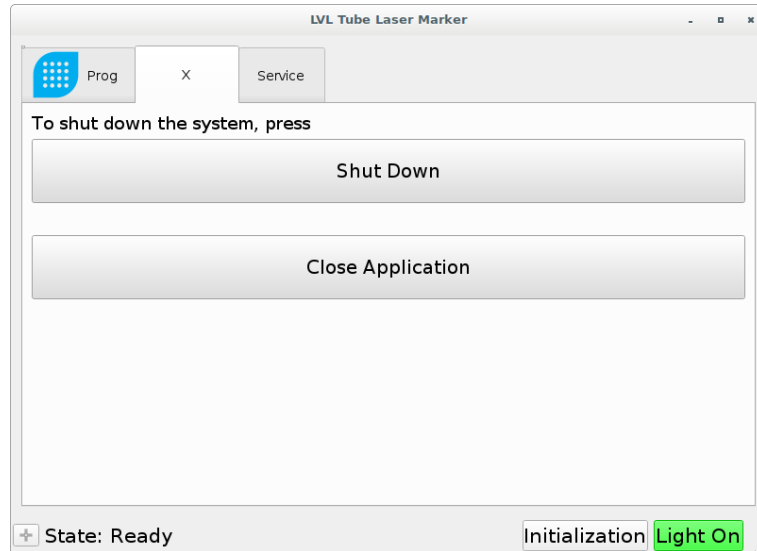
Figure 51: X tab window

Command	Explanation
Shut Down	Shuts down the touch panel
Close Application	Closes the GUI

Table 21: X tab window - explanation

Shut down option
- The PLC unit stays on till the device is turned OFF using the main switch.
- The touch panel is turned ON by turning the main switch to OFF and then to ON again.

Close application option
- The CSV files for the performed processes can be accessed by closing the GUI.
- The GUI can be reopened by double-clicking the LVL icon on the desktop of the touch panel.

8 Service Operation of the TLM

8.1 Service Menu

The Service tab allows access to most of the machine parameters, e.g. for changing the position of the actuators and adjusting parameters of the electronic components of the device.

Figure 52: Service window

The service menu is protected by a password (as default), and a numeric block for entering the password (see Figure 53) will appear when pressing the field Enter Password. Once the password is entered, the operator can access the service menu.

Figure 53: Numeric keypad

- The password for the service menu is provided to the project manager / the responsible person during the machine commissioning.
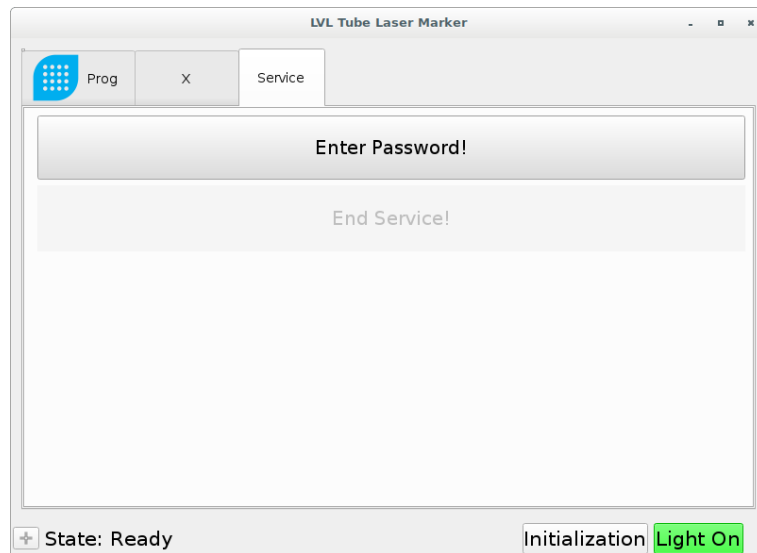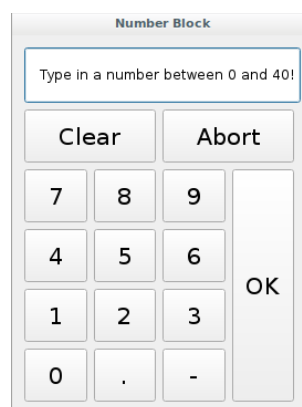
- The forgotten or lost password for the device can be retrieved with the assistance of the manufacturer.

