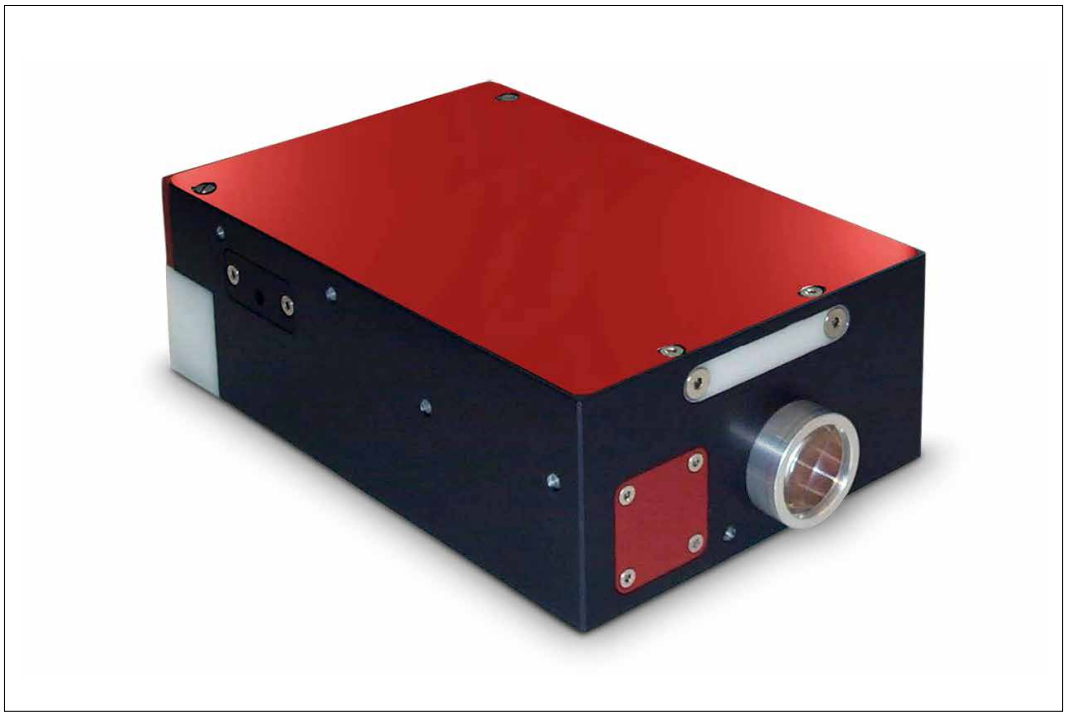
PRIMES

Operating Manual

Translation of the Original Instructions



MicroSpotMonitor-Compact MSM-C

LaserDiagnosticsSoftware

Revision 01 EN - 06/2022 (Revision 01/2019 DE)

IMPORTANT!

READ CAREFULLY BEFORE USE.

KEEP FOR FUTURE USE.

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 the beam position of an unfocussed beam
- The beam dimensions and beam position of a focussed beam
- The diffraction index M^2

Both the development and the production of the measuring 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.

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1 Basic Safety Instructions

Intended Use

The MicroSpotMonitor-Compact is exclusively intended for measurements which are carried out in or nearby the optical path of lasers with a power range between 10 mW and 1 kW. Please mind and adhere to the specifications and limit values given in chapter 19 „Technical Data“ on page 56. Other forms of usage are improper. The information contained in this operating manual must be strictly observed to ensure proper use of the device.

Using the device for unspecified use is strictly prohibited by the manufacturer. By usage other than intended the device can be damaged or destroyed. This poses an increased health hazard up to fatal injuries. When operating the device, it must be ensured that there are no potential hazards to human health.

The device itself does not emit any laser radiation. During the measurement, however, the laser beam is guided onto the device which causes reflected radiation (**laser class 4**). That is why the applying safety regulations are to be observed and necessary protective measures need to be taken.

In measuring mode, the device’s safety interlock must be connected with the laser control.

