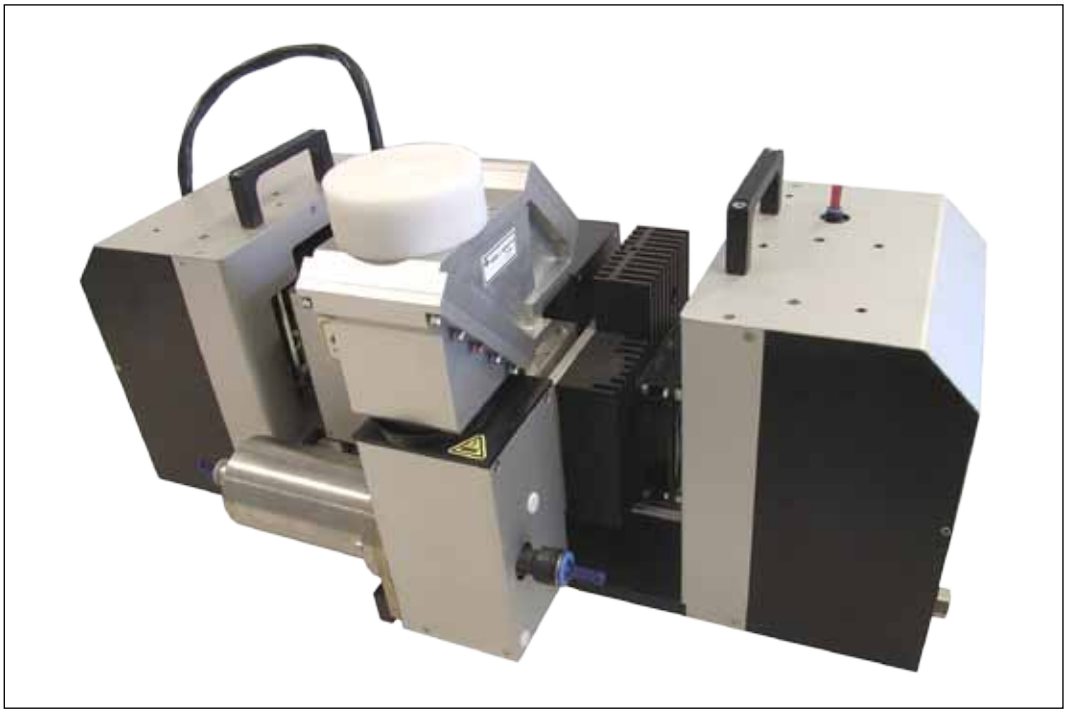
PRIMES

Short Start Guide

Translation of the Original Instructions



HighPower-MicroSpotMonitor

LaserDiagnosticsSoftware

Revision 02/2014 EN

Contents

PRIMES - The Company

PRIMES is a manufacturer of measuring devices used for the characterization of laser beams. These devices are used for the diagnostics of high power lasers that range from CO_2 lasers to solid-state lasers or diode lasers. The wavelength range is covered from infrared to near UV. A great variety of measuring devices for the determination of the following parameters is available:

- The laser power
- The beam dimensions and beam length of an unfocussed beam
- The beam dimensions and beam length of a focussed beam
- The diffraction index, M^2
- The polarization of the laser beam

Both the development and the production of the measuring the devices are effected by PRIMES. This is how we ensure an optimal quality, excellent service and a short reaction time which is the basis to meet our customers' requirements fast and reliably.

PRIMES Max-Planck-Str. 2 - 64319 Pfungstadt - info@primes.de - www.primes.de

1 Basic Safety Instructions

Intended use

The HighPower-MicroSpotMonitor (HP-MSM/HP-MSM-HB) is exclusively intended for measurements carried out in or near the optical path of high power lasers. Other forms of usage are improper. To ensure a safe operation, the device must only be operated according to the terms stipulated by the manufacturer.

Improper usage of the device is strictly prohibited and could lead to health endangering or even deathly injuries. When operating the device it must be ensured that there are no potential hazards to human health.

The device themselve does not emit any laser radiation. During the measurement, however, the laser beam is guided through the device which may cause scattered radiation. That is why the applying safety regulations are to be observed and necessary protective measures need to be taken.

Observing applicable safety regulations

As stated in ISO/CEN/TR standards and regulations as described in IEC-60825-1, ANSI Z 136 “Laser safety standards” and ANSI Z 136.1 “Safe Use of Lasers” published by the American National Standards Institute and additional publications like “Laser Safety Basics”, “LIA Laser Safety Guide”, “Guide for the Selection of Laser Eye Protection, and “Laser Safety Bulletin”, published by the Laser Institute of America (Tel: 407-380-1553) and “Guide for the Control of Laser Hazards” from ACGIH, 6500 Glenway Ave. D-5, Cincinnati, OH 45211, when humans are present in a dangerous zone with uncovered visible or invisible laser radiation or particularly uncovered laser beam systems, beam guiding systems or process regions, personal protection is required. This holds true for any use of this equipment. During measurement procedures there is always an unavoidable risk of laser radiation through direct or reflected emissions.

Taking necessary safety measures

If there are people present within the danger zone of visible or invisible laser radiation, for example near laser systems that are only partly covered, open beam guidance systems or laser processing areas, the following safety measures need to be taken:

- Please wear safety goggles adapted to the laser wave length that is in use
- Please protect yourself from direct laser radiation, scattered radiation as well as from beams generated from laser radiation (for example by using appropriate shielding walls or by weakening the radiation to a harmless level).
- Please use beam guidance – or beam absorber elements which do not emit any hazardous particles as soon as they get in contact with laser radiation and which resist the beam sufficiently.
- Please install safety switches and / or emergency safety mechanisms which enable an immediate closure of the laser shutter.
- Please ensure a stable mounting of the measuring device in order to prevent a relative motion of the device to the beam axis. This reduces the risk of scattered radiation and is also necessary to ensure an optimal performance for the measurement.

Employing qualified personnel

All users of the HP-MSM must have been introduced to the handling of the measuring device and need to have basic knowledge about the work with high power lasers, beam guidance systems as well as focussing units.

Modifications

The HP-MSM must not be modified, neither constructional nor safety-related, without our explicit permission. Modifications of any kind will result in the exclusion of our liability for resulting damages.

Liability disclaimer

The manufacturer and the distributor of the measuring devices do not claim liability for damages or injuries of any kind resulting from an improper use or handling of the devices or the associated software. Neither the manufacturer nor the distributor can be held liable by the buyer or the user for damages to people or material or financial losses due to a direct or indirect use of the measuring devices.

Please also note the **special safety instructions** in the following chapters!

2 Symbol Explanations

The following symbols and signal words indicate possible residual risks:

DANGER

means that death or serious physical injuries **will** occur if necessary safety precautions are not taken.

WARNING

means that death or serious physical injuries **can** occur if necessary safety precautions are not taken.

CAUTION

means that a slight physical injury **can** occur if necessary safety precautions are not taken.

NOTICE

means that property damages **can** occur if necessary safety precautions are not taken.

The devices themselves bear the following symbols to indicate possible dangers:

Warning of hand injuries

Warning of a hot surface

Read and observe the operating instructions and safety guidelines before the start-up!

Further symbols that are not security relevant:

Here you can find useful information and helpful tips.

With the CE marking the manufacturer guarantees that his product is in conformity with the EC guidelines

▶ Call for action

3 About this Operating Manual

This documentation describes the operation of the HP-MSM in the standard version (with 5-fold objective and cyclone) and its operation with the LaserDiagnosticsSoftware (in the following referred to as “LDS). The measuring device is operated via a computer or a system control.
The HP-MSM can also be provided with other objectives. Information can be found in chapter „21 Appendix“ on page 57.

With regard to the description of the software, the focus lies upon the configuration- and communication settings as well as the measuring operation.

This operating manual describes the software version v2.97, which is applicable at the time of printing. Due to the fact that the user software is continuously advanced, it may be possible that the attached installation CD bears a different version number. The correct functioning of the device, however, is ensured with the software.

Should you have any questions, please be so kind as to provide us with the software version installed on your computer. The software version, the creation date as well as the Windows® version our LaserDiagnosticsSoftware was programmed for can be found in the following menu item:
`Help>>About LaserDiagnosticsSoftware`.

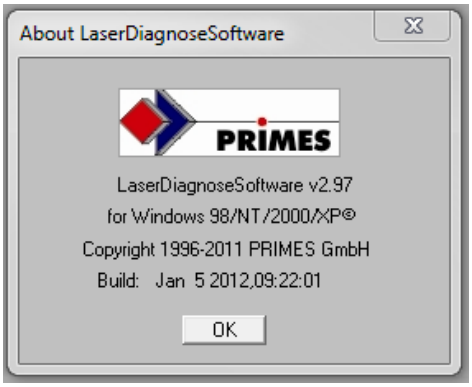


Fig. 3.1: Auxiliary information regarding the latest software version

4 Conditions at the Installation Site

- The measuring device must not be operated in a condensing atmosphere.
- The ambient air must be free of organic gases.
- Please protect the device from water and dust.

5 Introduction

5.1 Laser Beam Measurement

The production with laser beams can be monitored more effectively by means of the control of laser beam parameters. The laser beam is basically characterized by:

- the beam power
- the beam dimensions and the beam position of the unfocussed beam
- the beam dimensions and the beam position in the focus
- the polarization of the laser beam.

The basic laser beam parameter have a great influence on the results of the laser material processing. In order to achieve a reproducible process quality it is necessary to detect all changes with regard to the beam parameters. Changes can be caused not only by:

laser internal reasons, for example

- the aging or pollution of optical components or
- the misalignment of the resonator

but also by:

effects in the beam guidance system or the focussing unit, for example

- the pollution or the misalignment of mirrors or lenses
- organic trace gases in the air – thermal blooming

The processing result for the production with lasers is generally dependant on the beam power as well as the power density in the focussing range. Moreover, the position of the focussing point in relation to the processing zone must be known. Variations to these nominal sizes often lead to a reduced processing speed or processing quality.

Periodic measurements of the laser beam parameters enable a reliable control of the “tool” laser beam. This is a basic requirement for a reproducible production with the laser beam and therefore for the quality assurance.

PRIMES has developed measuring systems that are able to carry out measurements even in an industrial environment. A connection to the system control is supported and the possibility of a complete documentation of the results is therefore ensured.
Laser beam radius, -position and power density distribution in the focus as well as in the unfocussed beam have a strong influence on the result of the laser material processing. In order to achieve a reproduce a reproducible processing quality it is necessary to detect all variations of the beam parameters and to register them.

6 System Description

6.1 Area of Application

The HP-MSM (see Fig. 6.1) is intended for the analysis of the focused beam in the range between 15 µm up to 600 µm. In the focus range the power density distribution can be measured individually in up to 50 measuring planes. The focus caustic is then made up of these density distributions.
The beam geometries (beam position, beam radius and semiaxes – lengths as well as the dumping of the semiaxes to the device axes) are determined for each distribution according to the procedures described in the standard ISO 11146 (2. moment and 86 % power inclusion). By means of these beam geometries the beam propagation parameters (focus position, focus radius, Rayleigh length, divergence, M^2, K and beam parameter product) are determined. By means of the measuring data for the semiaxes of the beam, the ellipticity of the focus and the astigmatic difference are determined according to ISO 11146.

6.2 Device Assembly

The z-axis of the HP-objective is guided and driven on both sides. The measuring objective has an aperture of 50 mm. The measuring plane distance is approx. 100 mm. As a protection for the aperture lens, the measuring objective has a protective window and an additional compressed air rinsing (cyclone) against suspended particles.
For the compressed air rinsing, a filter stage with an ultra-fine filter for particles up to 50 nm is integrated. The compressed air supply has to be oil-free and anhydrous.
For the alignment of the measuring position to the beam, an alignment aid is part of the scope of delivery. It shows the position of the measuring plane.
Approx. 99.5 % of the laser beam is guided into the water-cooled absorber, which is intended for a max. beam power of 99.5 %.

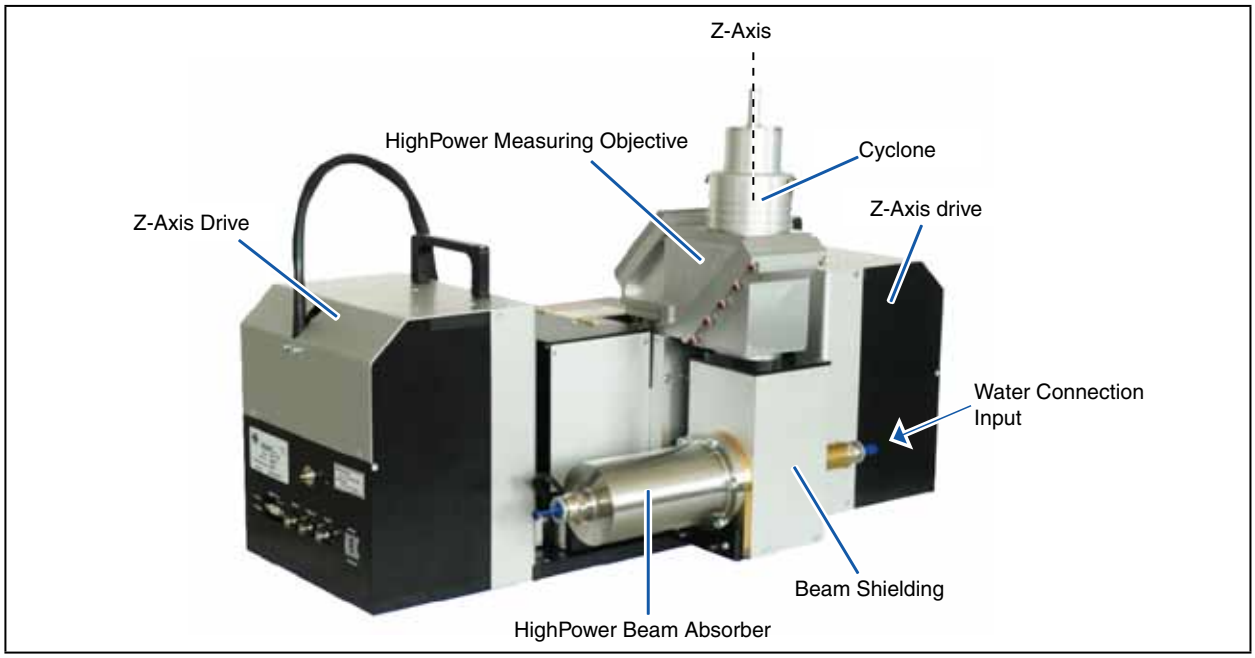


Fig. 6.1: Components of the HP-MSM

6.3 Measuring System

A beam splitter is integrated in the measuring objective so that 99.5 % of the laser power is guided to the appropriately dimensioned absorber via the beam splitter. The laser beam is weakened by further absorbers in the device until it can be guided to a CCD sensor.
The beam splitter and the measuring objective are intended for beam powers up to 10 kW. Please mind the damage threshold of the objective stated in chapter 17 on page 47.