For changing a password, see chapter 8.2.3.

Once the settings are adjusted, press the End Service button to terminate the service program and return to the job processing program.

8.2   Module Tabs

In the service menu, the operator can adjust the settings for each available module.
Each module has its own tab. These module tabs are located between the Service and the Advanced tab on the top of the service window.

The left of the service window occupies the commands and the respective sub-categories. In the Command line, the user can select module-specific commands from a drop-down menu. If the selected command has sub-categories, these are displayed below the Command line. These can be numbers or another drop-down menu (see Figure 54).
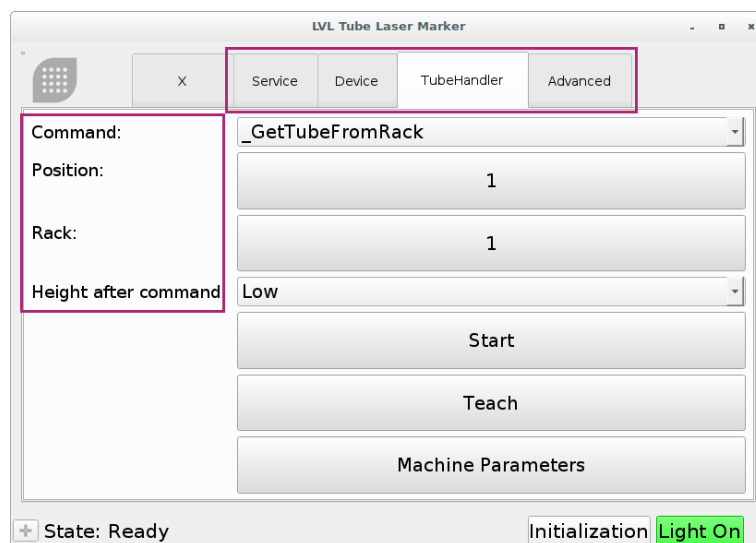
Figure 54: Module tabs window

Command	Explanation
Command	Drop-down menu for selecting a command.
Subcategories	Drop-down menu/numbers for selecting the subcategory of the selected command
Start	Executes the selected command with the selected subcategories.
Teach	Opens the Teach window of the module (see Figure 55)

Command	Explanation
Machine parameters	Opens the machine parameters window of the module [see Figure 56]

<p align="center">Table 22: Module tabs window - explanation</p>

> ℹ️ The status on the bottom left of the window changes from Ready to In Progress when a command is executed and returns to Ready once the command is finished.

All adjustable teach positions of the module are displayed in the Teach window [Figure 55].
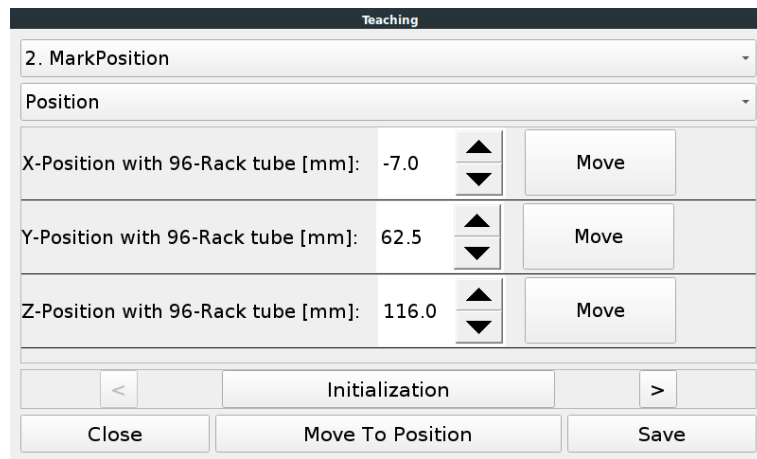
<p align="center">Figure 55: Teach window</p>

Command	Explanation
Move	Moves the selected axis to the provided/entered position.
Initialization	Initializes the current module by resetting the error.
Gripper close/open	Closes or open the SCH gripper
Move to position	Moves the module/axis to the provided/entered position.
Save	Moves the module/axis to the entered position and saves the values.
Close	Closes the teach window.