Observing applicable safety regulations

Please observe valid national and international safety regulations as stipulated in ISO/CEN/TR standards as well as in the IEC-60825-1 regulation, in 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, such as the “Laser Safety Basics”, the “LIA Laser Safety Guide”, the “Guide for the Selection of Laser Eye Protection” and the “Laser Safety Bulletin”, published by the Laser Institute of America, as well as the “Guide of Control of Laser Hazards” by ACGIH.

Necessary safety measures

DANGER

Serious eye or skin injury due to laser radiation

During the measurement the laser beam is guided on the device, which causes scattered or directed reflection of the laser beam (laser class 4).
The MicroSpotMonitor cannot be operated in any of the available configurations without taking the following precautions.

▶ **Please take the following precautions.**

If people are 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 must be implemented:

- Connect the device’s safety interlock to the laser control. Check that the safety interlock will switch off the laser properly in case of error.
- Please wear **safety goggles** adapted to the power, power density, laser wave length and operating mode of the laser beam source in use.
- Depending on the laser source, it may be necessary to wear suitable **protective clothing** or **protective gloves**.
- Protect yourself from direct laser radiation, scattered radiation, and beams generated from laser radiation (by using appropriate shielding walls, for example, or by weakening the radiation to a harmless level).
- Use beam guidance or beam absorber elements that do not emit any hazardous substances when they come in to contact with laser radiation and that can withstand the beam sufficiently.

- Install safety switches and/or emergency safety mechanisms that enable immediate closure of the laser shutter.
- Ensure that the device is mounted securely to prevent any movement of the device relative to the beam axis and thus reduce the risk of scattered radiation. This in the only way to ensure optimum performance during the measurement.

Employing qualified personnel

The device may only be operated by qualified personnel. The qualified personnel must have been instructed in the installation and operation of the device and must have a basic understanding of working with high-power lasers, beam guiding systems and focusing units.

Conversions and modifications

The device must not be modified, neither constructionally nor safety-related, without our explicit permission. The device must not be opened e.g. to carry out unauthorized repairs. 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, material or financial losses due to a direct or indirect use of the measuring devices.

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 **may** occur if necessary safety precautions are not taken.

CAUTION

Means that minor physical injury **may** occur if necessary safety precautions are not taken.

NOTICE

Means that property damage **may** occur if necessary safety precautions are not taken.

The following symbols indicating requirements and possible dangers are used on the device:

Read and understand the operating manual before using the device!

Labeling according to WEEE directive:
The device must not be disposed of with household waste, but in a separate WEEE collection in an environmentally friendly way.

Further icons and conventions in this operating manual

Here you will find useful information and helpful tips.

With the CE designation, the manufacturer guarantees that its product meets the requirements of the relevant EC guidelines.

▶ Call for action

3 Conditions at the installation site

- The device must not be operated in a condensing atmosphere.
- The ambient air must be free of organic gases.
- Protect the device from splashes of water and dust.
- Operate the device in closed rooms only.

4 Introduction

4.1 Laser Beam Measurement

Laser beams in industrial applications, whether they be CO_2, Nd:YAG- diode or fibre lasers, work with invisible beams in the infra-red or near infra-red spectral range (NIR). Hence changes in beam quality or power cannot be detected visually, and only become evident from the outcome of their application. Under some circumstances, this results in very expensive rejects being produced.
If the deterioration in quality is not recognised in the manufacturing process, this usually results in the subsequent failure of the product in use, with consequences for the manufacturer of rectification, replacement and loss of image.

This is where PRIMES beam diagnostics devices for measuring beam quality, focusability and laser power come in. Process monitoring in production with laser beam diagnostics devices by PRIMES enables consistent quality assurance and allows the timely detection and elimination of malfunctions of laser beams.

PRIMES measuring devices allow the reliable recording of current beam parameters, and enable ongoing documentation of beam properties for quality assurance purposes. This is a requirement that should not be underestimated in many industrial areas, such as automotive or medical technology.