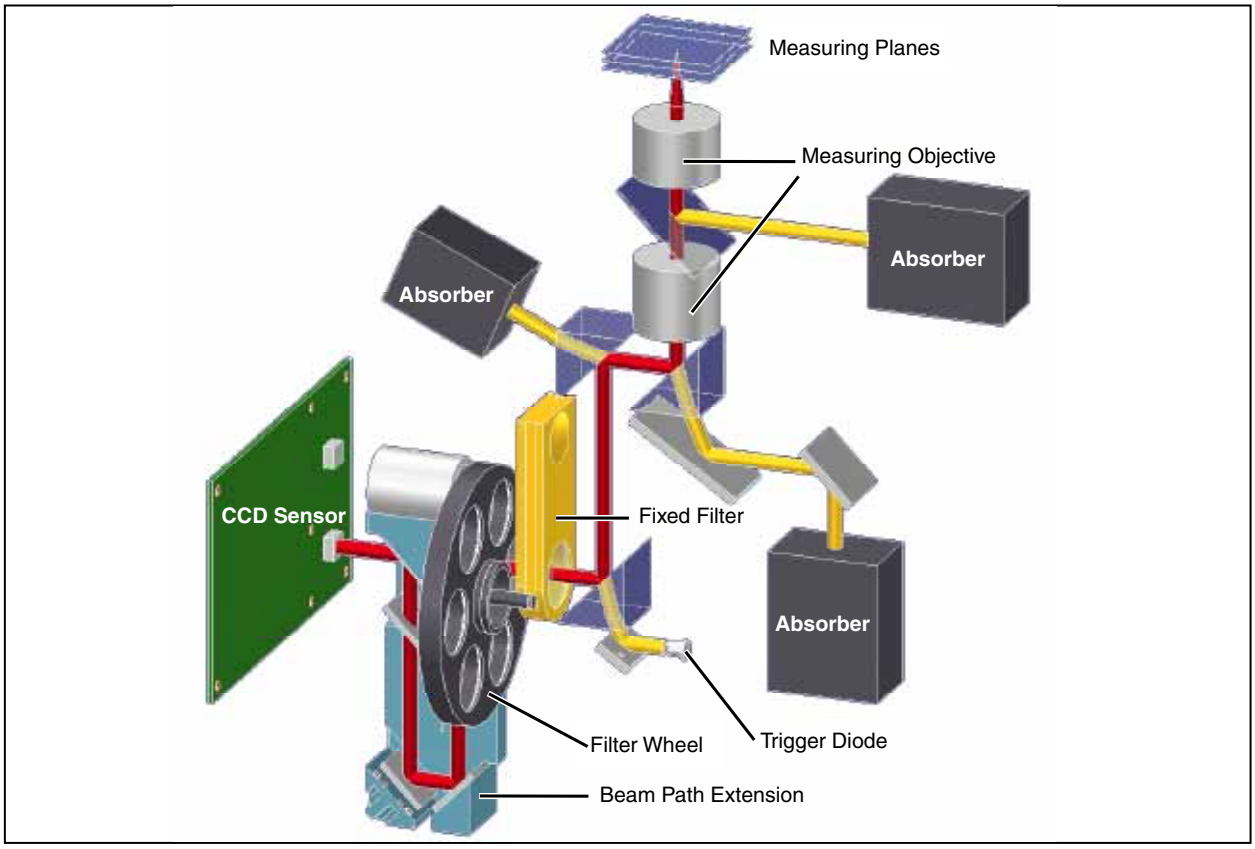
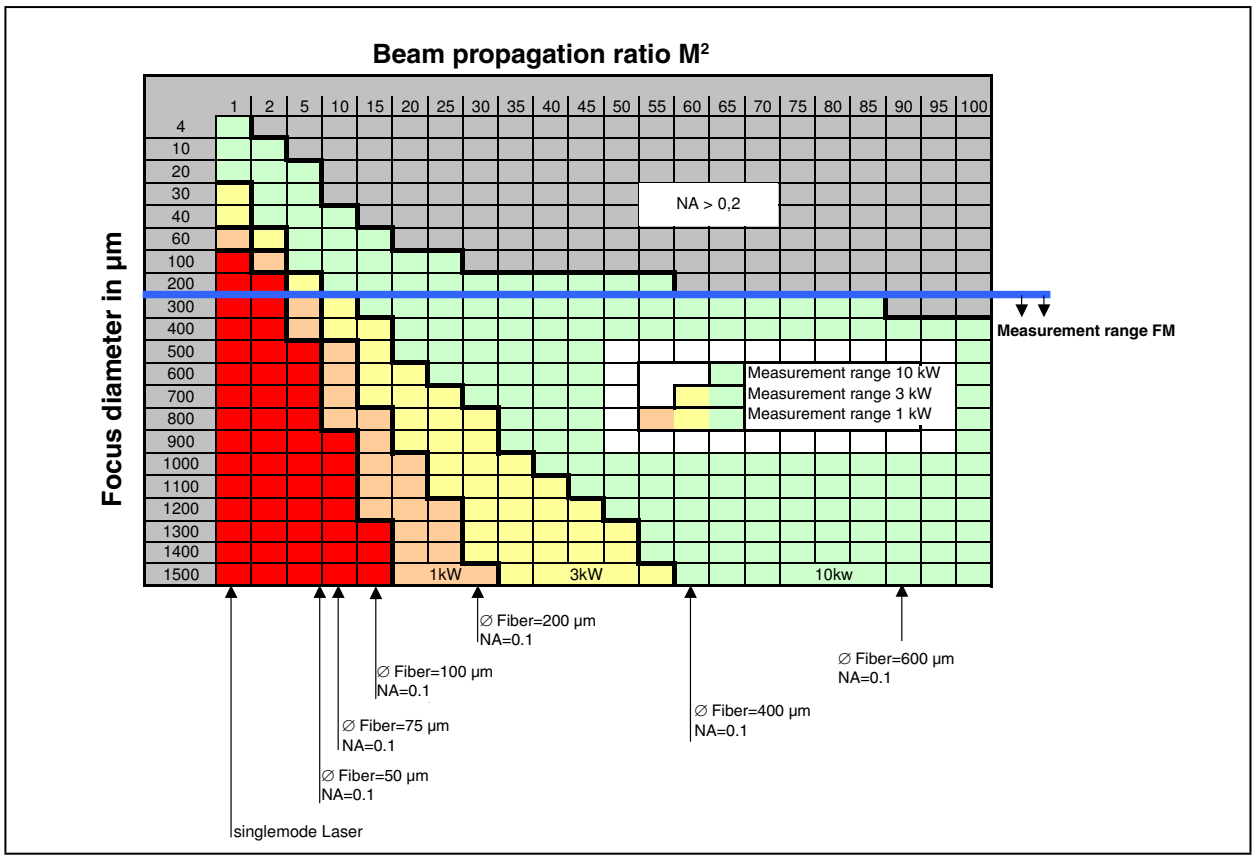


Fig. 6.2: Optomechanical assembly

6.4 Measurement Range of the HP-MSM



7 Short Overview Installation

The short overview provides information concerning necessary safety instructions, necessary media for the operation and required connection elements.

1. Taking Safety Precautions	page 6

Minding special safety precautions

WARNING

Danger of injuries due to scattered radiation

- **The numerical aperture (NA) of the laser beam has to be smaller than 0.2 in order to ensure that no scattered radiation occurs on the corner of the objective.**
- **Wear safety goggles which are adapted to the used laser wavelength.**
- **When mounting the device, please ensure that it cannot be moved by unintentional pushes or pulling the cables or hoses.**
- **Shield the device from scattered radiation.**

2. Remove the transport lock	page 16
3. Alignment to the laser beam and stable mounting An alignment aid is part of the scope of delivery • You require four screws M6. We recommend screws of the safety class 8.8 and a tightening torque of 20 N·m. • HP-MSM-HB: 2 mounting holes	page 18
4. Connecting the compressed air • Anhydrous and oil-free compressed air, 3 bar …4 bar • Connection diameter 6 mm	page 23
5. Installing the water-cooling • Connection diameter 12 mm • Flow rate 7 l/min … 8 l/min	page 21
6. Electrical connection • Voltage supply	page 24
• External safety switch (interlock)	page 25
7. Connection with the computer	page 27
• Via Ethernet or USB or RS 232	page 30
8. Installing the LaserDiagnosticsSoftware on the computer • Software is part of the scope of delivery	page 32

8 Transport and Mounting

NOTICE

Danger of damage during transport

Hard impacts or dropping can damage optical parts.

▶ **Please be careful when transporting and installing the device!**

8.1 Removing Transport Lock

First of all, the transport lock is to be removed after the device was unpacked. The transport lock secures the linear actuator of the y- and z-axis. It is located on the bottom plate beneath the objective and is fastened by means of three hexagon socket screws (AF 3 mm) as shown in Fig. 8.1.

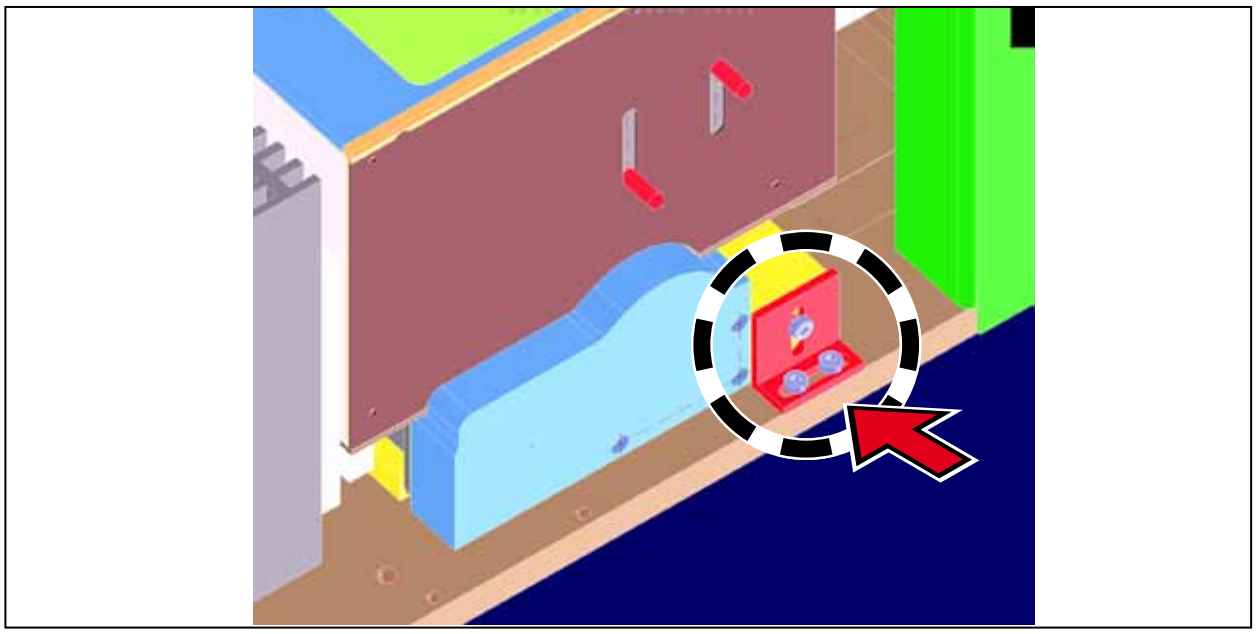


Fig. 8.1: Position of the transport lock

NOTICE

Danger of damage

The device must only be transported with a mounted lock.

▶ **Keep the transport lock in a safe place for future reuse.**

8.2 Preparation

Before mounting the device, please check the space available, especially the required space for the mechanical and electrical connections. The measuring device has to be positioned stably and fastened with screws (see chapter 8.3 on page 17).

NOTICE

Danger of damage

Obstacles in the movement range can lead to collisions and may damage the device.

- **Keep the movement range free from obstacles (cutting nozzles, pressure rollers etc.).**

8.3 Mounting Position and Fastening

The HP-MSM must only be operated in a horizontal position with a beam incidence from above. Check the space available before mounting the device, especially the required space for the connection cable and –hoses as well as the movement range of the z-axis (please see chapter „18 Dimensions“ on page 48).

WARNING

There is a danger of injuries

If the appropriate position of the measuring device is changed, this could cause scattered radiation during the measurement.

- **When mounting the device, please ensure that it cannot be moved, neither due to an unintended push or a pull on the cables and hoses.**

For the fastening, there are four bores in the bottom plate ∅ 6.6 mm.

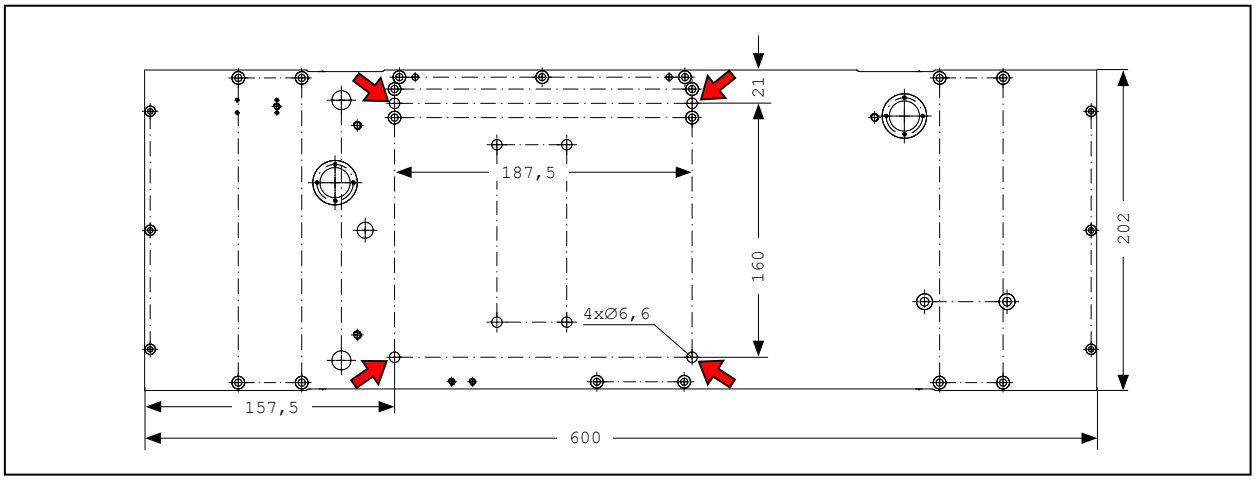


Fig. 8.2: Fastening bores, view from below

We recommend screws of the strength class 8.8 and a tightening torque of 20 N·m.

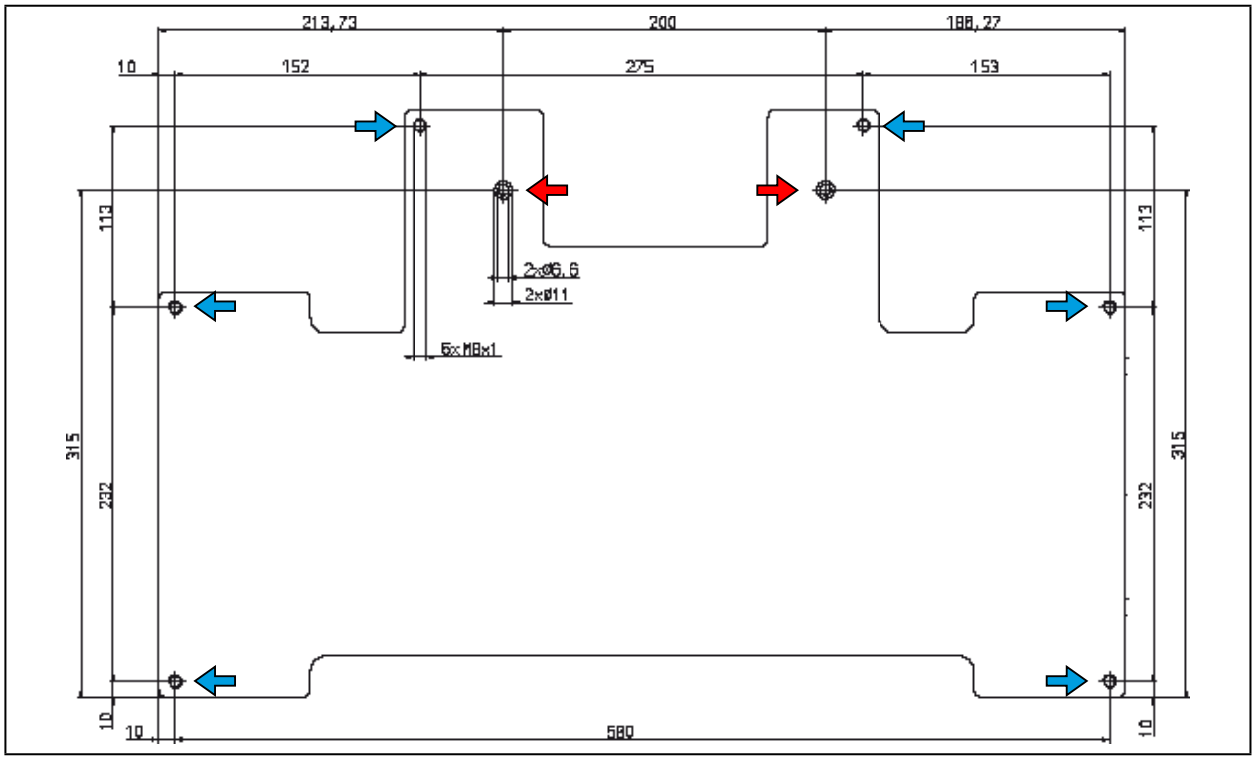


Fig. 8.3: Fastening bores, view from above

2 mounting holes ∅ 6.6 mm

6 thread holes M8x1 for the alignment

8.4 Alignment

Due to the imaging characteristics of the objective it is necessary that the laser beam focus is positioned in a certain range above the objective.
The further the focus lies above the objective, the shorter it is displayed behind the objective.

NOTICE

Danger of damage

The focus has to be in a defined range with reference to the objective. In case it is too close or too distant, the optics might be damage when it comes to high beam intensities.

▶ **Use the enclosed alignment aid for the alignment.**

Positioning the focused laser beam above the objective:

The size of the range in which the focus is to be positioned before the first measurement depends on the chosen objective, the used wavelength and the type of focusing. The measurement range lies within an upper and a lower limit.

Upper limit:

If the focus is located too high above the objective, a focus on the beam path can develop. Together with too high beam intensities, the optics might be damaged.

Measuring plane:

The beam distribution of the measuring plane is displayed on the camera chip.

Lower limit:

If the focus is too close to the objective, the aperture lens might be damaged – depending on the type of focusing and the used power.

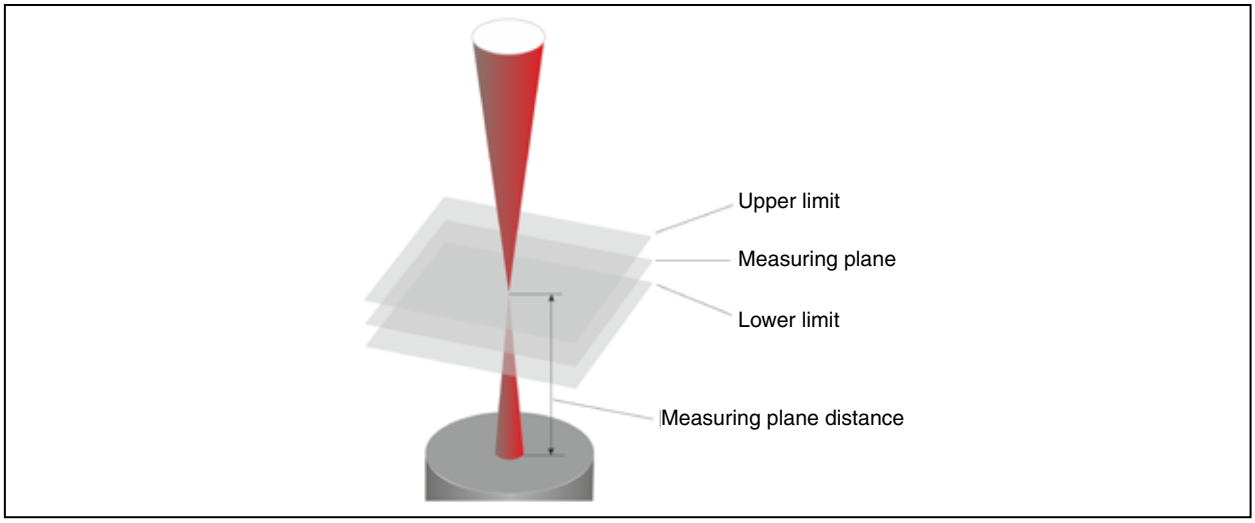


Fig. 8.4: Measuring range of the HP-MSM

The measuring plane distance equals the distance of the measuring plane of the upper corner of the objective. In order to be able to align the HP-MSM beneath the laser, an associated alignment aid is provided with each objective. By means of this alignment aid and a pilot laser beam, you can position the measuring device with the necessary accuracy.

When working with the alignment aid, the compressed air has to be turned off.

1. Put the alignment aid on the cyclone. The upper corner equals the z-position of the measuring plane of the objective.
2. Turn on the pilot laser. If the laser hits the little bore in the cover vertically, it is displayed centrally on the sensor.

Please mind that the focus is more likely to lie below the marking on the alignment aid than above it, as there is more clearance.