<p align="center">Table 23: Teach window - explanation</p>

All configurable machine parameters are displayed in the machine parameters windowFigure 56.
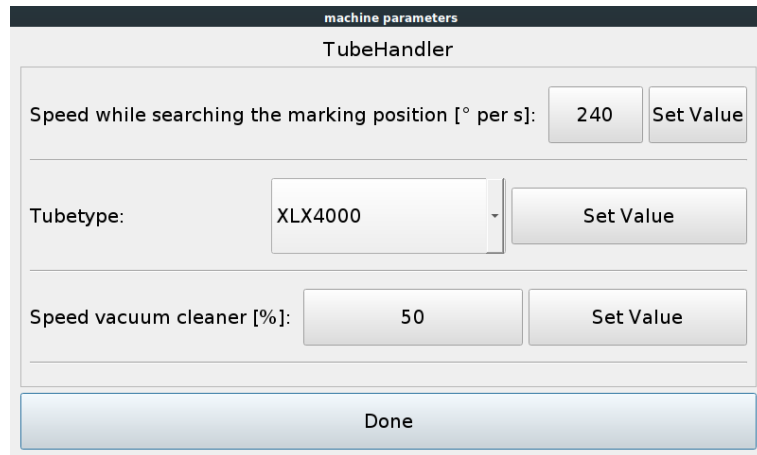
Figure 56: Machine parameters window

Button	Explanation
Set value	Saves the entered value.
Done	Closes the machine parameter window.

Table 24: Machine parameters window - explanation

8.2.1 Device Tab
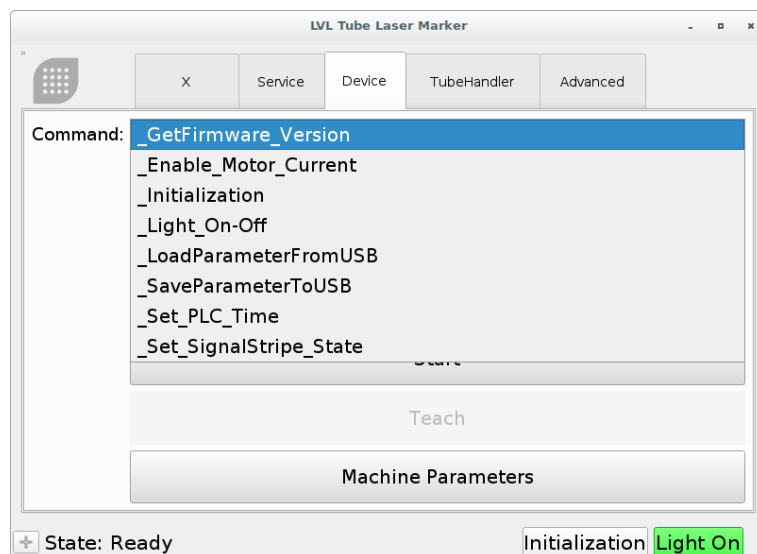
Figure 57: Device Tab

Commands	Explanation
_GetFirmware_Version	Get the PLC version of the device.
_Enable_Motor_Current	Enables the motor current of the device.
_Initialization	Initializes the device module.
_Light_On_Off	Switches the process room light on or off.
_LoadParameterFromUSB	Loads the PLC files from the USB to the control unit
_SaveParameterToUSB	Saves the PLC files from the control unit to the USB
_Set_PLC_Time	Sets the PLC time to the current time
_SetSignalStripe_State	Sets the state and color of the signal strip