With PRIMES devices for beam diagnostics, troubleshooting of laser applications is simplified considerably. The beam intensity profile, beam diameter, beam caustic before and after focusing, and laser power to be applied are directly measured and analysed. Based on the readings and their evaluation, maintenance and servicing personnel can work in a targeted way on repair. Loss of time and system downtimes due to “trying out” possible causes of the problem are effectively avoided.

The same applies to process optimisation and approval of process windows in laser material processing. Only if the focal position and focal dimension and also the intensity profile of the laser beam are known, can processes such as laser beam cutting, welding or drilling be adjusted to the particular component geometry, materials be selected and the breadth of process windows be determined reliably.

5 System Description

The MicroSpotMonitor-Compact (MSM-C) extends the product family of camera-based focus analysis systems by a modular configurable measuring system which was optimized for the limited installation space available in micro-production plants. The following parameters are measured:

- Beam diameter
- Power density distribution

The compact device does not have its own movement axes. In connection with the movement system of a laser processing plant, however, even caustic measurements which are in conformity with the current standards can be carried out easily. For an integration into the plant control a PROFIBUS interface is additionally available. Hence, the determined beam parameters of the machine control are directly available for further processing. OPTIONally, the MSM-C can also be supplied with a 90° deflection unit for an optimization of the installation situation within the plant.

Fig. 5.1: MSM-C standard

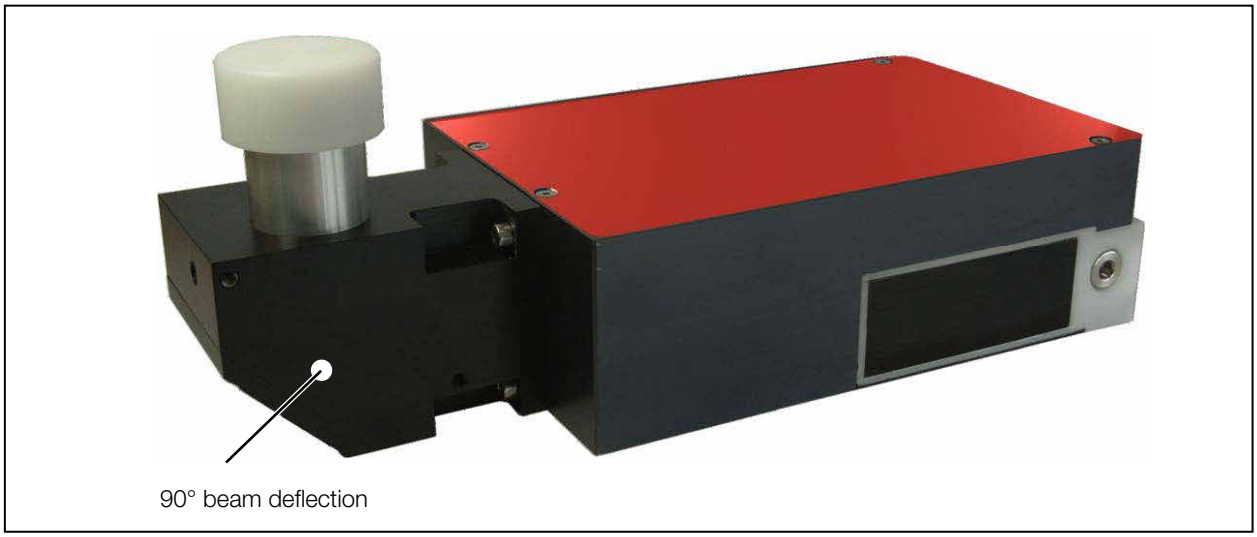


Fig. 5.2: MSM-C with the OPTION beam deflection

5.1 Measuring Principle

The beam geometry and the power density distribution are measured with the camera-based measuring system via a CCD sensor. The measuring data are transmitted to the computer via Ethernet or, OPTIONally, via a Profibus-Interface of the system control.