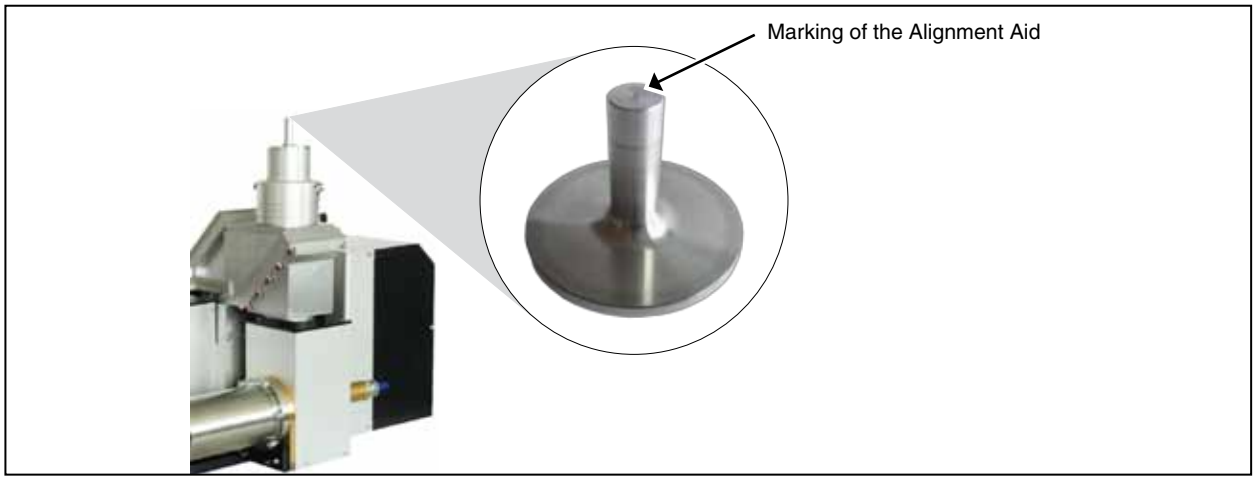


Fig. 8.5: Alignment Aid for the HP-MSM

The measuring plane distance equals the distance of the picture plane from the upper corner of the cyclone or – respectively – the protective window retainer. This does not only depend on the beam path (standard, beam path extension BPE, alignment objective AO) but also on the wavelength (see Tab. 8.1).

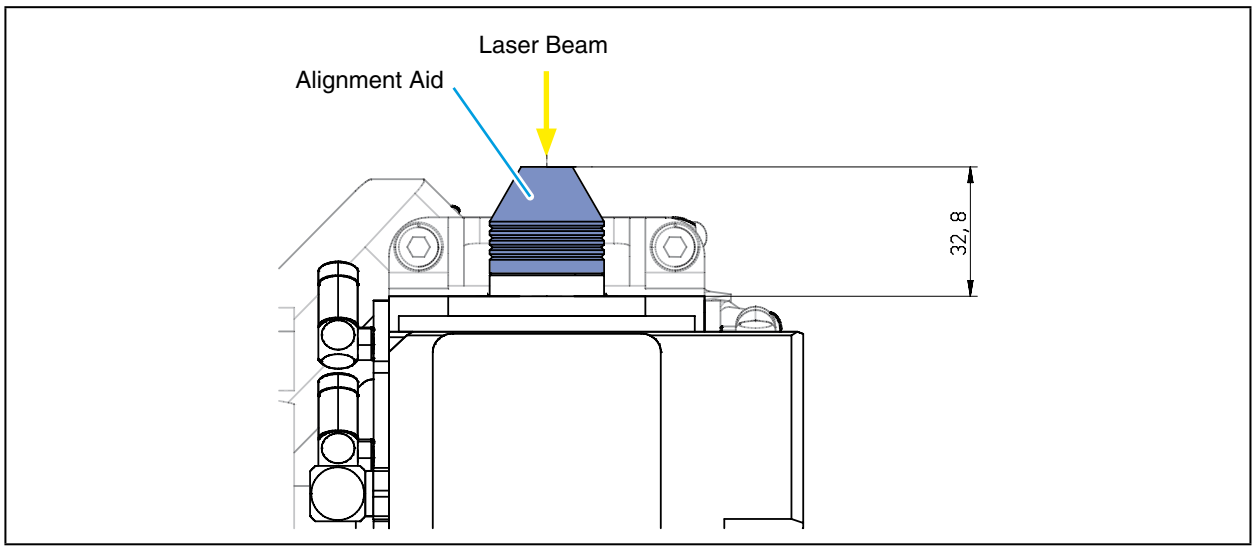


Fig. 8.6: Alignment Aid for the HP-MSM-HB

The measuring plane distance equals the distance of the picture plane from top of the mounting plate of the cyclone. This does not only depend on the beam path (standard, beam path extension BPE, alignment objective AO) but also on the wavelength (see Tab. 8.1).

Measuring Objective	Wavelength in nm	Length of the Alignment aid in mm	Measuring Plane Distance in mm		
			Standard	BPE	AO
MOB HP-MSM, 5-fold					
From the Corner of the Cyclone	1064	32.1	32.1	27.7	27.8
From the corner of the Protective Window Retainer	1064	84.6	84.6	80.6	80.7
MOB HP-MSM-HB, 5-fold	1064	–	32,8	32,8	32,3

Tab. 8.1: Measuring Plane Distances

Due to the production tolerances, the values of the measuring plane distance contain a defect of ±800 µm. However, it is possible to have the measuring distance of the objective calibrated to ± 50 µm (TCP-calibration).

9 Mechanical Connections

For the operation of the HP-MSM a water– and compressed air supply is required.

9.1 Cooling Circuit System

9.1.1 Conditions

The connections at the HP-MSM are intended for PE-hoses with a diameter of 12 mm. For a reliable operation a water flow rate of 7 l/min up to 8 l/min is required. Normally, 2 bar primary pressure at the entrance of the absorber are sufficient in case of an unpressurized outflow.

Do not add any additives to the cooling water, especially no anti-freeze agents. These could significantly change the thermal conductivity and could therefore reduce the cooling efficiency.

Do only operate the HP-MSM in a non-condensing atmosphere. The temperature of the cooling water must not lie below the ambient temperature.
Do only cool the device during the measuring operation. We recommend starting the cooling approx. 2 minutes before the measurement and terminating it approx. 1 minute after the measurement.

9.1.2 Connection

- Connect both the inlet flow and the return flow with the absorber (see Fig. 9.1).

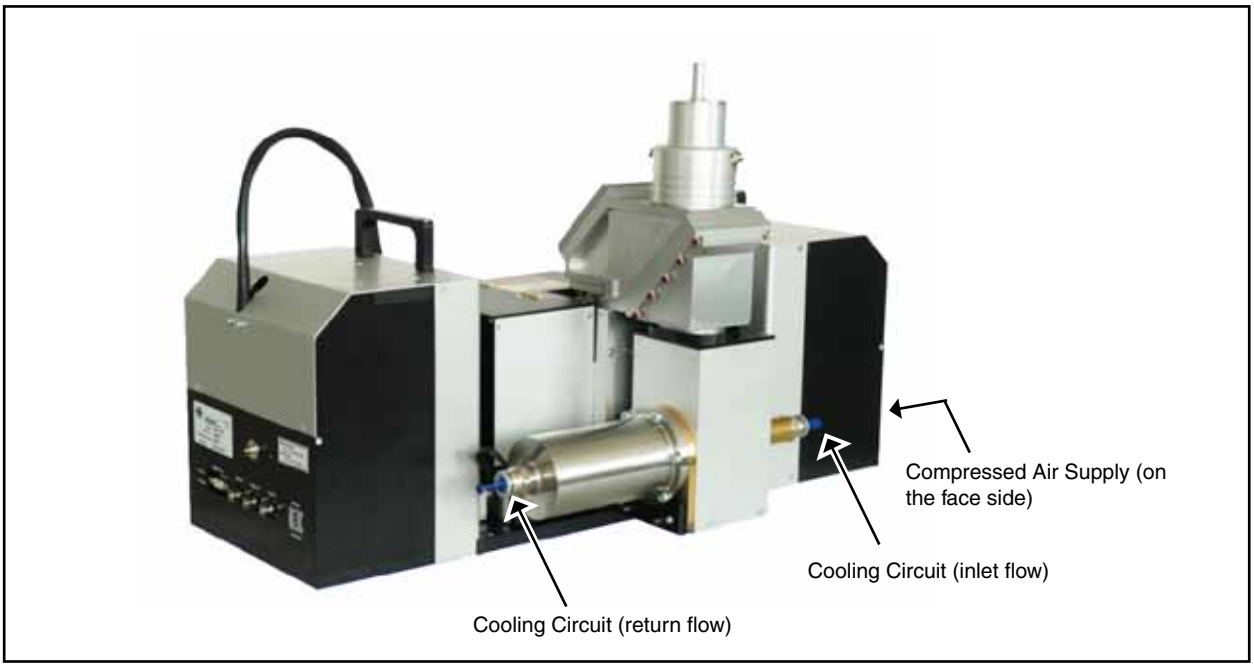
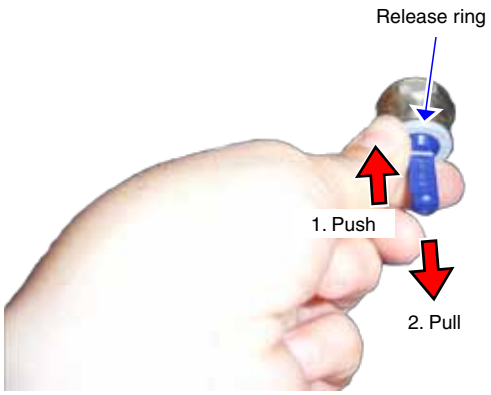


Fig. 9.1: Media Connections of the HP-MSM



- Please push down the grey release ring of the connection and pull out the plug with your free hand.
- Remove the sealing plugs of the water connections and keep it in a save place.
- Close the flow line (Water In) and the return flow (Water Out) of the device, by inserting the hose as far as possible (approx. 20 mm deep).

NOTICE

Danger of damage due to different chemical potentials

The parts of the HP-MSM which get in contact with cooling water consist of copper, brass or stainless steel. This could lead to corrosion of the aluminium due to the different chemical potentials.

- **Do not connect the device with a cooling circuit made of aluminium!**

9.2 Compressed Air

The compressed air is required in order to generate a rotating air flow in the cyclone which is directed to the outwards. This is supposed to prevent the penetration of dirt particles.
Connect the compressed air supply by means of a plastic hose with an outer diameter of 6 mm.
Please only connect dry and oil-free compressed air with a pressure of 3 bar ... 4 bar.

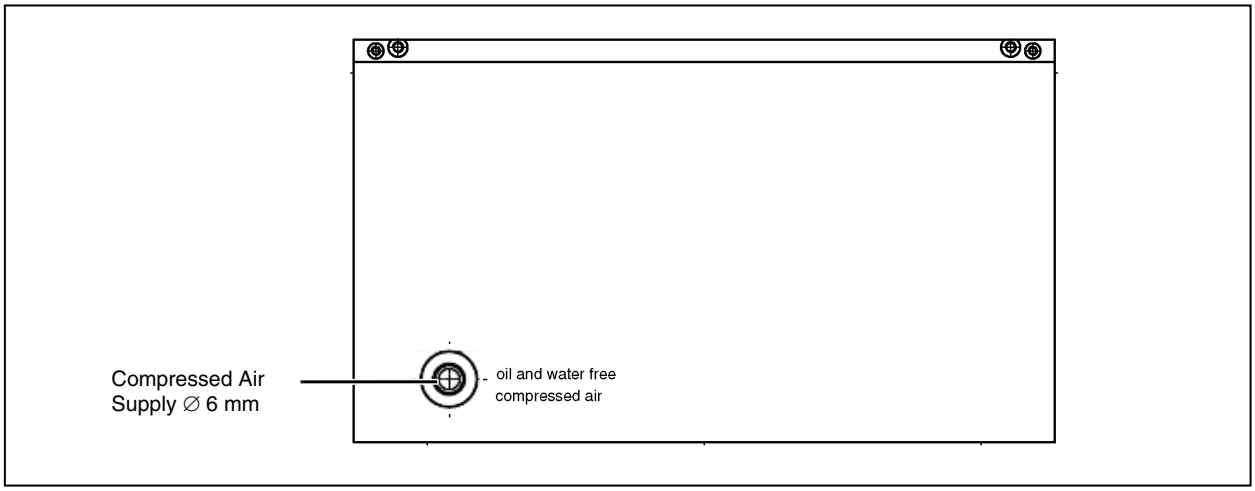


Fig. 9.2: Compressed air supply (on the face side)

In the HP-MSM the compressed air is cleaned by means of three filters and the pressure is regulated by means of an air regulator. The air regulator is preset for a pressure of 3 bar … 4 bar. In case this value is exceeded, the compressed air supply of the cyclone is interrupted.

Fig. 9.3: Cyclone with alignment aid

10 Electrical Connections

10.1 Connection Overview

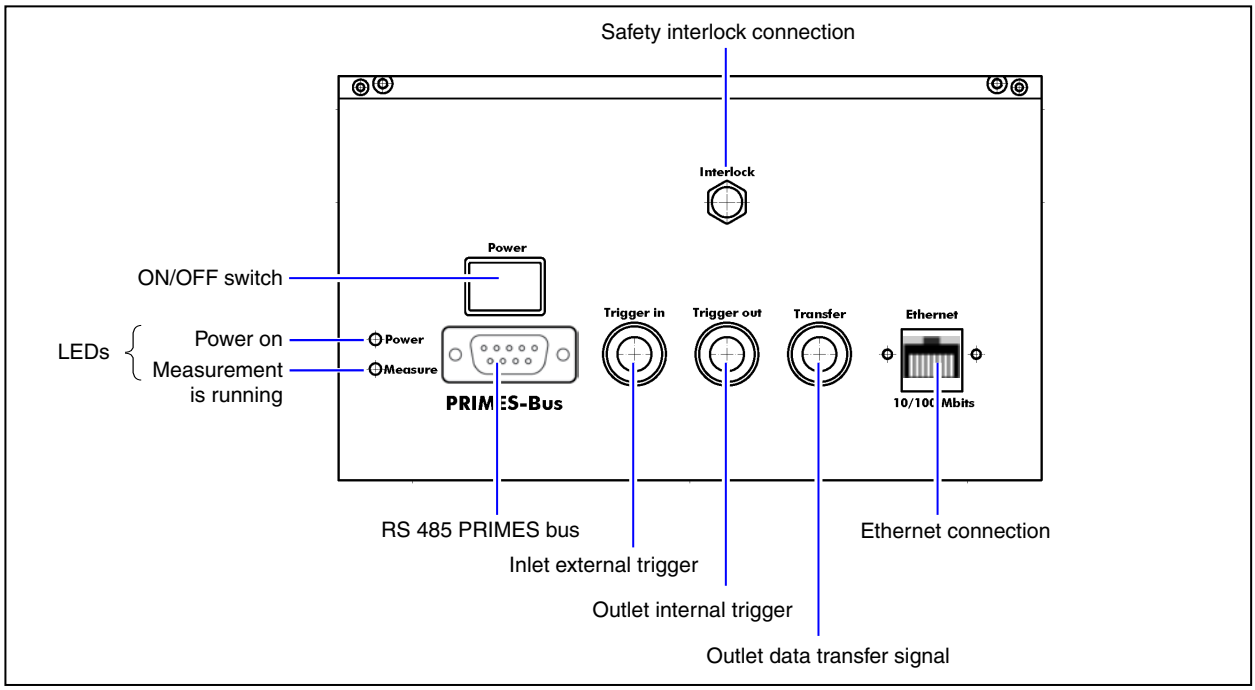


Fig. 10.1: Connections of the HP-MSM

The HP-MSM requires a voltage supply of 24 V±5 % (DC) for the operation. A suitable power supply is included in the scope of delivery. The supply voltage and the data are transmitted via the PRIMES-RS485 bus.

NOTICE

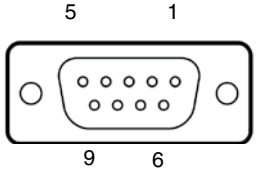
Danger of damage

The supply voltage of 24 V is tramsitted via the RS485-based PRIMES bus. In case of a direct connection of the measuring device with the computer the latter might be damaged!

- **Only connect the computer and the measuring system via the PRIMES-RS485/RS232-interface converter or via the PRIMES power supply with an integrated converter!**

10.1.1 PRIMES Bus (RS 485)

D-Sub-Socket, 9-pin (view: connector side)



Pin	Function
1	GND
2	RS-485 (+)
3	+24 V
4	Not assigned
5	Not assigned
6	GND
7	RS-485 (–)
8	+24 V
9	Not assigned

Tab. 10.1: D-Submin socket, PRIMES bus

In case you would like to use self-configured cables, please keep the following aspects in mind:

- The length of the cable reaching from the power supply to the measuring device must not exceed 2 m. Otherwise the voltage drop of the cable would be too high.
- Due to the susceptibility of RS232-connections, the cable length between converter and computer must neither exceed 2 m.

In addition, in case of a power supply with an integrated converter:

The length of the cable from the power supply to the measuring device must not exceed 2 m. In case of greater distances up to 10 m, please use the PRIMES special cable with a bigger core cross-section (please see Fig. 10.5 on page 29).

10.1.2 Trigger In

BNC socket; inlet for an external trigger

10.1.3 Trigger Out

BNC socket; Outlet for the internal trigger

10.1.4 Transfer

BNC socket; Outlet for the internal data-transfer signal

10.1.5 Ethernet (RJ-45)

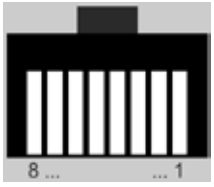


Fig. 10.2: Ethernet connection socket

10.1.6 External Safety Circuit (Shutter Interlock)

The external safety circuit protects the measuring device from damages caused by switching of the laser in case of an error.

NOTICE

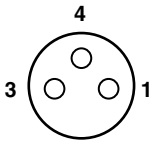
Danger of damage

If the safety circuit is not connected, the device can be damaged due to overheating or the still closed shutter can be destroyed by the laser beam.