Table 25: Device Tab - explanation

8.2.2 Tube Handler Tab

Figure 58: Tube Handler tab

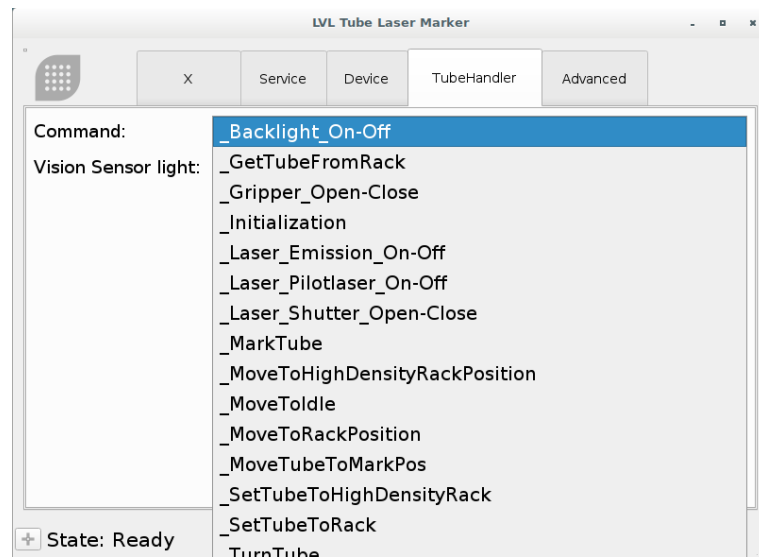| Commands	Explanation
_Backlight_On-Off	Switches the backlight at the tube handler on or off.
_GetTubeFromRack	Picks the tube from the desired rack position.
_Gripper_Open-Close	Opens or closes the gripper of the tube handler.
_Initialization	Performs a module initialization with an error reset.
_Laser_Emission_On-Off	Laser source is switched on or off.
_Laser_Initialization	Performs an initialization of the laser module with an error reset.
_Laser_Pilotlaser_On-Off	Switches the pilot laser on or off.
_Laser_Reset	Resets the laser module to default values.
_Laser_Shutter_Open-Close	Opens or closes the laser shutter.
_MarkTube	Performs laser marking of the tube with the actual text.
_MoveToHighDensityRackPosition	Moves the tube handler to the desired tube position in the high-density rack.
_MoveToIdle	Moves tube handler to the idle position.
_MoveToRackPosition	Moves tube handler to the desired position in the rack.
_MoveTubeToMarkPos	Moves the tube to the laser marking position.
_SetTubeToHighDensityRack	Puts a tube into the desired position of the high-density rack.
_SetTubeToRack	Places the tube in the desired position in the rack.
_TurnTube	Turns the tube clockwise at the desired angle.
_VacCleaner_Start-Stop	Switches the vacuum cleaner (extraction system) on or off.

Table 26: Tube Handler tab - explanation

8.2.3 Advanced Tab

In the Advanced tab, the user can enter a new password or change the existing password for the service menu. Additionally, the actual software version (Common Hash and Project specific Hash) is shown.

The I/O status of the parts integrated into the device can be viewed through the toggle Display IO States button. (see Figure 59).
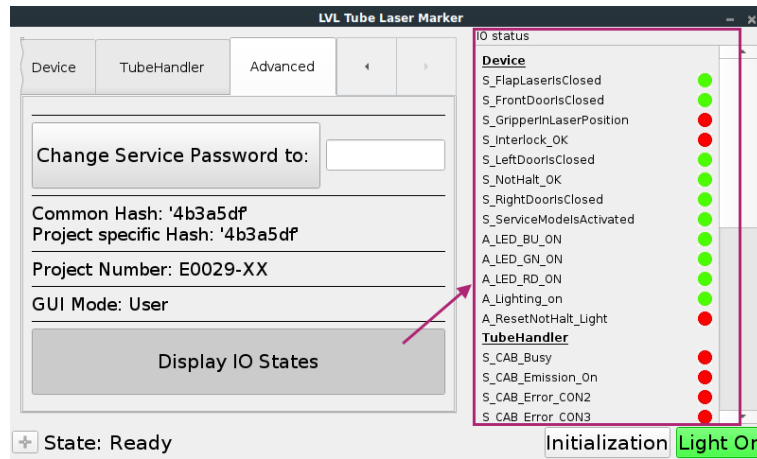
Figure 59: Advanced tab

Command	Explanation
Change Service Password to	Create a new password or change an existing password.
Display IO States	Activates/deactivates the IO status display on the right side of the window.

Table 27: Advanced tab - explanation

- For activating a new or changing an existing password, the GUI has to be restarted after entering the respective password and pressing the Change Service Password to: button.

- The password can only be numeric. Alphabets or special characters cannot be used for the password.

- The forgotten or lost password for the device can be retrieved with the assistance of the manufacturer.

On the right side of the window, the I/O states of the individual modules are displayed. These show the current status of all inputs and outputs, sorted by module.

Color	Description
Green	I/O is active or the signal is high
Red	I/O is inactive or the signal is low

Table 28: I/O status - explanation

9 Error Handling in the TLM

The error handling in the Tube Laser Marker is intuitive and results in user-friendly troubleshooting in case of errors that may arise during normal operation.