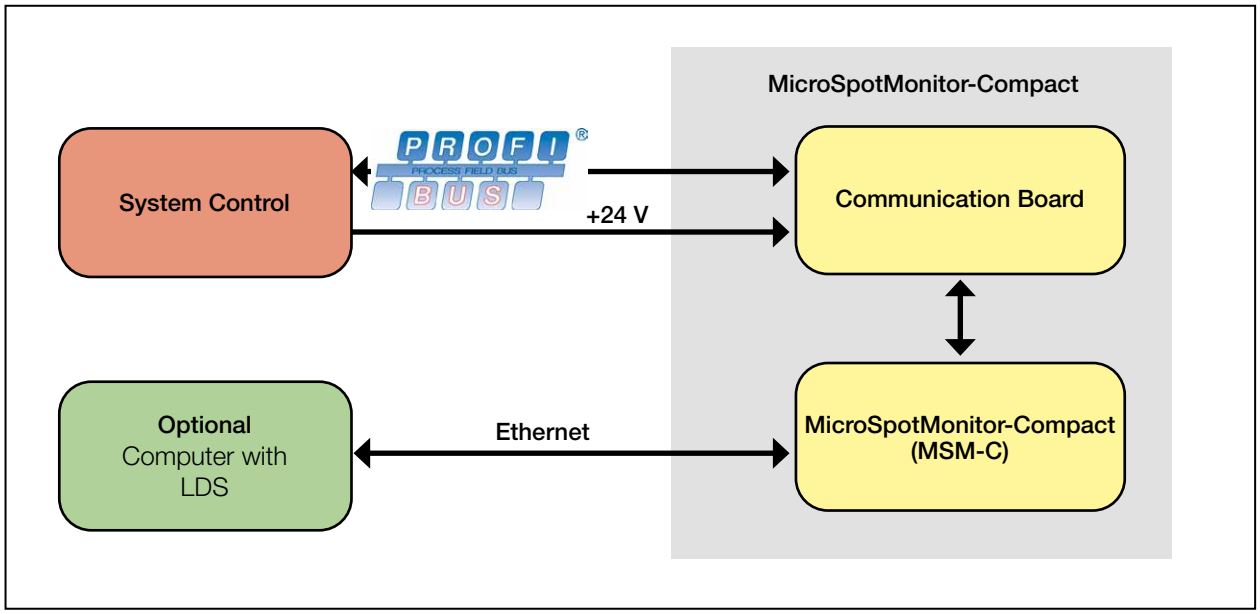


Fig. 5.3: Block diagram MicroSpotMonitor-Compact

5.2 Device Assembly

The beam coming from the laser is weakened by two beam splitters and is then guided to the CCD sensor via a deflection mirror. If necessary, an additional filter can be built in front of the sensor.