▶ **When connecting the laser control with the pins 1 and 4, please ensure that the laser is turned off in case of an interruption of this connection.**

The following conditions opens the safety circuit:

- The voltage supply at the HP-MSM is not connected or interrupted
- There is a temperature rise at the absorber
- A referencing procedure is triggered during the measurement

Interlock			
Pin diagram (view from plug-in side)	**Pin**	**Core Color PRIMES Cable**	**Function**
	1	Brown	Mutual Pin
	3	Blue	If ready for operation, bridged with pin 1
	4	Black	If not ready for operation (interlock mode), bridged with pin 1

Tab. 10.2: Interlock socket

10.2 Computer Connection

For a connection with the computer the following is required:

for a connection with the computer via RS232	
PRIMES-RS485/RS232 converter (included in the scope of delivery)	
or	
PRIMES power supply with integrated converter (accessories)	

additionally, for a connection with the computer via USB:	
USB serial converter (included in the scope of delivery)	

If you connect the computer via a USB interface, you also have to install the driver for the USB/ serial converter (please see chapter 12.2 on page 32). Do not connect the USB adapter with the computer the completion of the driver installation. The USB driver can be found on the enclosed CD-ROM.

10.3 Connection with Standard Power Supply and Converter

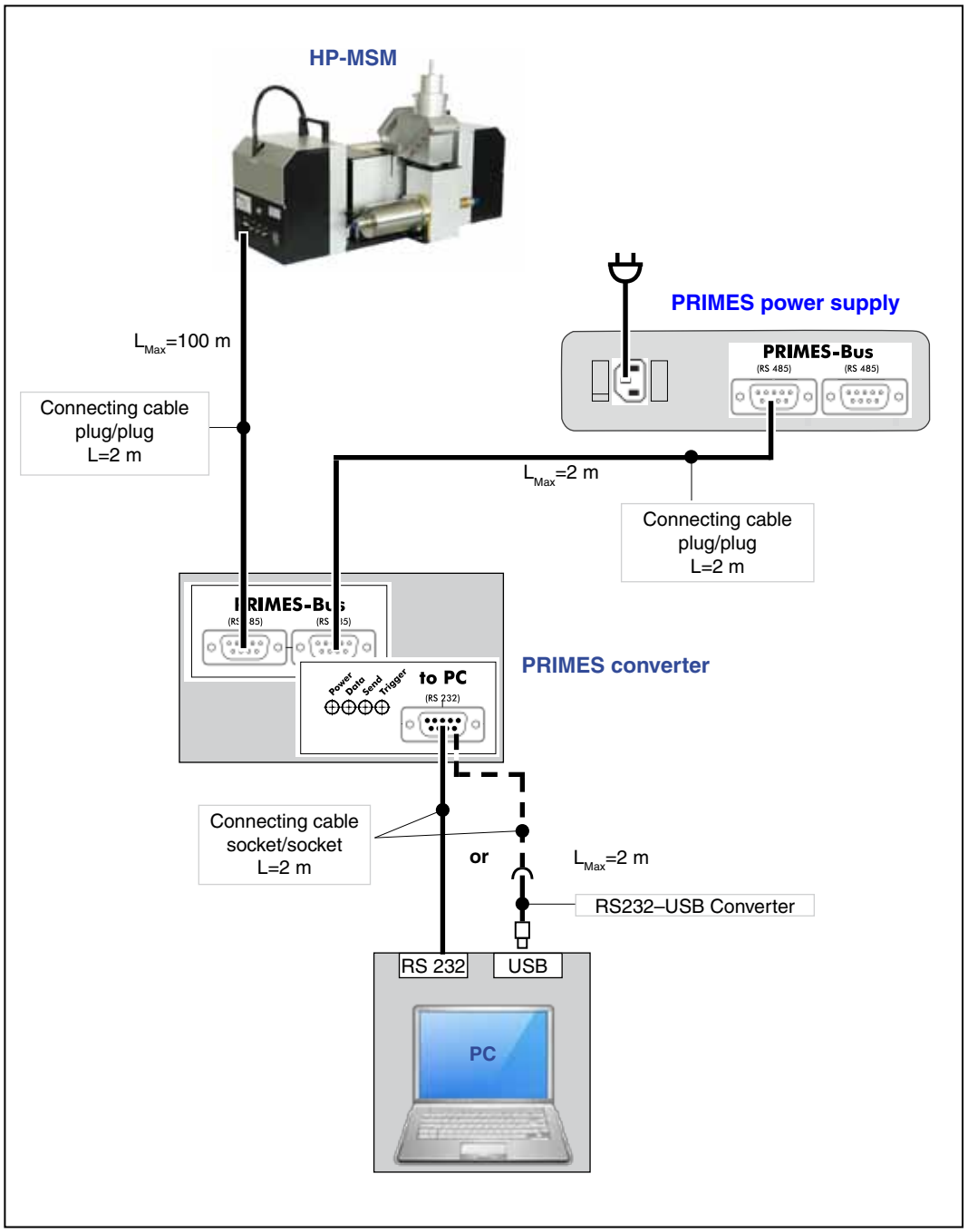


Fig. 10.3: Connection with standard cable 2 m

10.4 Connection with Standard Power Supply and Converter (with extension 10 m)

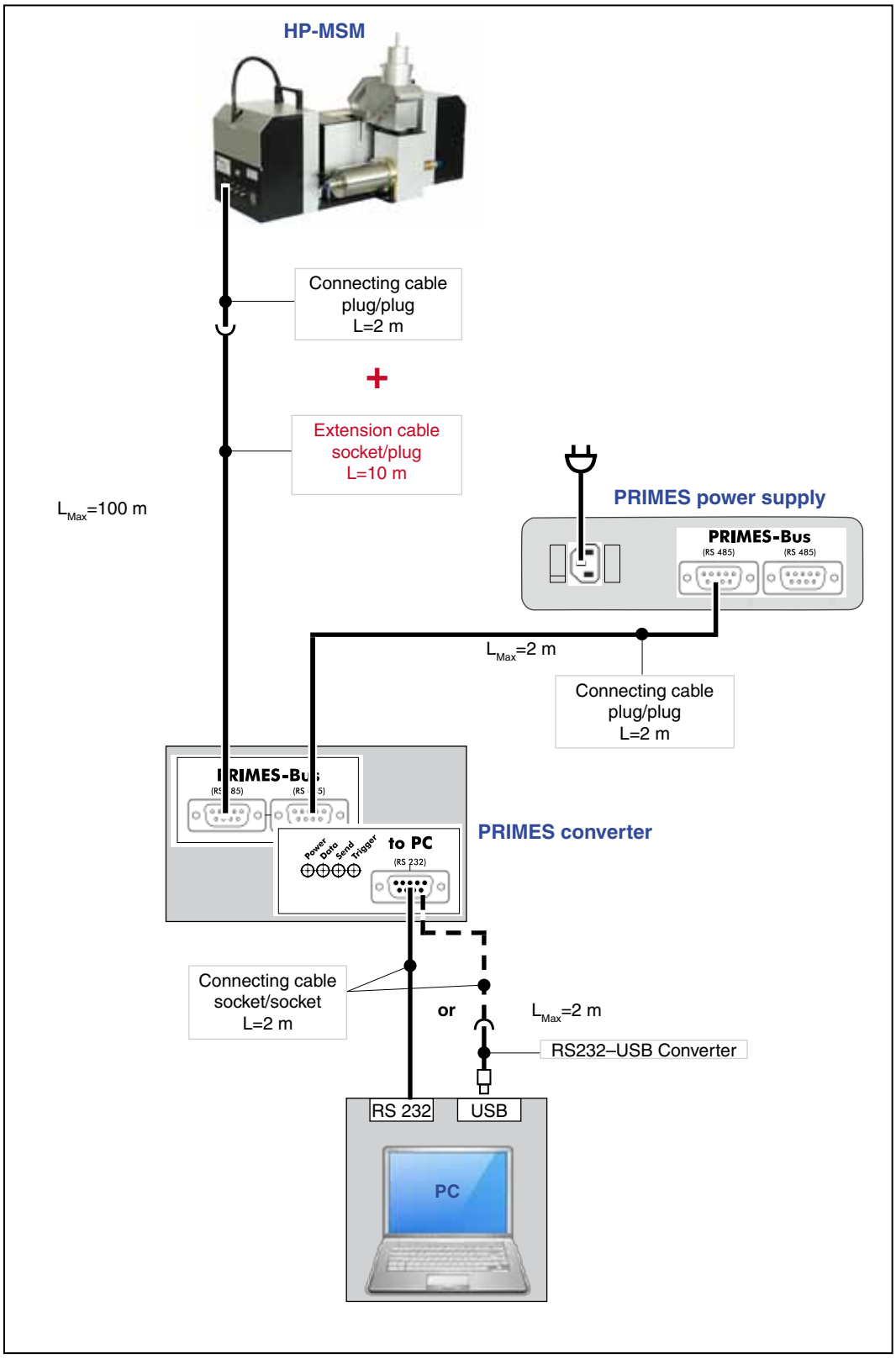


Fig. 10.4: Connection with standard cable 2 m and an extension 10 m

10.5 Connection with Power Supply with Integrated Converter

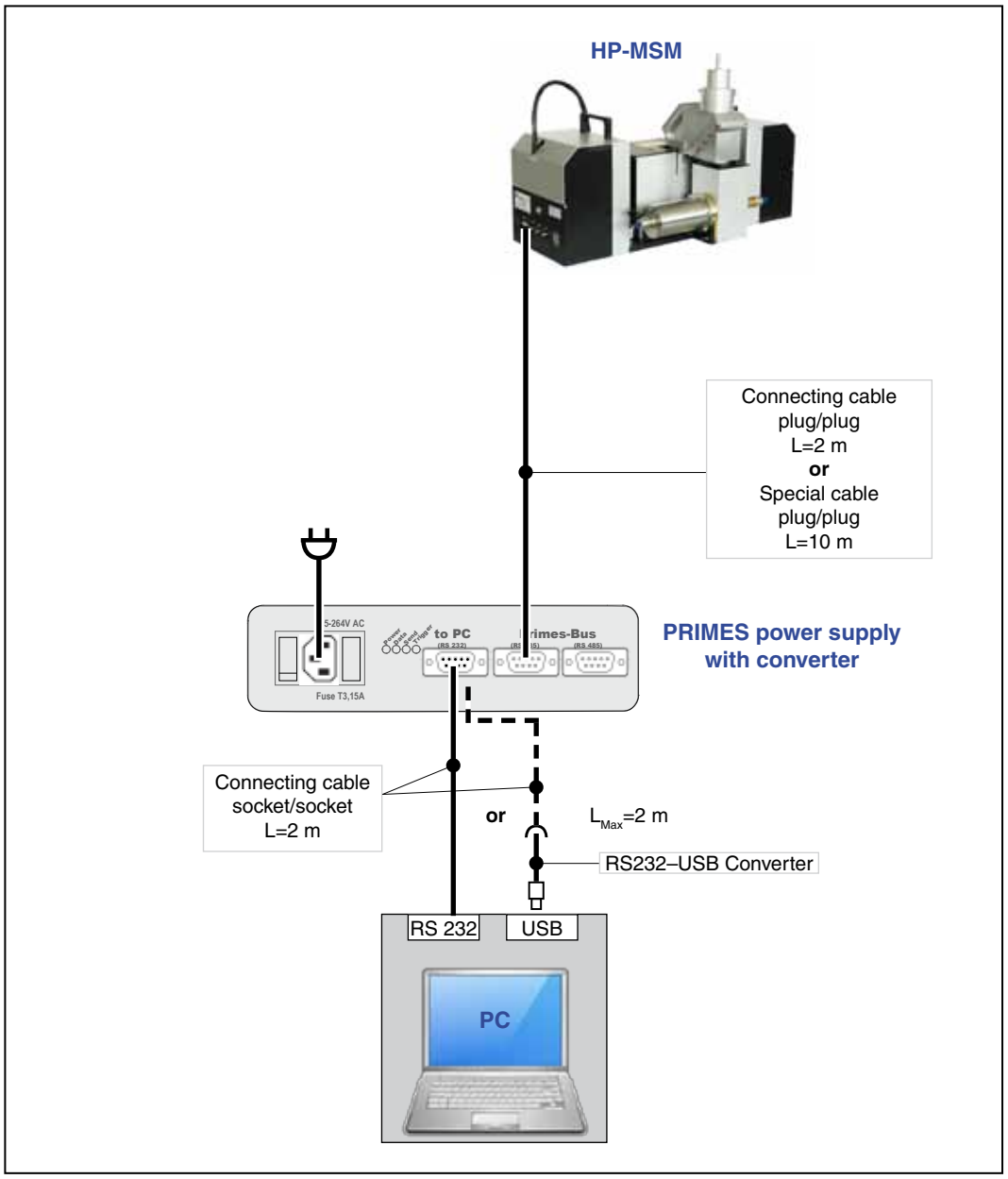


Fig. 10.5: Connection with a standard cable 2 m or special cable 10 m

NOTICE

Danger of damage

The connection or disconnection of the bus cables with a connected supply voltage leads to voltage peaks, which can destroy the communication modules of the measuring device.

▶ **Please only establish connections when the power supply is turned off! Do not remove any cables as long as the supply voltage is turned on!**

If you add further devices with the PRIMES-bus, you have to start a bus scan cycle (LDS-menu `Communication>>Find Primes devices`).

10.6 Connection via Ethernet

Connect the device with the computer via a crossover cable or with the network via a patch cable.

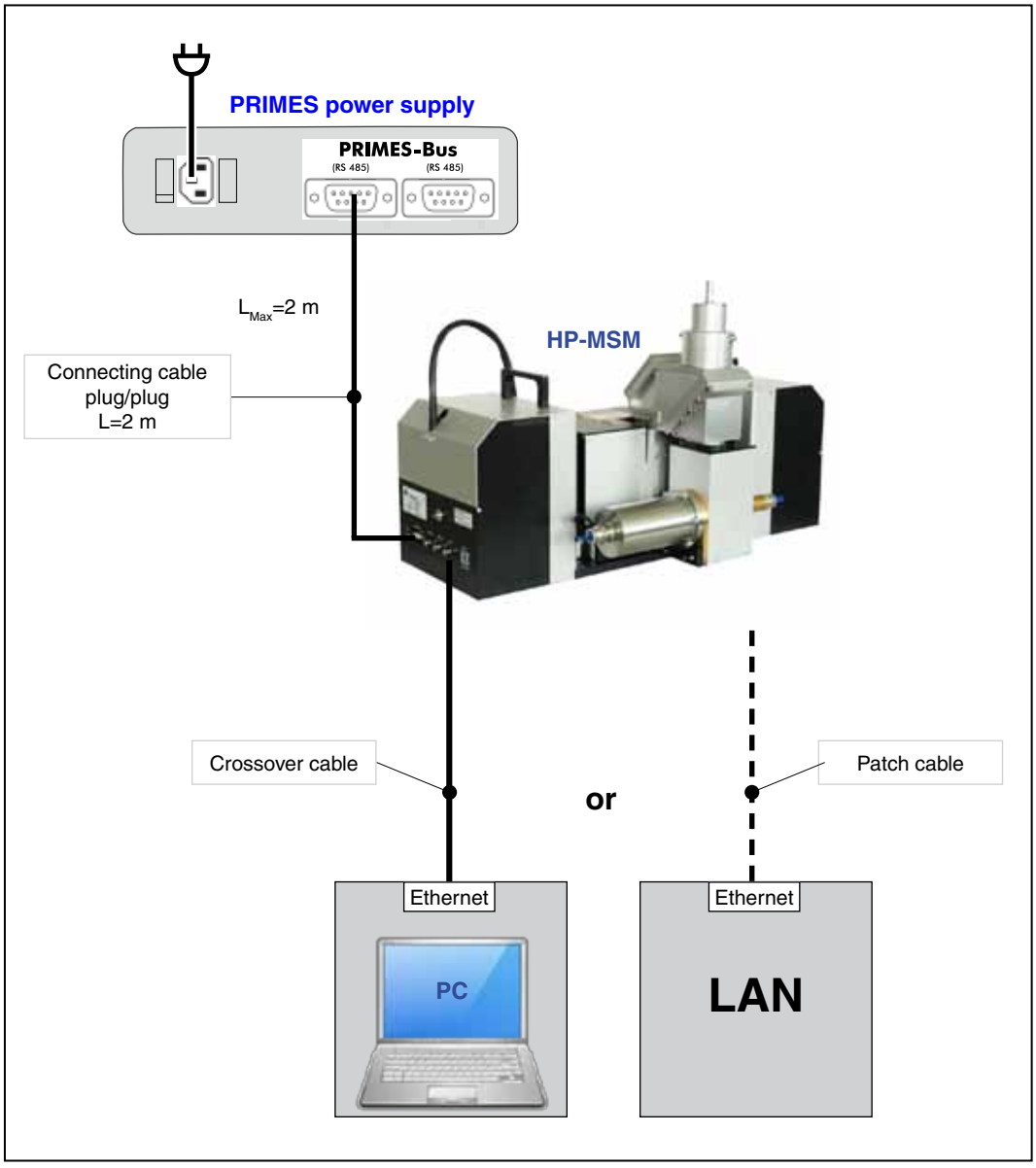


Fig. 10.6: Connection via Ethernet with a PC or a local network

11 Displays

11.1 Power Supply/Converter

The PRIMES converter as well as the PRIMES power supply with an integrated converter have four LEDs displaying the current status of the system. These signals help monitoring the status of the system, especially in case of a malfunction of the system.

Description	Color	Meaning
Power	red	Voltage (24 V)
Data	green	Devices send data to the bus
Send	red	PC sends data to the bus
Trigger	yellow	Trigger signal (only for service purposes)

11.2 HP-MSM

The device has two status LEDs.

Description	Color	Meaning
Power	green	Voltage (24 V)
Measure	yellow	Measurement is running

12 Software

In order to operate the measuring device, the “PRIMES LaserDiagnosticsSoftware” (LDS) has to be installed on the computer. The program can be found on the enclosed medium.

12.1 System Requirements

Operating system:	Windows® XP/Vista/7
Processor:	Intel® Pentium® 1 GHz (or comparable processor)
Free disc space:	15 MB
Monitor:	19“ screen diagonal is recommended, resolution at least 1024x768

When operating on a notebook, please deactivate all power saving functions. Otherwise problems could occur due to the fast serial data transmission.

12.2 Installing the Software

The installation of the software is menu driven and is effected by means of the enclosed medium. Please start the installation by double-clicking the file
“Setup LDS v.2.97.exe” and follow the instructions. The driver which may be required for the USB / serial converter can be installed via the LDS setup as well. In this case, the enclosed CD from the adapter manufacturer is not needed.