Specific details about the error are displayed in a message box on the touch panel, describing the cause of the error. If Continue is pressed on the message box, the application guides the operator through troubleshooting the error. The required steps that have to be performed by the user are displayed on the touch panel. Once all steps are completed, the device continues with normal operation.

Here is an example of how to perform error handling.

In this case, the bottom barcode of a tube in Rack position 5 is not readable due to wear or damage. Once the gripper of the Tube Handler picks the tube and places it in the laser marking chamber, the following error message occurs.
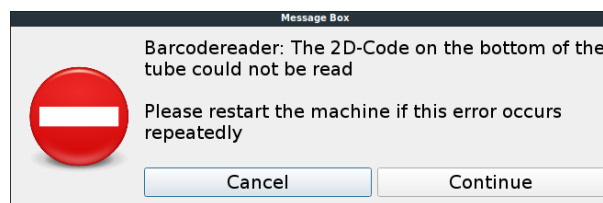

Figure 60: Error message window – problem description

Once the operator presses Continue, another message window pops up, asking the operator to perform the respective steps to resolve the issue.
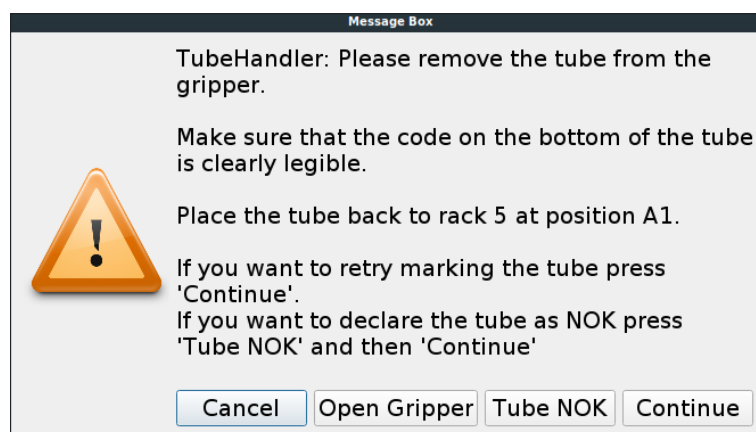
Figure 61: Error message window

In this case, the device is allowed with the following options.
- Cancel: Cancels the current process completely.

- **Open Gripper**: Opens the gripper of the Tube Handler, so the operator can pick the tube from the gripper, verify the barcode for damages and place the tube back in the respective position. (In this case Rack Position 5 and Tube Position A1)
- **Tube NOK**: The operator can declare the tube as not okay, making the gripper to start processing the next tube.
- **Continue**: The operator can verify the barcode and retry the complete process once again.

Once the Open Gripper is selected and the tube is removed from the gripper, the tube can be placed back in the respective position and further options can be selected. Depending on the selected option, the device performs its process accordingly.

> **WARNING!**
>
> Risk of damage to parts
> - Pressing Continue without resolving the actual error can cause collisions between parts within the device.

10 Maintenance and Cleaning of the TLM

> ⚠️ **CAUTION!**
>
> Overheating due to restricted airflow.
>
> - The area around the Tube Laser Marker operating unit and the extraction and filter system should be checked regularly to ensure that the airflow is not restricted, for instance by books, papers, or other objects interfering with the airflow.

To ensure an undisturbed working process, it is important to clean and maintain the equipment regularly.

10.1 Maintenance

Component / Module	Recommended Operation	Frequency	Recommended Personnel
Device housing / exterior surfaces	Clean	Approx. 1 x per month	Operator
Laser chamber	Clean	Approx. 1 x per month	Operator
Laser lens protective glass	Check for mechanical damages	Semi-annually	Operator
Laser lens protective glass	Clean	Quarterly	Operator
Laser lens protective glass	Replace	Approx. 1 x per year	Service Technician
Extraction and filter system	Check prefilter and particulate air filter for suspended particles and replace them if necessary	Approx. 1 x per month	Operator
Extraction and filter system	Check the activated carbon filter and replace it if necessary	Quarterly	Operator
Extraction and filter system	Change filter: - Activated carbon filter - Particulate air filter - Prefilter Refer to the CAB manual supplied	As needed (depending on operating conditions)	Operator

Table 29: Maintenance

For the maintenance of the laser unit and extraction and filter system unit please see chapter 4.5.1 and 4.5.2 respectively.