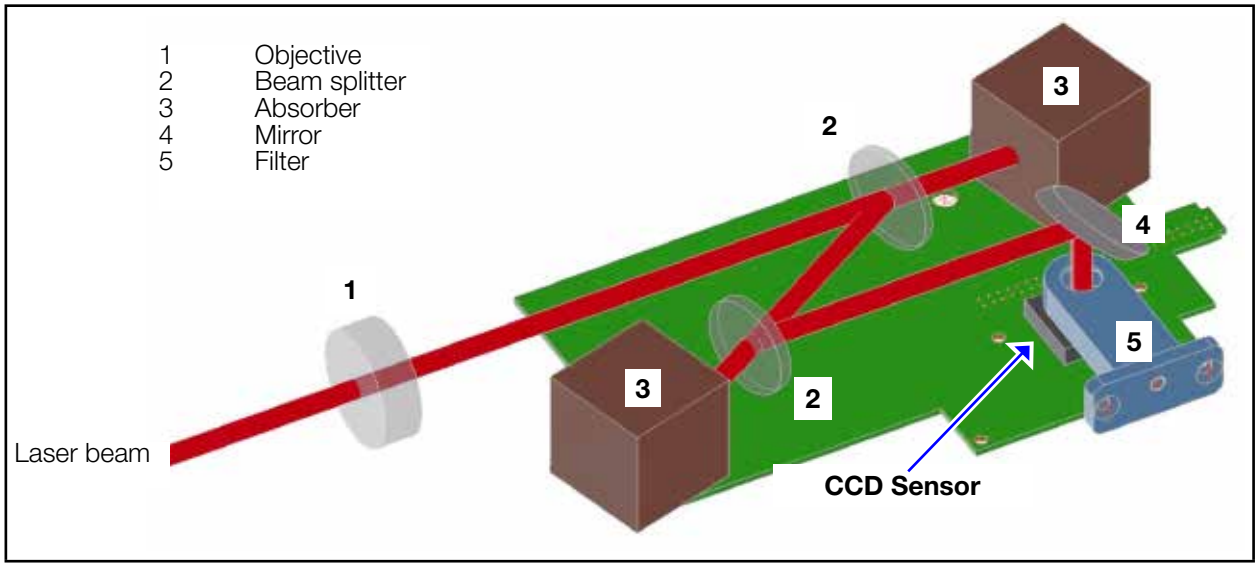


Fig. 5.4: Optomechanical assembly of the MicroSpotMonitor-Compact

6 Short Overview Installation

This short overview provides you with information on necessary safety measures, necessary media for the operation as well as required connection elements.

1. Taking Necessary Safety Measures

Please mind special safety instructions

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 at the edge of the objective.**
- **Please wear safety goggles adapted to the wave length that is in use.**
- **Please ensure a stable mounting of the device so that it cannot be moved by pushes or by pulling the cables and tubes.**
- **Shield the device from residual radiation.**

2. Alignment to the Laser Beam and Stable Mounting
- An alignment aid is included in the scope of delivery.
- You need two screws M5. We recommend screws of the strength class 8.8 and a tightening torque of 5 N·m.

3. Installing the Water Cooling
- Flow rate 0,7 l/min ... 1,2 l/min
- Connection diameter 6 mm
-

4. Connecting Compressed Air (only OPTION Cyclone)
- Water- and oil-free compressed air, flow rate 3 ... 5 l/min
- Connection diameter 4 mm

5. Electrical Connection
- Voltage supply (suitable power supply is included in the scope of delivery)
- External safety switch (custom connector, customer-specific connection)
- Profibus (OPTION)
  Data line plug/socket, 5-pole, M12-SPEEDCON, B-coded, suitable cable, please see page 19.
  Voltage supply plug/socket, 5-pole, Binder connector M12, suitable cable, please see page 19.

6. Connection with the Computer
- Via Ethernet (RJ45)

7. Installing the LaserDiagnosticsSoftware on the Computer
- Software is included in the scope of delivery.

7 Transport

NOTICE

Damaging/destroying the device

Optical components may be damaged if the device is subjected to hard shocks or is allowed to fall.

- ▶ Handle the device carefully when transporting or installing it.
- ▶ To avoid contamination, cover the apertures with the provided lid or optical tape.
- ▶ Only transport the device in the original PRIMES transport box.

NOTICE

Damage/destruction of the device caused by leaking or freezing cooling water

Leaking cooling water can damage the device. Transporting the device at temperatures near or below freezing and without emptying the cooling circuit completely can damage the device.

- ▶ Empty the lines of the cooling circuit completely.
- ▶ Even when the lines of the cooling circuit have been emptied, a small amount of residual water will remain in the device at all times. This may leak out and end up inside the device. Close the connector plug of the cooling circuit with the included sealing plug.

8 Installation

8.1 Mounting Position and Attachment

WARNING

Danger of injuries due to scattered radiation

If the measuring device is moved from the measured position, this can lead to scattered radiation during the measuring operation.