If you connect the computer via a USB interface, you also have to install the driver for the USB / serial converter (please see Fig. 12.1). Please do not connect the USB adapter with the computer before the installation of the driver is complete.

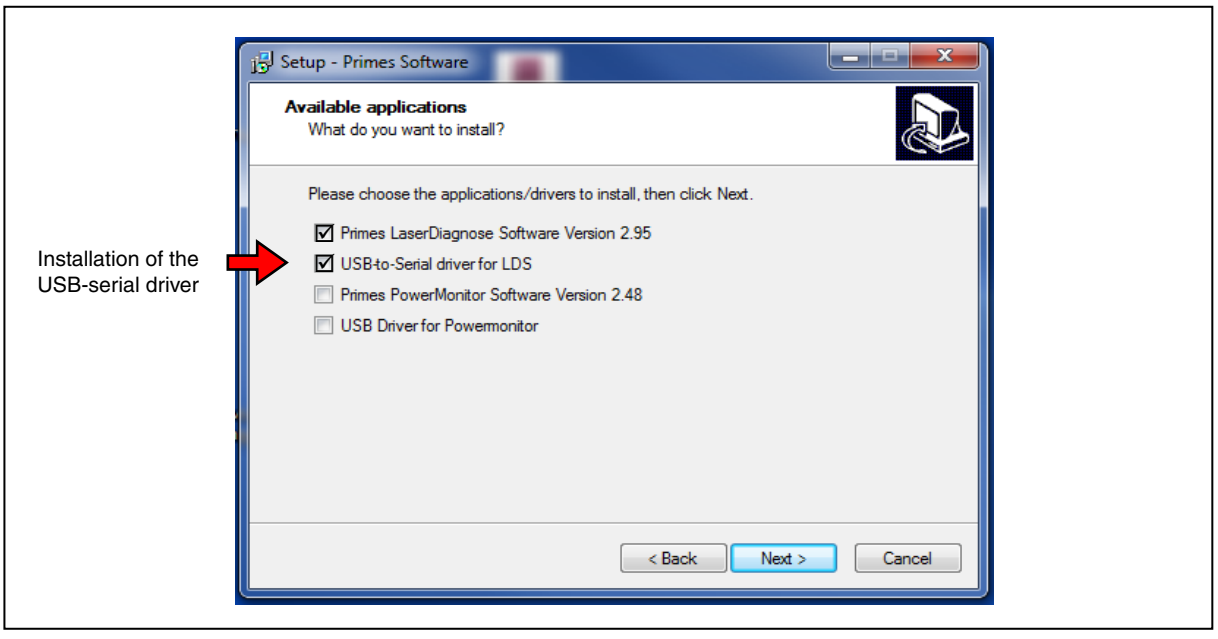


Fig. 12.1: Setup of the PRIMES Software

If not stipulated differently, the installation software stores the main program “LaserDiagnosticSoftware.exe” in the directory “Programs/PRIMES/LDS”. Moreover, the settings file “laserds.ini” is also copied into this directory. In the file “laserds.ini” the setting parameters for the PRIMES-measuring devices are stored.

Please check in the Windows® Device Manager (System Control >> Device Manager) whether the new virtual COM-connection number for the USB connection is in the range of 1 to 6. If not, this has to be changed subsequently. Otherwise, this could lead to communication problems between the measuring device and the computer (please see chapter 12.2.1).

12.2.1 Changing the COM-connection number

▶ Please open the Device Manager (System Control >> Device Manager) and double-click on the directory “connections”. The connection numbers can be found in section “Prolific USB-to-Serial Comm Port” (in Fig. 12.2 “COM6”).

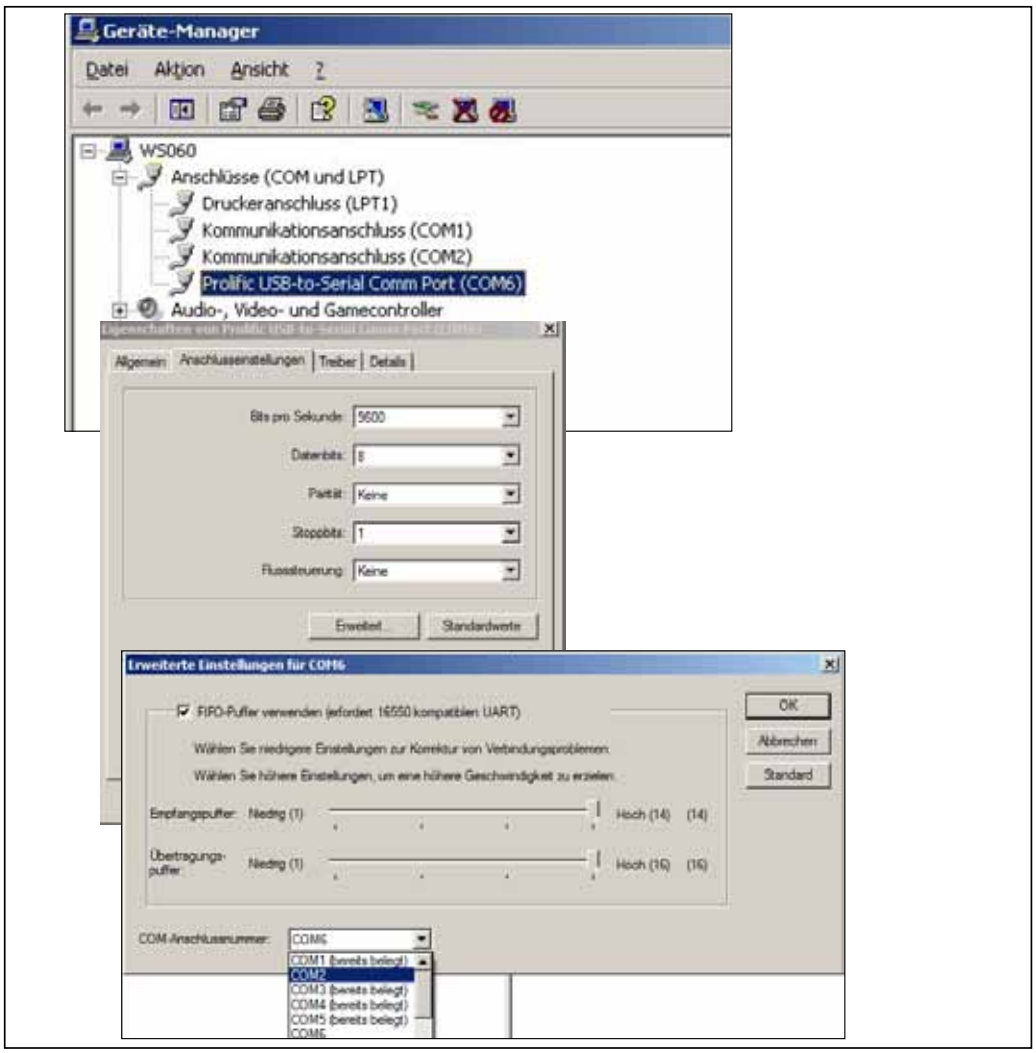


Fig. 12.2: Connection settings in the Device Manager

▶ Please pick the new interface and open the settings with the right mouse button.

▶ Please pick the register “Connection settings”, click on the button “advanced” and choose the desired connection number.

▶ Please confirm the settings and close all windows.

Please always use the same USB-connection as the COM-connection number could otherwise change.

Further information with regard to the converter can be here: http://www.prolific.com.tw

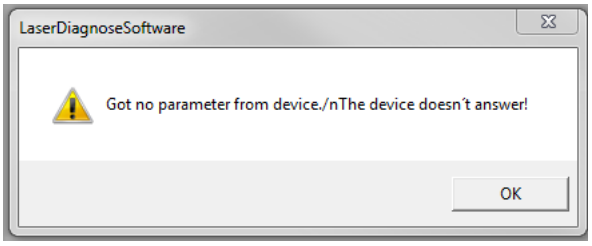
13 Checking the Communication

After connecting the devices, the communication between the computer and the measuring system is checked. In order to do so, the software menu **`Communication`** is used.

13.1 Checking the Computer Interface

Please start the LDS on your computer. Select **`Communication>>Rescan bus`**.

Possible error message:

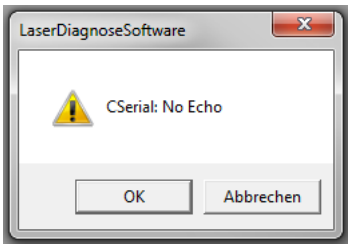


Reasons:
Power supply is not switched on or the cable connection is not correct.

Remedy:

- ▶ Check the cabling of the devices
- ▶ In case the system is connected with the bus via a RS232/RS485 converter, a missing power supply is often the reason. A communication is only possible if the bus is supplied with a direct current voltage of 24 V.
- ▶ Turning off the power supply of the devices and turning it on again.

Possible error message:



Reasons:
The program can not open the preset interface

Remedy:

- ▶ Please check whether a different program, e.g. a fax software possibly occupies the interface. A serial port can only be used by one program at a time.
- ▶ Please check whether the program opens the right port. After starting the program, the used interface can be changed in the menu **`Communication>>Free communication`**. Here, all interfaces available for the program are shown. These settings can also be stipulated in the file **laserds.ini** in the installation directory of the LaserDiagnosticsSoftware. The desired standard channel can be selected in the selection field ***Com Port***.

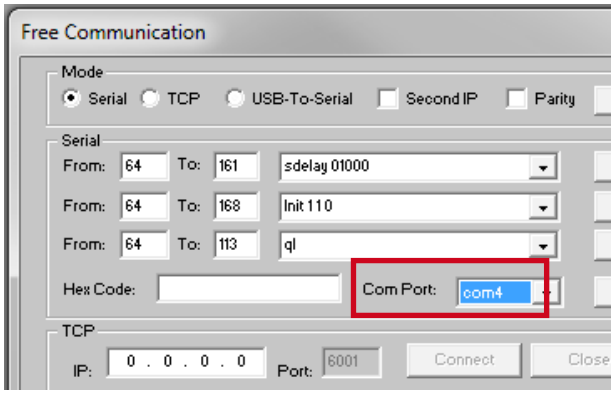


Fig. 13.1: Channel of the serial interface

Please activate:

- Serial: if you connect the measuring device with the RS-232 connection of the computer

or

- USB-to-serial: if you connect the measuring device with the USB connection of the computer (with USB/RS-485 converter)

TCP: connection via Ethernet
Second IP: connection via Ethernet
Parity: should always be deactivated

13.2 Checking the Communication with the Devices

The communication can be checked by means of the LDS. Therefore, each device receives a certain command. If the device replies as stated in Tab. 13.1, the communication works without any errors.

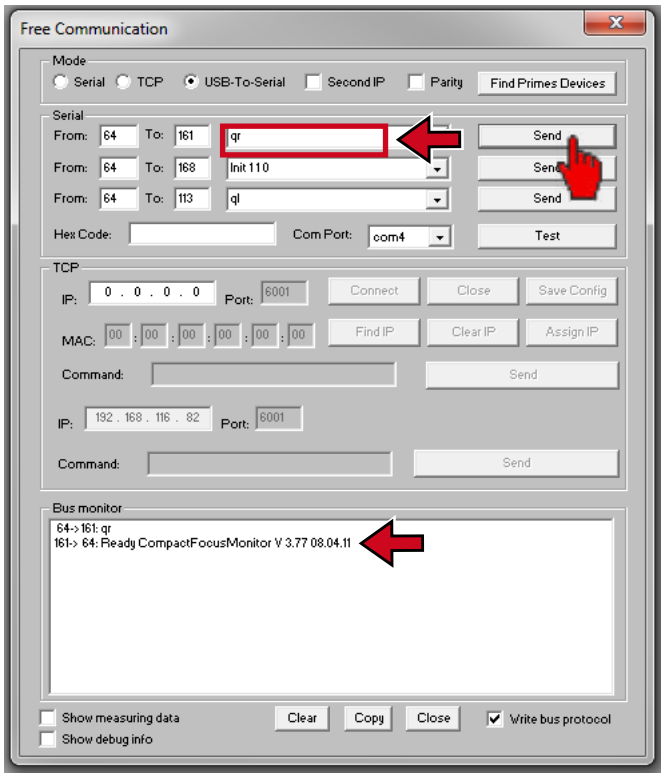


Fig. 13.2: Dialogue window **`Free Communication`**

Please select **`Communication>>Free communication`**. In the appearing window, the address of the sender (PC) has to be entered in the field ***From***, the address of the recipient (PRIMES device) has to be entered in the field ***To*** and the text field on the right is intended for the command. You can send your demand by clicking on the button Send. The answer of the device appears in the bus monitor.

Device	**From** (PC address)	**To** (device address)	**Command**	**Reply**
HP-MSM	64	168	qr	aID

Tab. 13.1: Communication commands and responses

qr (query request) is the command for a device scan.

If there is no answer from the device addressed, the following measures can be taken:

- Turn off the 24 V power supply and turn it on again. Then resend the command.
- Check the cabling of the device. Are all plugs connected and screwed?
- A device blocks the PRIMES measuring bus. Turn off the power supply and take the faulty device off the bus. Then you can put the rest of the system into operation again.
- The computer blocks the bus. This can be recognized from the red LED “send” at the interface converter glows permanently. Please restart the computer.

Test

With the button ***Test*** you can check whether an echo is received from a signal sent. However, as soon as the PRIMES system is connected this is generated as if a modem was connected.
If no echo is received, the error message “**No echo**” appears.

14 Setting up an Ethernet Connection

The HP-MSM has an Ethernet interface. You can directly connect the measuring device with a computer via a crossover cable or with a local network via a patch cable. The measuring device is supplied with voltage via an RS485 interface.

• IP Address:

The DHCP operation (Dynamic Host Configuration Protocol) is activated ex works. If an IP assignment is not possible from the DHCP server, the device uses the static IP address set ex works.

Every device has a fixed IP address which is stated on the housing. The address can be changed later. However, this requires special network knowledge. In this case, we would ask you to get in touch with us. If a special IP address is required with regard to your application, please be so kind as to inform us when placing the order.

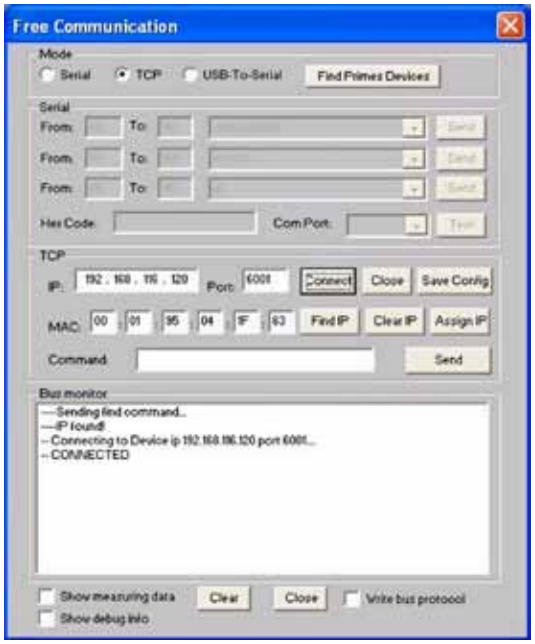
Connection with a local network via a patch cable

First of all, the mode “TCP” has to be selected in the menu `Communication>>Free Communication`. The DHCP server assigns a valid IP address to the PRIMES device. Enter this IP address in the menu `Communication >> Free Communication` and click the button ***Connect***.

Direct connection with a computer via a crossover cable

In case the communication with the HP-MSM is supposed to be effected directly via a crossover cable, you first have to assign a fixed IP address to the computer (e.g. 192.168.116.18).

Then you have to enter the IP address of the device in the menu *`Free Communication`* before clicking the button **Connect**.



Please mind that the network addresses of the computer and the measuring device have to be the same, otherwise a communication is not possible.

Example:

The IP address of the computer is “192.168.100.2” and the IP of the device is “192.168.100.88”. The subnet mask “255.255.255.0” stipulates the first 3 number groups as the network address.

15 Starting the Software

Please do not start the software before all devices are connected and turned on.

Please start the program by double-clicking the PRIMES symbol in the new start menu group or the desktop link.

15.1 Graphical User Interface

Firstly, a start window is opened in which you can choose, whether you would like to measure or whether you would just like to depict an existing measurement (factory setting “measurement”).

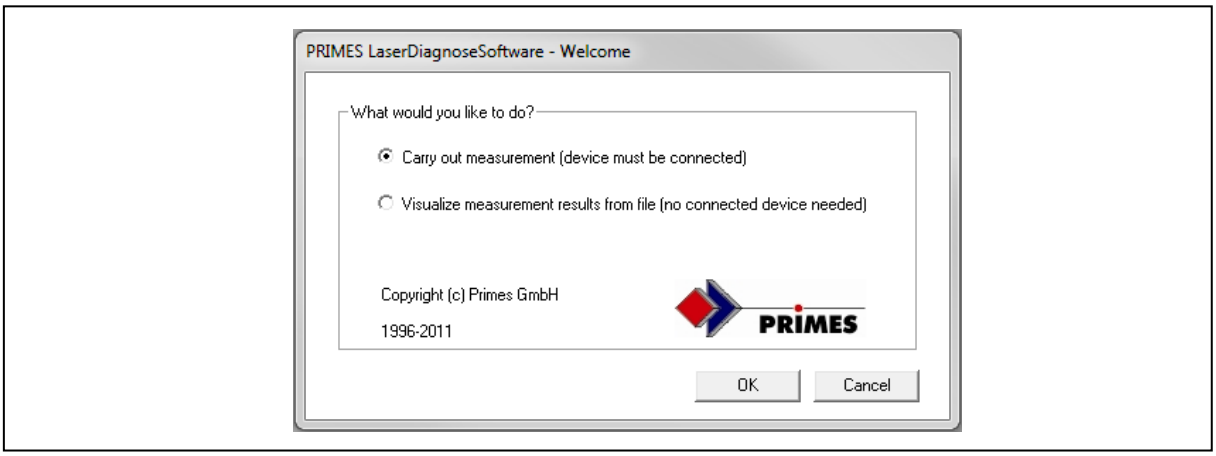


Fig. 15.1: Start window of the LaserDiagnosticsSoftware

After the detection of the connected device, the graphical user interface and several important dialogue windows are opened.