10.2 Cleaning

Component / Module	Material	Detergent
Device - housing / exterior surfaces	Coated steel & anodized aluminium	All-purpose cleaner, no abrasives or solvents
Device - housing doors	Plexiglas	Special cleaner for perplex (Plexiglas)
Laser chamber (see also cab user manual)	Coated steel	Remove contamination: Suitable extraction device
Laser lens protective glass (see also cab user manual)	glass	Remove dust: small bellows. Remove coarse dirt: lens cleaning paper with 99% Isopropanol
Extraction system – housing (see also cab user manual)	Resilient varnish	Damp cloth, common household cleaning agent. Do not use any solvents. Dry well with a dry cloth.

Table 30: Cleaning

Test all common cleaning agents before usage in a spot on the surface that cannot be seen from a normal viewing angle.

CAUTION!

Malfunction of the electronics

- Do not aim sprays directly at electrical components, as this may cause the electronics to malfunction.
- Switch off the device during cleaning.
- Clean the housing of the device with a mild, commercially available cleaning agent.
- If necessary, use 70% ethanol to disinfect the device housing.

11 Technical Data of the TLM

Weight	
Tube Laser Marker	approx. 130 kg
Extraction and filter system	approx. 40 kg

Dimensions (Width x Height x Depth)	
Tube Laser Marker	approx.80 cm x 90 cm x 75 cm
Extraction and filter system	approx.35 cm x 65 cm x 35 cm

Operating data	
Power supply	100 – 240 VAC; 50/60 Hz
Maximum current	7 A @ 230 VAC / 15 A @ 115 VAC
Standby power consumption	90 W
Operating power consumption	650W

Ambient conditions for operation	
Temperature	15°C to 35°C
Humidity	10% to 80% non-condensing

Ambient conditions for storage/transport	
Ambient temperature	0°C to 50°C
Humidity	10% to 80% non-condensing

Laser Classes	
Laser class 1	During normal operation
Laser class 2	When using pilot laser
Laser class 4	Internal laser without safety equipment

Thermal effects of tube laser marking[†]	
Surface temperature of the marked tube	Increase by approx. 5°C
Temperature of liquid in the tube	Increase by approx. 1°C

Conditions during the operation of the device[‡]	
Noise emission	<85 dBA (EN ISO 3746)

Table 31: Technical data

Generally, only one socket for the power connection of the Tube Laser Marker is necessary. The extraction and filter system is supplied through a socket from the main power supply panel of the Tube Laser Marker (see Figure 6).

[†] The thermal measurement is made at a room temperature of 24°C. MX500 Tube with 500µl distilled water has been used for the test. Surface temperature is measured using thermal imaging camera and the temperature of the liquid is measured using Type K thermocouple.

[‡] The noise measurement is measured per EN ISO 3746 and during the normal operation with the doors closed and the extraction and filter system running at 50% of the capacity.