- **When mounting the device please ensure that it cannot be moved by unintended pushes or by pulling the cables.**

Before mounting the device please check the space available, especially the space needed for the connection cables and -tubes (please see chapter 21 on page 59).
The MSM-C is mounted horizontally and with a lateral beam incidence. By means of the OPTIONal 90° beam deflection a vertical beam incidence is also possible.
There are two fastening screw threads M5 in the bottom of the housing which are intended for the mounting on a customer‘s mount (please see Fig. 8.1). We recommend screws of the strength class 8.8 and a tightening torque of 5 N·m.
With regard to the OPTION PROFIBUS there are four additional tapped holes M5 and two additional dowel holes (6^{H7}) in the housing cover.

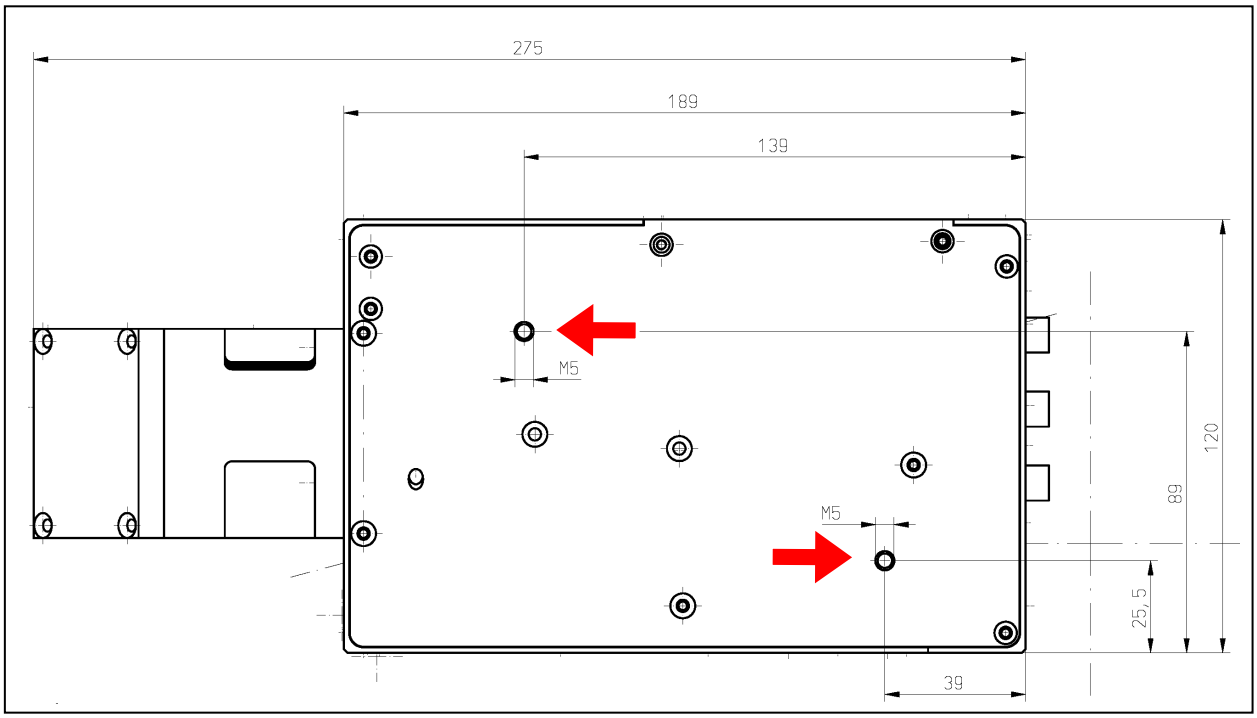


Fig. 8.1: Fastening screw thread in the bottom of the MSM-C

NOTICE

Danger of damage of internal components

Screws which are too long can lead to a damage of the screw-in thread.

- **Please ensure that the fastening screws do not reach further into the housing than 10 mm.**

8.2 Adjustment

Due to the depiction features of the objective it is necessary to position the laser beam focus in a certain distance above the objective. The higher the focus lies above the objective the shorter it is later depicted behind the objective.