In order to ensure that corresponding information can be assigned quickly, special markups for menu items, menu paths and texts of the user interface will be used in the following chapters.

Markup	Description
`Text`	Marks menu items. Example: Dialogue window **`Sensor parameters`**
`Text1>>Text2`	Marks the navigation to certain menu items. The Order of the menus is depicted by means of the Sign “>>” Example: **`Presentation>>Caustic...`**
Text	Marks buttons, options and fields. Example: With the button ***Start*** ....

The graphical user interface mainly consists of the menu as well as the tool bar by means of which different dialogue or display windows can be called up.

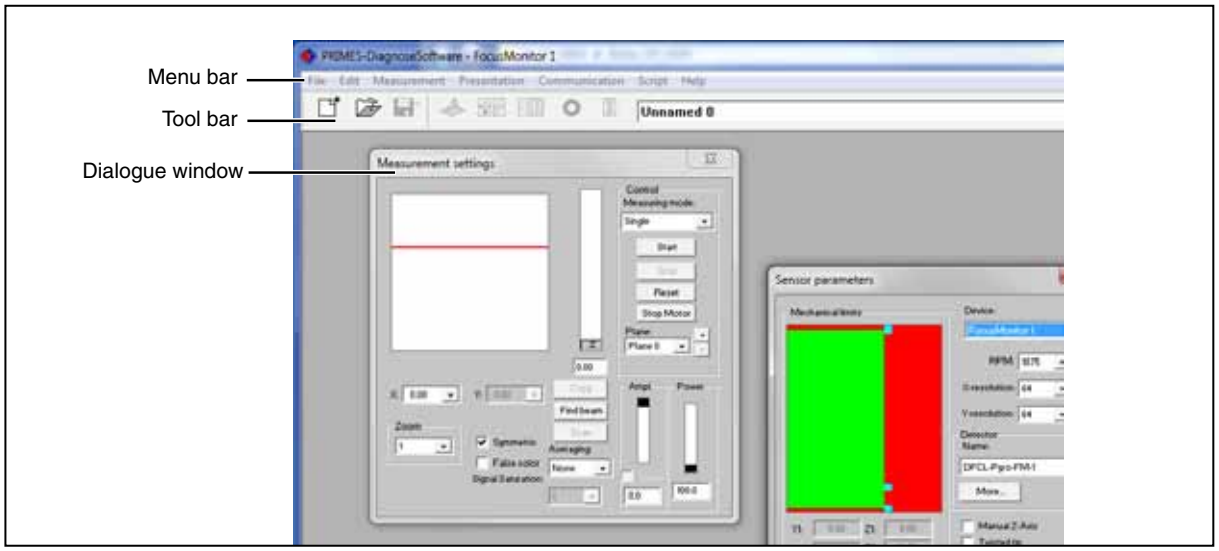


Fig. 15.2: The main elements of the user interface

It is possible to open different measuring and dialogue windows simultaneously. In this case, windows that are basically important (for the measurement or the communication) remain in the foreground. All other dialogue windows are overwritten as soon as a new window is opened.

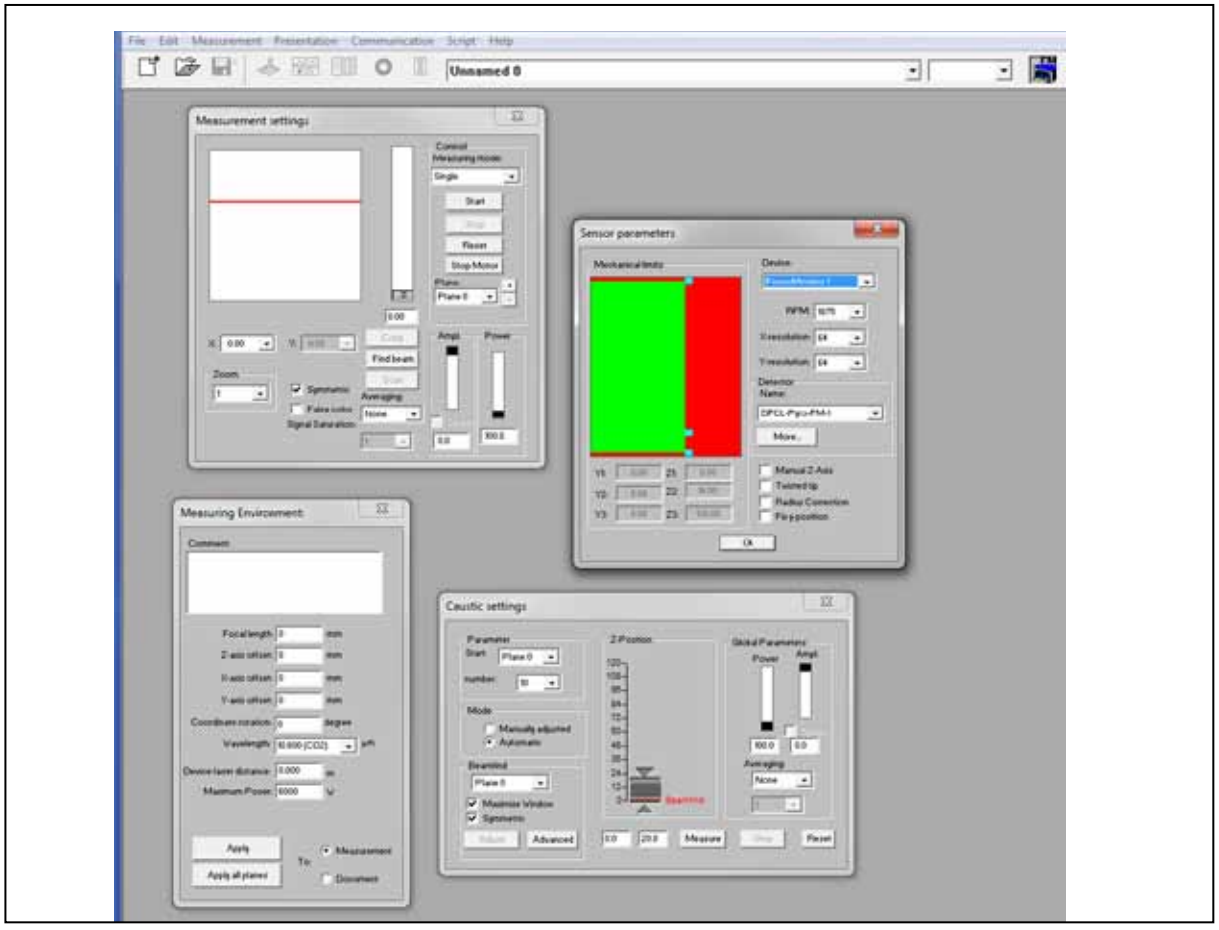
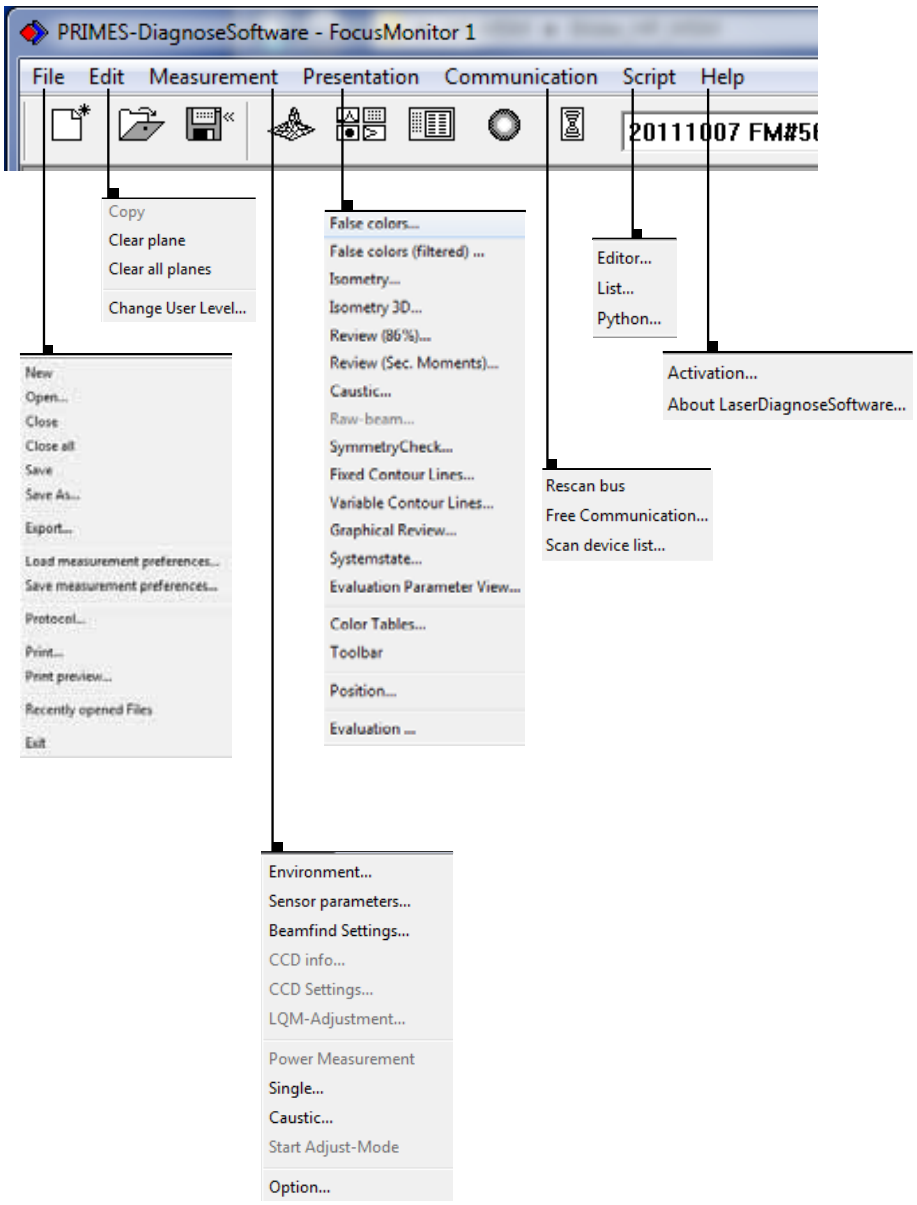


Fig. 15.3: The main dialogue windows

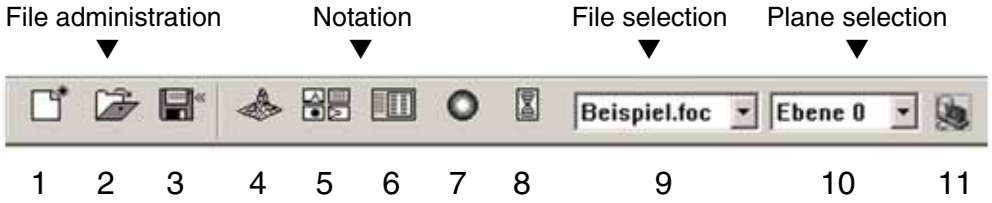
The menu bar

In the menu bar, all main and sub menus offered by the program can be opened.



The tool bar

By clicking the symbols in the tool bar, the following program menus can be reached immediately.



1 - Create a new data record
2 - Open an existing data record
3 - Save the current data record
4 - Open the isometric view of the selected data record
5 - Open the variable contours line view
6 - Open review (86%)
7 - Open false color depiction
8 - Caustic presentation 2D
9 - List with all data records opened
10 - Display of the selected measuring plane
11 - Display of the measuring devices available for the bus by means of graphical symbols

All measuring results are always written into the document selected in the tool bar.
It is only possible to display documents chosen here. After opening, the data set has to be explicitly selected

15.2 Menu Overview

File	
New	Opens a new file for the measuring data.
Open	Opens a measuring file with the extensions “.foc” or “.mdf”.
Close	Closes the file selected in the tool bar.
Close all	Closes all files opened.
Save	Saves the current file in foc- or mdf format.
Save as	Opens the menu for the storage of the files selected in the tool bar. Only files with the extensions “.foc” or “.mdf” can be imported safely
Export	Exports all current data in protocol format “.xls” and “.pkl”.
Load measurement preferences	Opens a file with measurement settings with the extension “.ptx”.
Save measurement preferences	Opens the menu to save the settings of the last program run. Only files with the extension “.ptx” can be opened.
Protocol	Starts a protocol of the numeric results. They can either be written into a file or a data base.
Print	Opens the standard print menu.
Print preview	Shows the content of the printing order.
Recently opened files	Shows the file opened before.
Exit	Terminates the program.
Edit	
Copy	Copies the current window to the clipboard.
Clear plane	Deletes the data of the plane selected in the tool bar.
Clear all planes	Deletes all data of the file selected in the tool bar
Change user level...	By entering a password a different user level is activated.
Measurement	
Environment	Here, different system parameters can be entered, e.g. - Reference value for the laser power - Focal length - Wave length - Remarks
Sensor parameters	The following device parameters can be e.g. set here: - The spatial resolution - The mechanical movement limits in z-direction - Selection of one of the measuring devices connected with the bus - The manual settings of the z-axis
LQM-Adjustment	Not relevant for HP-MSM
Beamfind settings	Not activated with HP-MSM
CCD info	Provides information on device parameters.
CCD settings	Here, special settings can be made, e.g.: - Trigger mode - Trigger level - Exposure time - Wave length
Power measurement	Opens the measuring window power measurement.
Single...	This menu item enables the start of single measurements, of the monitor mode and the video mode.

Caustic...	Enables the start of a caustic measurement. Not only automatic measurements but also serial measurements of manually set parameters are possible. The automatic measurement starts with a beam search and then caries out the entire measuring procedure independently. Only the z-range that is to be examined as well as the desired measuring plane have to entered.
Start adjustment mode	Starts a special monitor mode optimized for the application of the BeamMonitor for the alignment of laser resonators.
Options	Enables the setting of device parameters
Presentation	
False colors...	False color display of the spatial power density distribution.
False colors (filtered)...	Usage of a spatial filtration (spline-function) on the false color display of the power density distribution.
Isometry...	3-dimensional display of the spatial power density distribution.
Isometry 3D...	Allows a 3D display of caustic and power density distribution with spatial rotation as well as an optional isophote display.
Review (86%)...	Numerical overview of measuring results in the different layers basing on the 86% beam radius definition.
Review (2. Moments)...	Numerical overview of the measuring results in the different layers basing on the 2nd moment beam radius definition.
Caustic...	Results of the caustic measurement and the results of the caustic fit – such as beam propagation ratio k, focus position and focus radius.
Raw beam...	Not relevant for HP-MSM
Symmetry check...	Analysis tool to check the beam symmetry especially for the alignment of laser resonators. No standard feature of the devices.
Fixed contour lines…	Display of the spatial laser density distribution with fixed intersection lines for 6 different power levels.
Variable contour lines…	Display of the spatial power density distribution with freely selectable intersection lines.
Graphical review	Enables a selection of graphical displays – among them the radius, the x- and y-position above the z-position and the time.
System state	Listing of the controlled system parameters.
Evaluation parameter	Loading stored evaluation parameters.
Color tables...	Different color charts are available in order to analyse e.g. diffraction phenomena in detail.
Tool bar	In order to display or to hide the tool bar.
Position	Moving the device into a defined position
Evaluation	Comparison of the measured values with defined limit values and evaluation (optionally).
Communication	
Rescan bus	The system searches the bus for the different device addresses. This is necessary whenever the device configuration at the PRIMES bus was changed after starting the software.
Free Communication	Darstellung der Kommunikation auf dem PRIMES-Bus. Display of the communication on the PRIMES bus
Scan device list	Lists the device addresses of the single PRIMES devices.
Script	
Editor	Opens the script generator, a tool, by means of which complex measuring procedures are controlled automatically (with a script language developed by PRIMES).
List	Shows a list of the opened windows.
Python	Opens the script generator in order to control complex measuring procedures automatically (script language Python).
Help	

Activation	Enables the activation of special functions
About LaserDiagnostic-Software	Provides information regarding the software version

Further information regarding the function volume of the software can be found in the standard operating manual of the “MicroSpotMonitor”.

16 Initial Operation

The following steps refer to the standard device with 5-fold HP-objective and cyclone.

1. Make sure that all installations described in chapter 7 on page 15 have been carried out.
2. Turn on the water-cooling.
3. Turn on the power supply and the measuring device.
4. Wait until the measuring device has finished the referencing procedure (duration approx. 30 seconds).
5. Start the LaserDiagnosticsSoftware on your computer.
6. Change the z-position to 60 mm (center of the measuring range).
7. Put the alignment aid on the cyclone. The upper corner equals the z-position of the measuring plane of the objective. Turn on the pilot laser. If the laser hits the little bore in the cover vertically, it is displayed centrally on the sensor.
8. Remove the alignment aid and open the compressed air supply.
9. First of all, the laser has to be measured with a small power and stipulate the measuring range for the caustic measurement (the focus plane has to remain 1 or 2 Rayleigh lengths above the entrance lens of the measuring objective and the laser beam has to remain smaller than 40 mm on the measuring objective. The measuring range typically includes 2 to 3 Rayleigh lengths above and below the focus plane).
10. Carry out a test measurement with the desired z-range and with small power.
11. Increase the power gradually until the measuring power is reached and carry out a caustic measurement (it might be necessary to adapt some parameters).
12. During the measurement with high powers, please check the environment of the measuring objective for scattered radiation and test the housing of the absorber for local heating (if applicable, the loss angles in x and y direction have to be reduced to below 10 mrad).