12 Layout

12.1 Dimensions of the Device
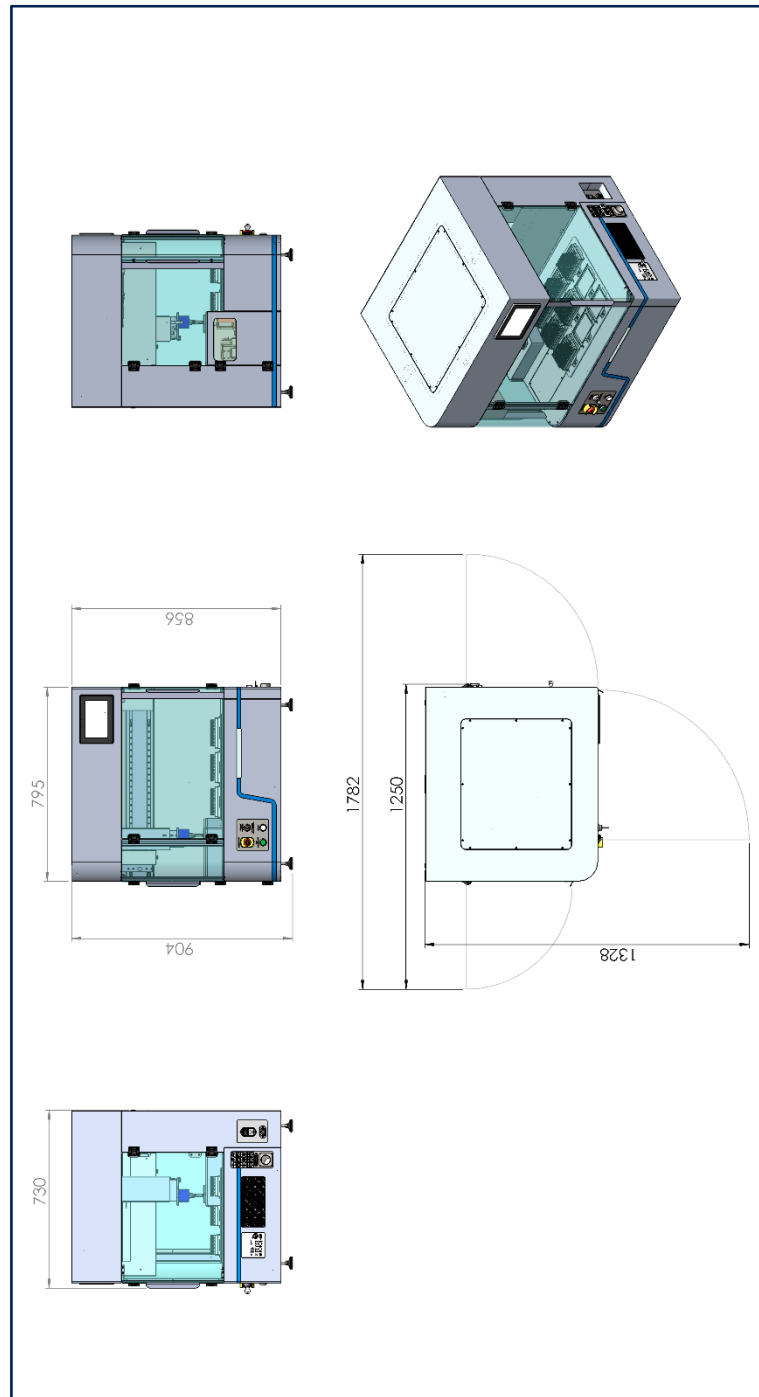

Figure 62: Dimensions of the device

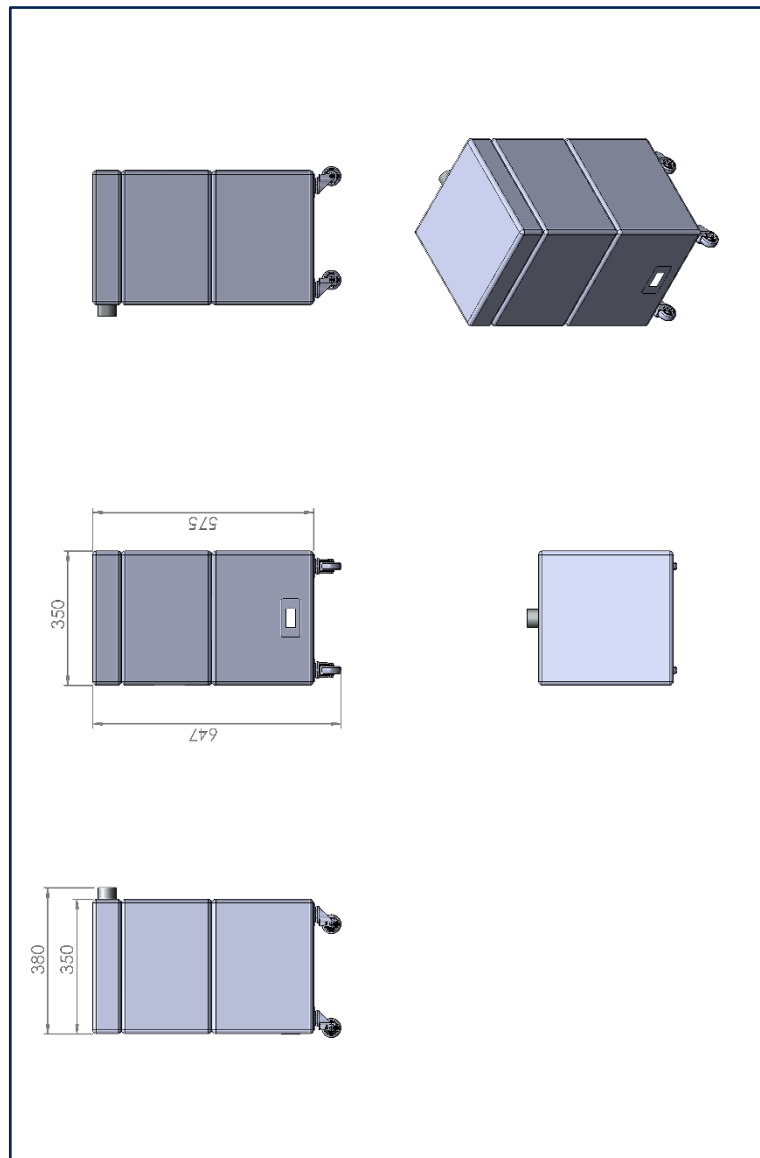## 12.2 Dimensions of the Extraction and Filter System

Figure 63: Dimensions of the extraction and filter system
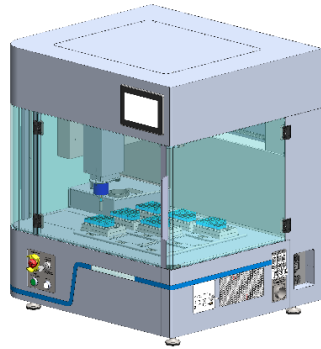
13 Scope of Delivery

Figure 64: Tube Laser Marker

Figure 65: Extraction and filter system

Figure 66: Power supply cables

Figure 67: Connection – extraction and filter system

Figure 68: I/0 Link D-Sub cable – extraction and filter system

Figure 69: Suction hose & nozzle – extraction and filter system

Figure 70: USB stick

Figure 71: Hand scanner

Figure 72: 1 set of hexagon keys
(located inside the device, on the back)

Figure 73: 1 set of Torx keys
(located inside the device, on the back)

Figure 74: Set of Service keys

Figure 75: Keyboard and mouse

The complete scope of delivery includes the following items:

1. TLM Device

2. 3 Power supply cords with IEC connector C19 with EU, US and UK plugs

3. Extraction and filter system AF5

4. Power connection cable with IEC C13 male/female plugs (for connection of extraction and filter system to the device)

5. I/O Link D-Sub Cable (for connection of extraction and filter system to the device)

6. Suction hose 2.5 m for extraction and filter system

7. Crevice nozzle for the suction hose

8. Laser lens cover

9. Hand Barcode scanner

10. Service keys:

    a. Service access key

    b. Electric cabinet access key

    c. Operating mode select switch

    d. Laser source access key

11. USB sticks

    • LVL USB stick with user manuals for all included components

12. 1 set of Allen keys

13. 1 set of Torx keys

14. Wireless mouse & keyboard (Layout depending on delivery region)

15. Operating manuals of all included components

- All articles within the scope of delivery are either packed in the interior of the device or outside the device into the shipping box.

- If any of the articles are missing, please contact your distributor or the manufacturer immediately.

14 Declaration of Conformity

CE-Declaration of Conformity

LVL technologies GmbH & Co. KG, Theodor-Storm-Straße 17,
74564 Crailsheim, Germany
Registered as a limited company in Germany
Commercial Register Number: HRA 721984 Ulm

LVL technologies GmbH & Co. KG, certify with sole responsibility that the following products:

Article Number: TLM-864
Description: SAFE® Access Tube Laser Marker (suction device included)
Serial Number: E0029-01, -02, -03, -04, -05

Year of Declaration: 2022
For the following intended use:
Automatic printing of 2D barcoded tubes

To which this documentation relates, is in conformity with the following documents:

2006/42//EG, Appendix I	EG Maschinenrichtlinie (EC Machinery Directive)
2014/35/EU	Elektrische Betriebsmittel zur Verwendung innerhalb bestimmter Spannungsgrenzen; EU-Niederspannungsrichtlinie (EU Low Voltage Directive)
2014/30/UE	EU-Richtlinie zur elektromagnetischen Verträglichkeit; EMV Richtlinie (EMC Directive)
RoHS Directive (2011/65/UE)	EU-Richtlinie zur Beschränkung der Verwendung gefährlicher Stoffe (Restriction of Hazardous Substances Directive)

Distributed by LVL technologies GmbH & Co. KG

Martin von Lueder/ General Manager/ Crailsheim, 18.10.2022

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