17 Technical Data

Supply Data		
Supply Voltage, DC Max. current consuption in standby mode	V A A	24 ± 5 % 1.8 0.4
Cooling Circuit Cooling Water Flow Rate, min. Cooling Water Temperature T_{in} [1]	l/min/kW –	0.7 dew-point temperature < T_{in} < 30 °C
Compressed Air (cleaned and dry) Minimum Pressure Maximum Pressure	bar bar	3 4
Characteristics Measurement		
Max. medium power Short-time	kW kW	8 10
Beam Diameter	µm	15 ... 600
Wave Length Range	nm	1000 ...1100
Max. Energy Density on ther 1. optical surface at 10 ns	J/cm²	up to 3
Max. Energy Density on the 1. optical surface (cw-mode)	GW/cm²	10
Communikation		
Ethernet PRIMES Bus (RS485) Safety circuit (Interlock)	Mbit - -	100 - potential free
Ambient Conditions		
Service Temperature Range Storage Temperature Range	°C °C	+15 ... +40 +5 ... +50
Reference Temperature	°C	+22
Admissible Relative Air Humidity (non-condensing)	%	80
Measures and Weight		
L x W x H (without cables and plugs)	mm	600 x 287 x 343
Weigt, approx.	kg	35

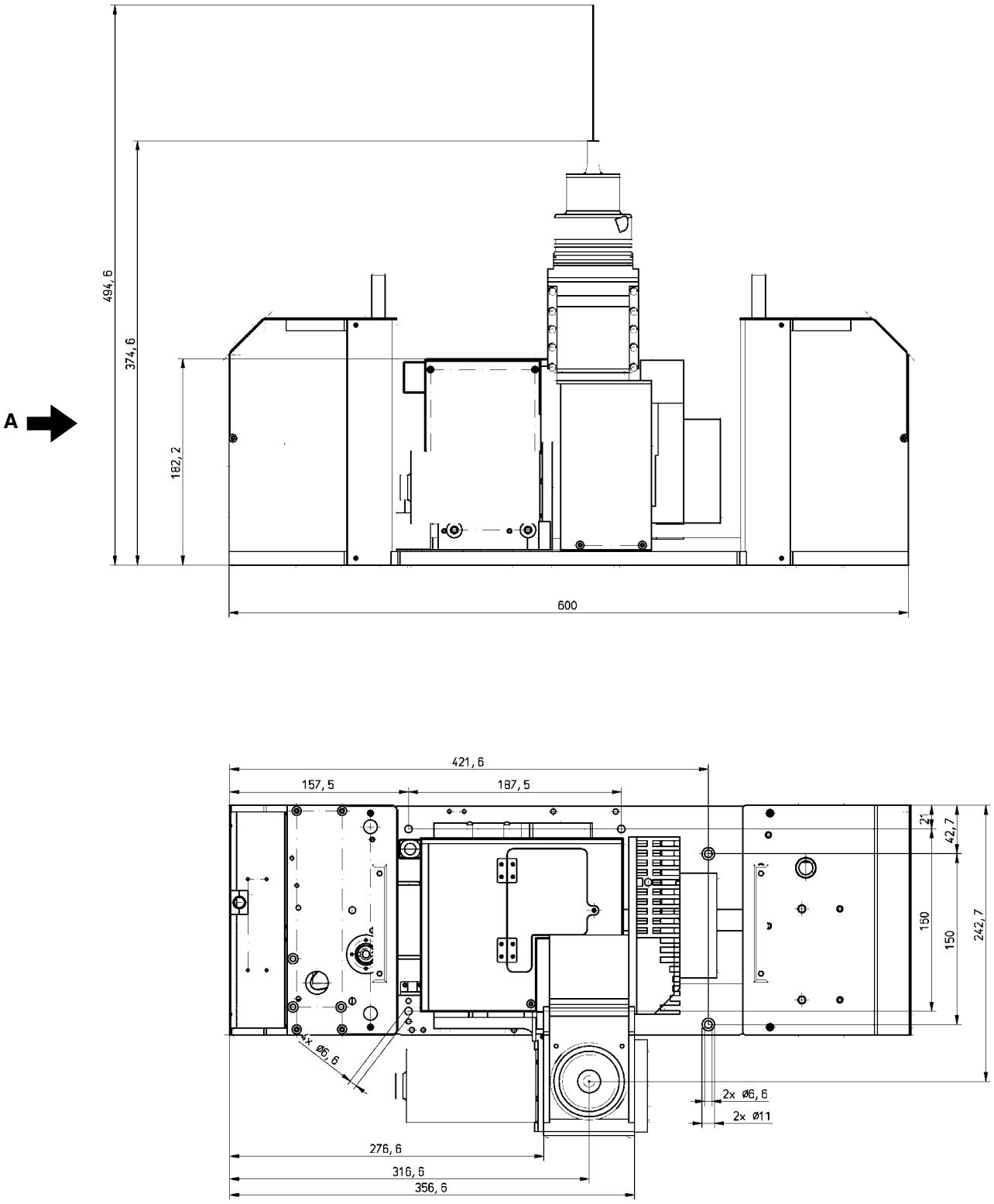
[1] Please contact PRIMES in advance in case you intend not to work within this specification.

Additional Technical Data of the HighBrilliance Measuring Objective

Admissible laser power	kW	8
Admissible wavelength range of the laser light	nm	1025 - 1080
Admissible measuring range	-	$\pm 3z_R$
Beam diameter in the measuring plane	µm	20 ... 1000
Design wavelength	nm	1064
Magnification	-	4.5
Max. input-NA	-	0.11
Free working distance, approx.	mm	37.8
Weight, approx.	kg	5.5

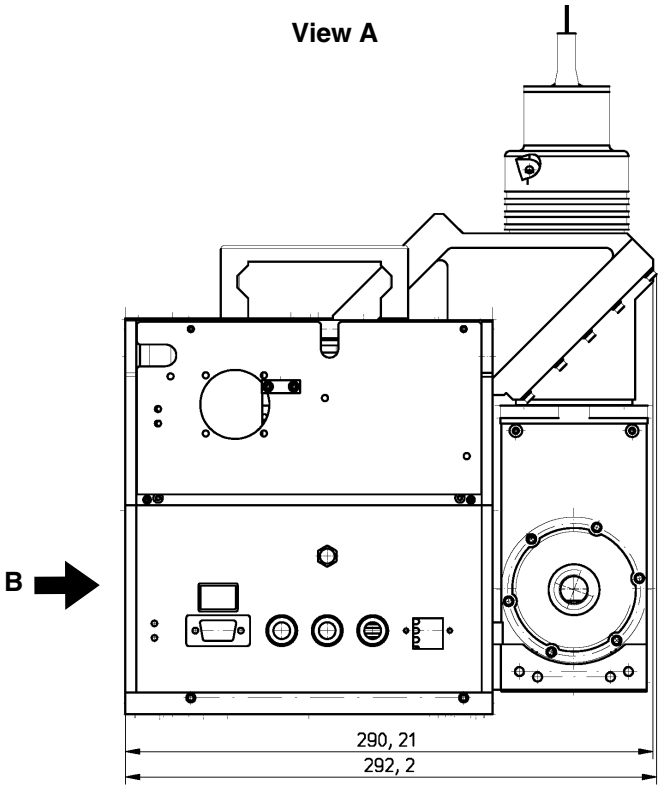
18 Dimensions

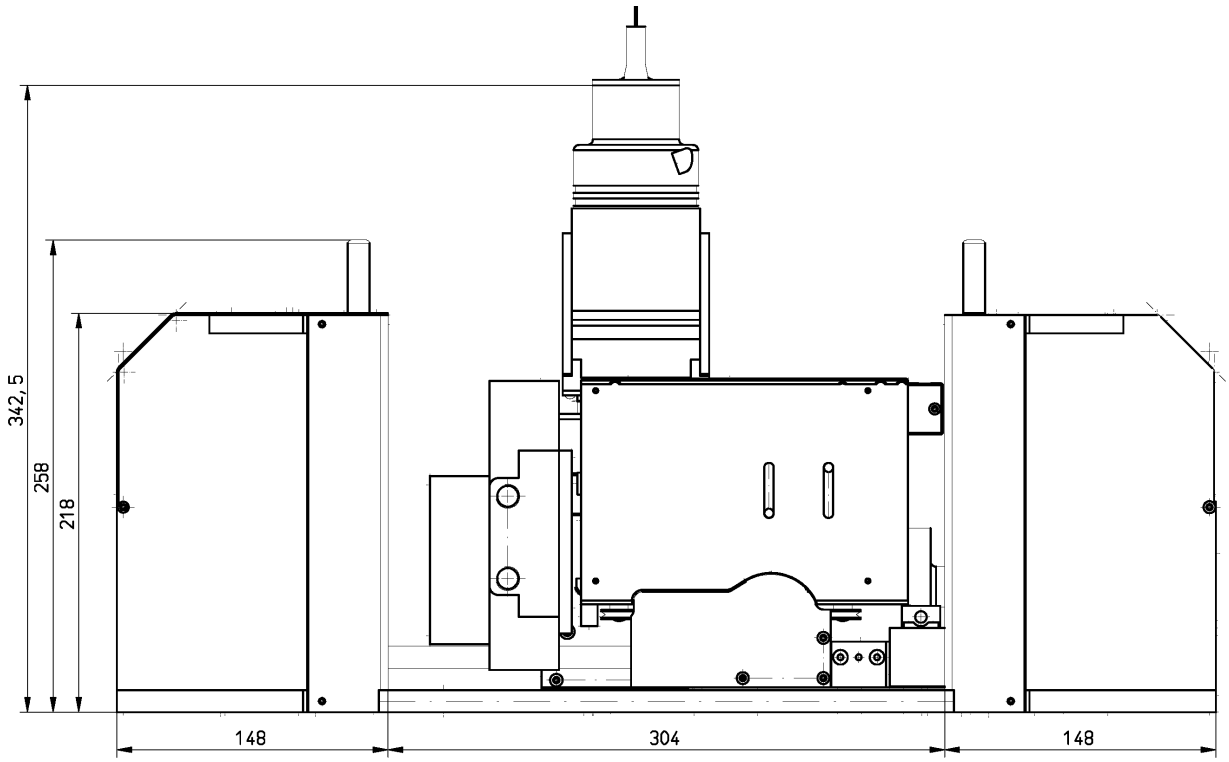
18.1 HP-MSM with 5-fold Objective and Cyclone (with alignment aid)



All dimensions in mm

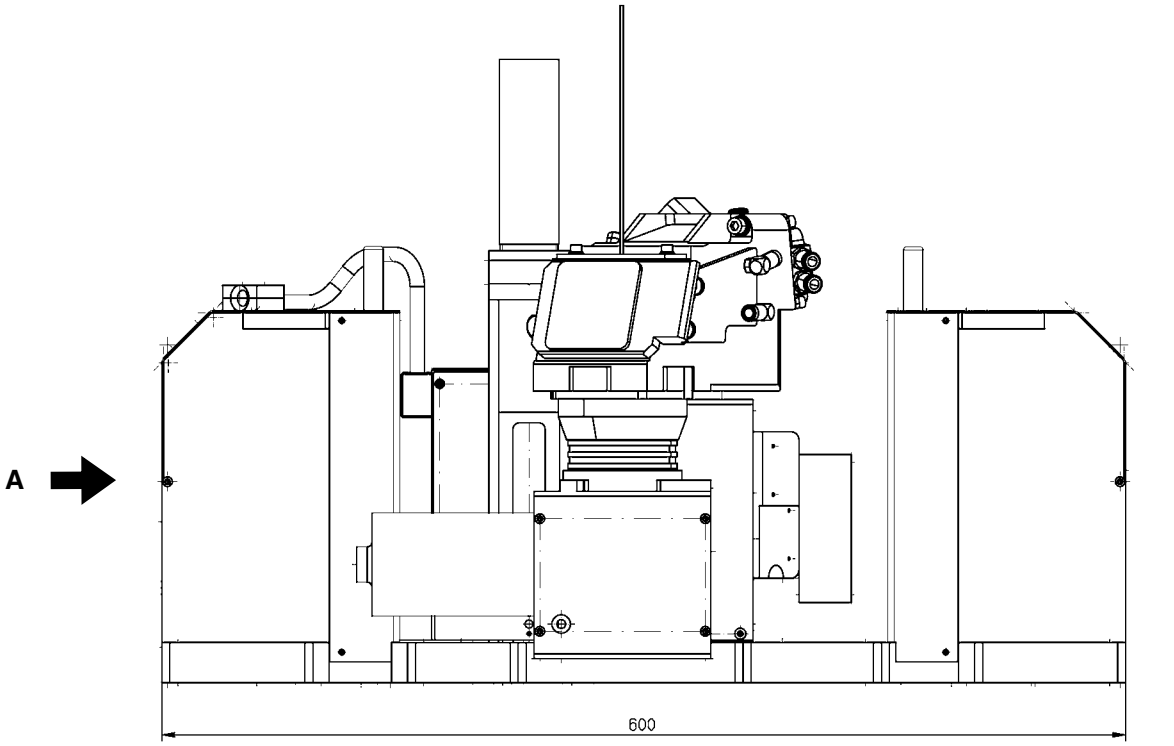
HP-MSM with 5-fold Objective and Cyclone (continuation)

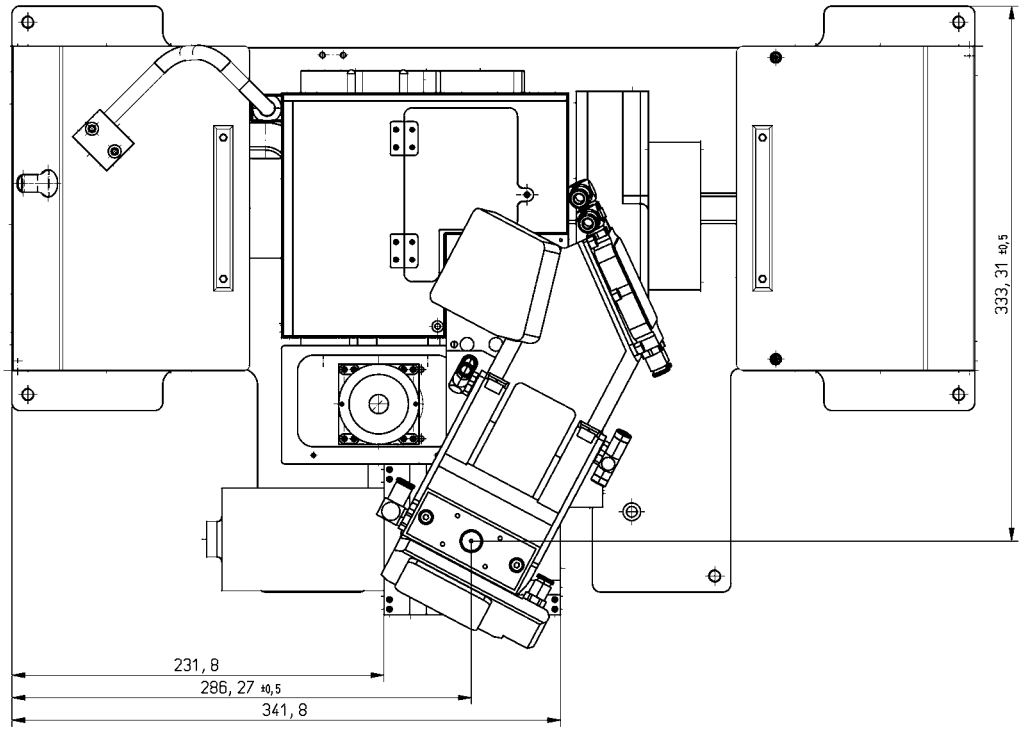




All dimensions in mm

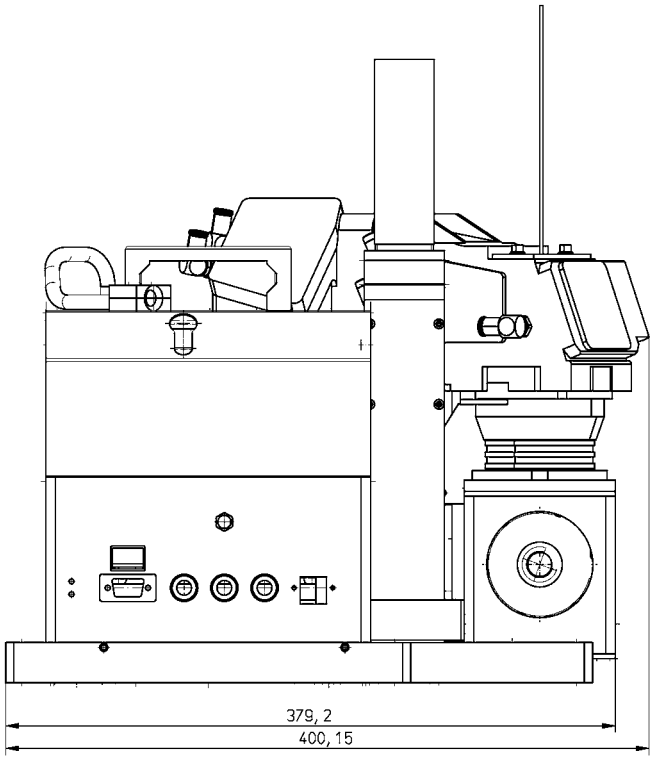
18.2 Main Dimensions of the HP-MSM with HB Objective





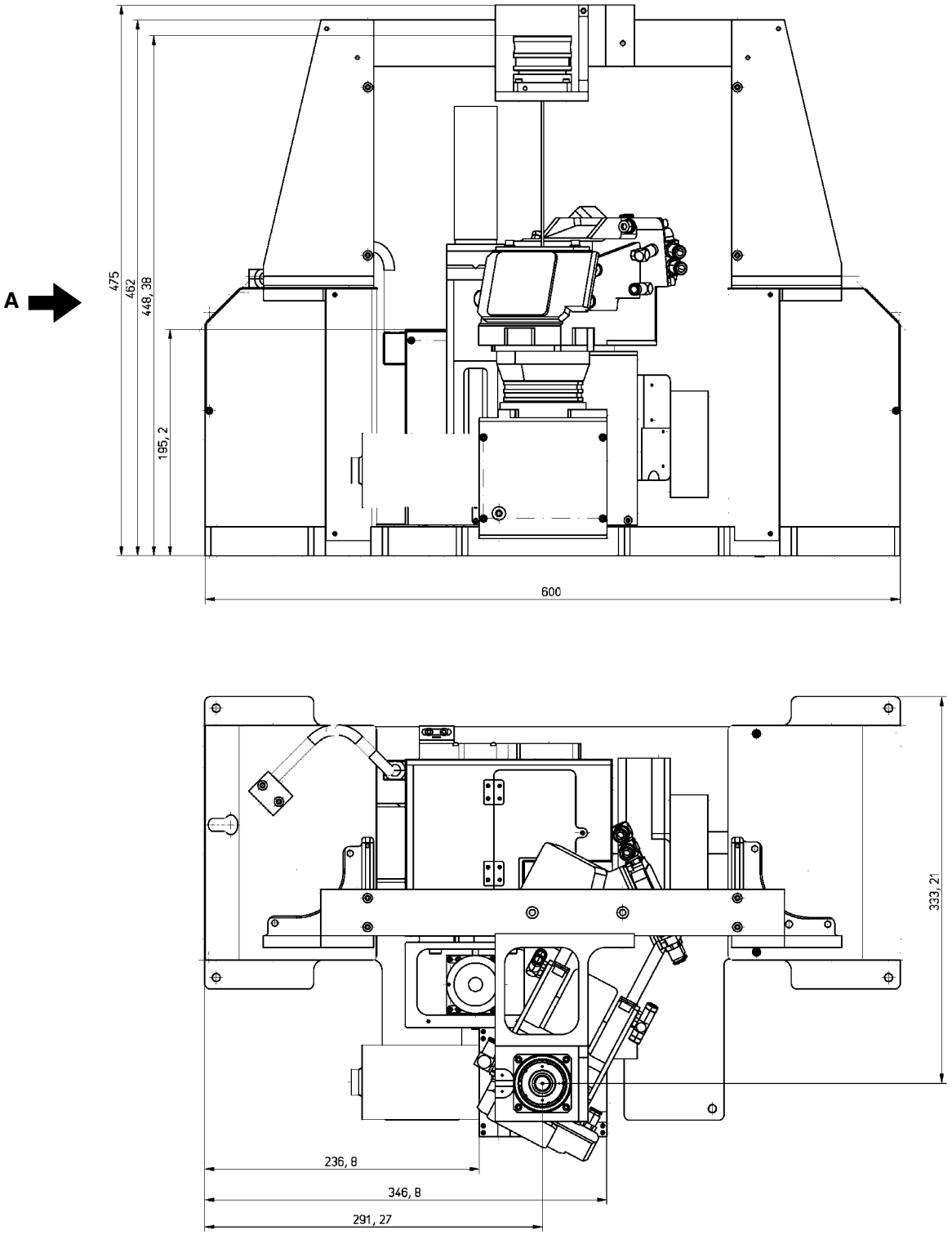
Main Dimensions of the HP-MSM with HB Objective (continuation)

View A



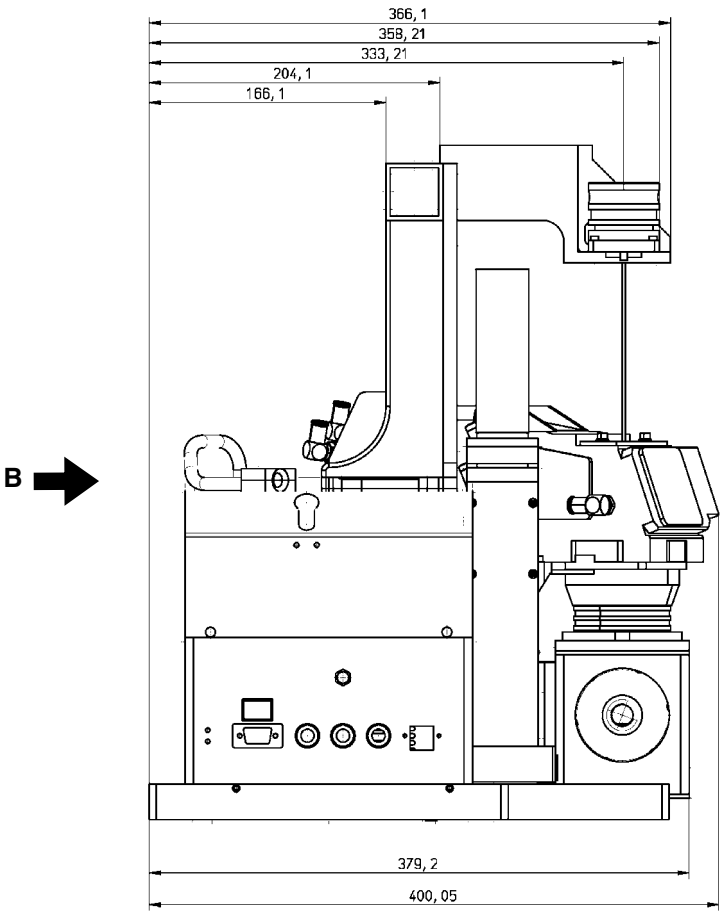
All dimensions in mm

18.3 Main Dimensions of the HP-MSM with Fiber Bridge and HB Objective



Main Dimensions of the HP-MSM with Fiber Bridge and HB Objective (continuation)

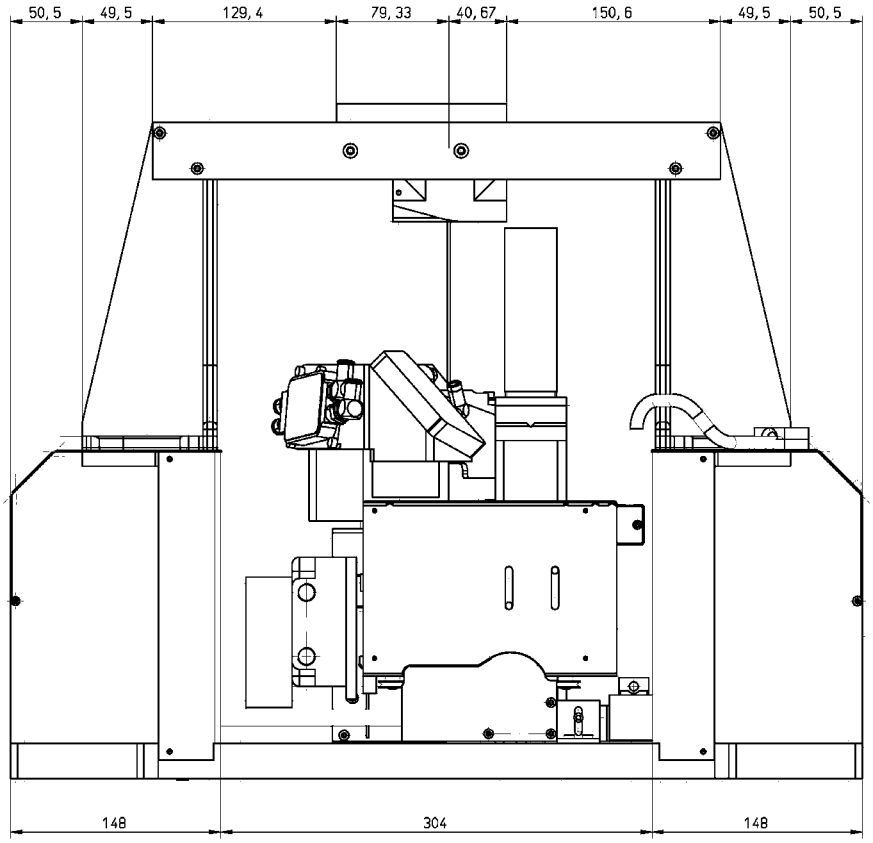
View A



All dimensions in mm

Main Dimensions of the HP-MSM with Fiber Bridge and HB Objective (continuation)

View B



All dimensions in mm

19 Measures for the Product Disposal

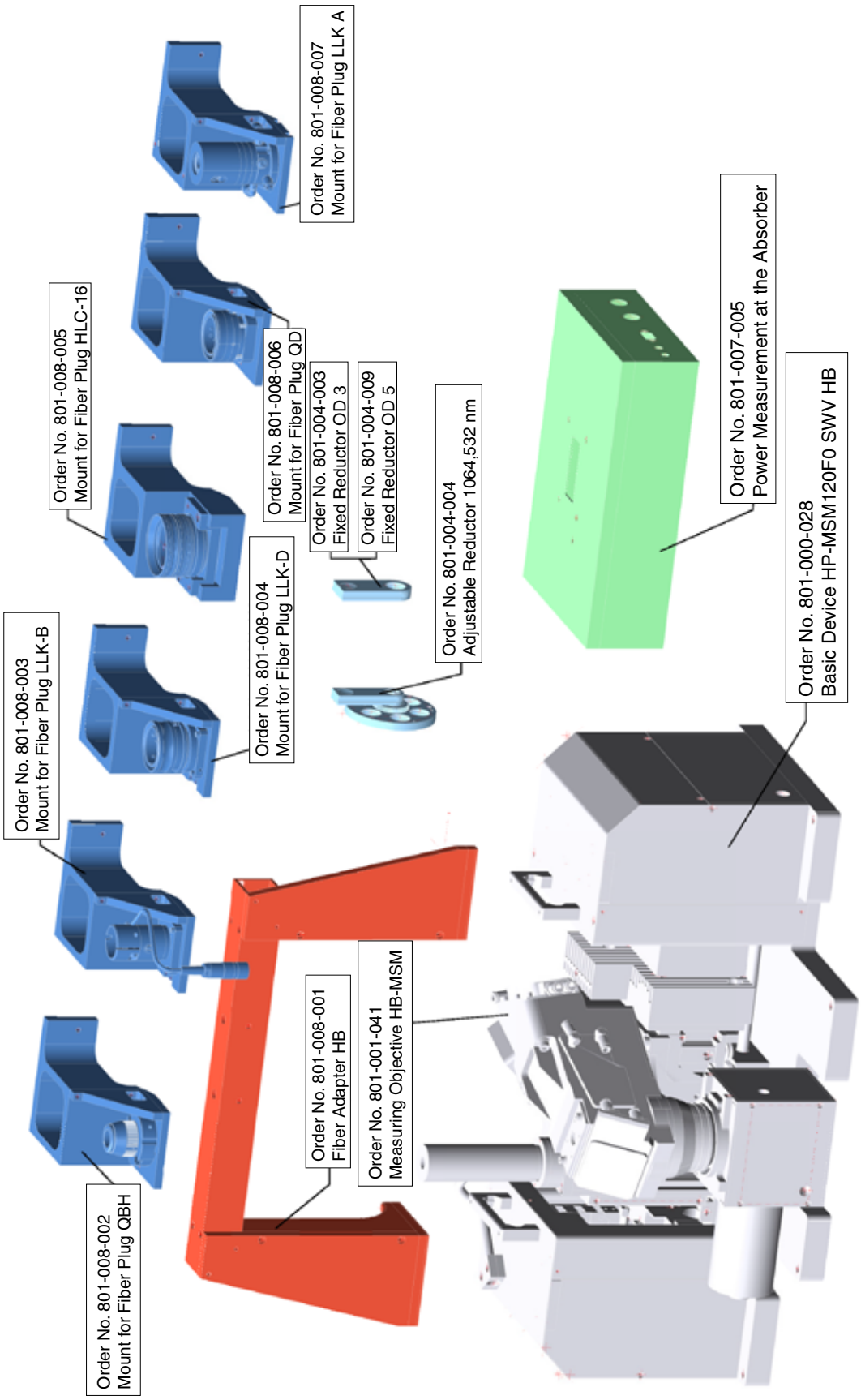
Due to the Electrical and Electronic Equipment Act (“Elektro-G“) PRIMES is obliged to dispose PRIMES measuring devices manufactured after August, 2005, free of charge. PRIMES is a registered manufacturer in the German “Used Appliances Register“ (Elektro-Altgeräte-Register “EAR“) with the number

WEEE-Reg.-Nr. DE65549202.

Provided that you are located in the EU, you are welcome to send your PRIMES devices to the following address where they will be disposed free of charge:

PRIMES GmbH
Max-Planck-Str. 2
64319 Pfungstadt
Germany

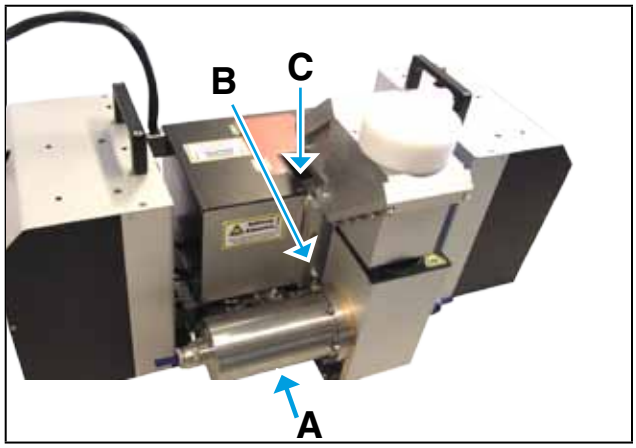
20 Accessories



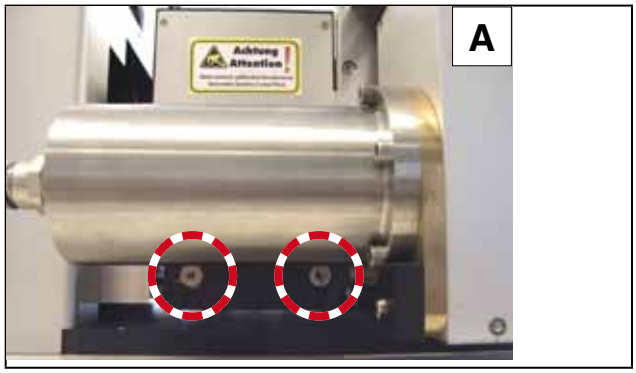
21 Appendix

21.1 Exchanging the 5-fold Objective

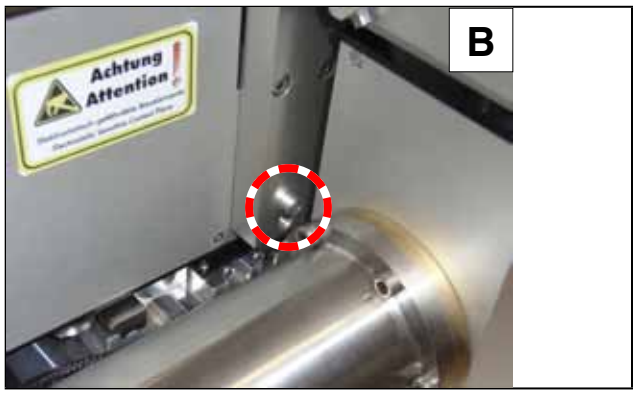
Required tools: Hexagon key AF 2.5 mm and 4 mm.



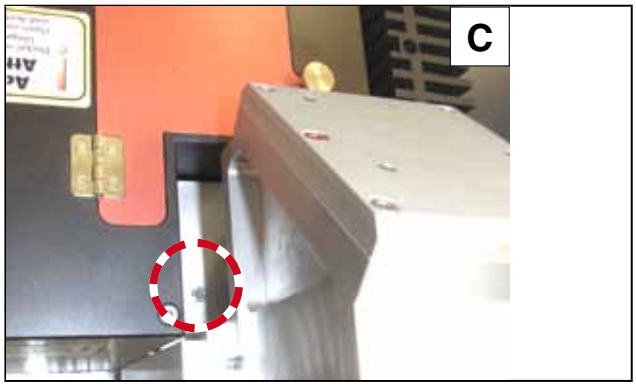
1. Move the HP-MSM to a central z-axis position (e.g.: z = 60 mm)



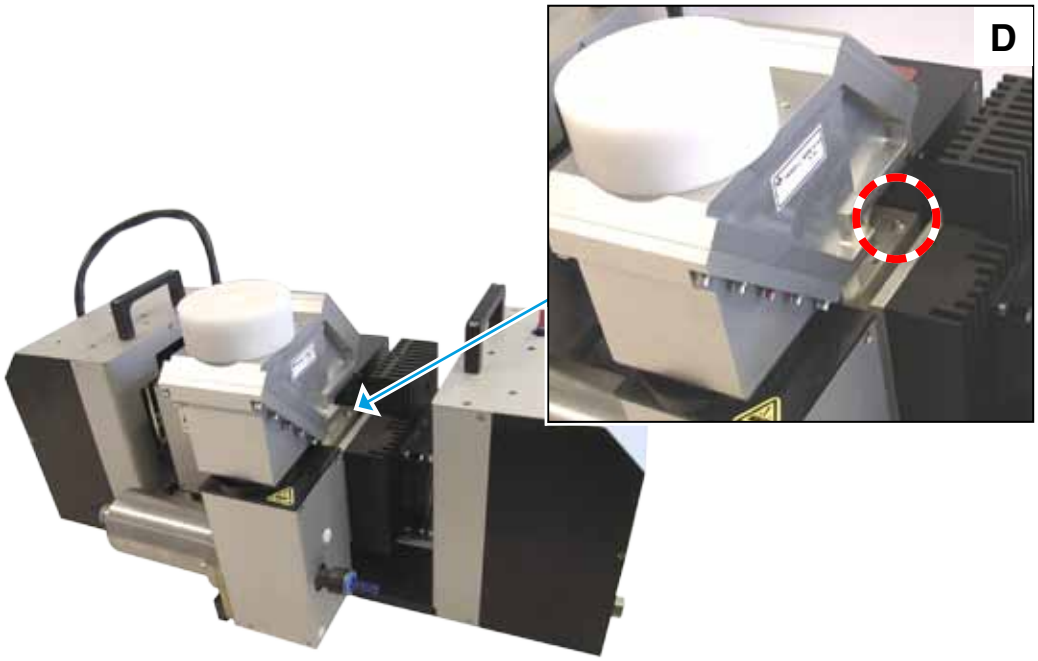
2. Dismount the absorber by removing the two counter-sunk screw (AF 4 mm) beneath the absorber (image A). Hold the absorber in one hand when dismounting it.
3. Remove the two cables.
4. Mask the aperture of the absorber or ensure that no dirt can fall into the aperture when storing it. The same holds true for the aperture of the measuring objective.



5. Now remove the hexagon socket head screw (AF 4 mm), which secures the measuring objective laterally to the device. The set screw lying beneath also has to be removed (image B).



6. Remove the two upper hexagon socket head screws (AF 2.5 mm), see image C and D.
7. Pull the measuring objective out in an upwards direction.
8. Open apertures have to be closed as quickly as possible either by masking them or by mounting a new measuring objective. Thereby it is insured that no dirt or dust can enter the measuring system.



Mount the new objective in reversed order.

Please do not forget connecting the cables again when mounting the absorber.

21.2 Power Measuremenr at the HP-MSM

The PowerLossMonitor is a system for the determination of power losses, especially for water-cooled optical components. The system determines the flow rate as well as the temperature rise of the cooling-agent between in- and outlet. Based on these data, the absorbed power is determined.

Water flow plan of the PowerLossMonitor (PLM) at the HighPower-MicroSpotMonitor:

Caution!

The lengths of these connections have an influence on the time constants of the measuring device. Only use the enclosed hoses here!