NOTICE

Danger of damage of optical components

The focus has to have a specified distance to the objective. If distance is too small or too big, optical components could be damaged when it comes to high beam intensities.

▶ **Please adjust the distance according to the specifications given in the TCP certificate.**

Positioning of the focused laser beam:
The distance between the measuring plane in which the focus is to be positioned before the first measurement depends on the objective selected. In order to be able to adjust the MSM-C more easily beneath the laser, an OPTIONal TCP calibration is carried out with each objective. By means of the distance given in the TCP certificate and the marking on the device (reticule), you can position the measuring device with the required accuracy. The measuring plane distance equals the distance of the measuring plane to the spot on the device which is marked with the reticule.

9 Electrical Connection

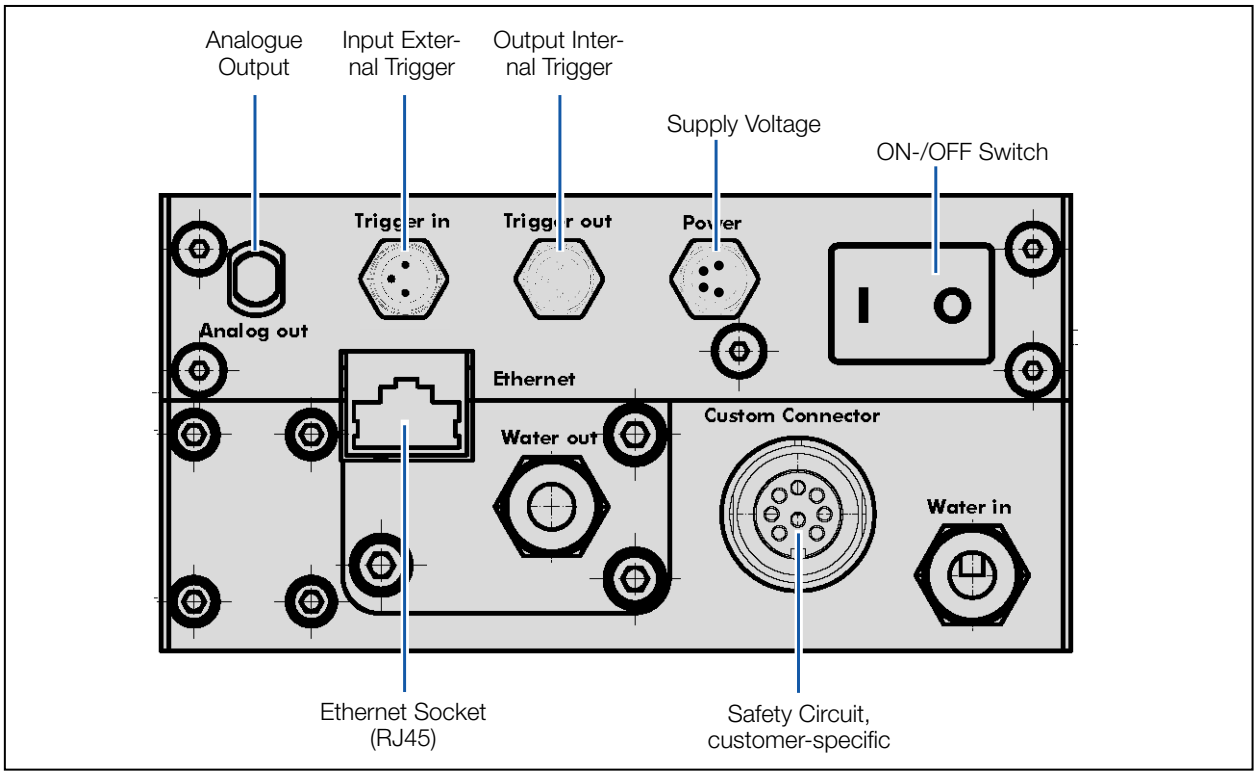


Fig. 9.1: Electrical connections MSM-C (standard)

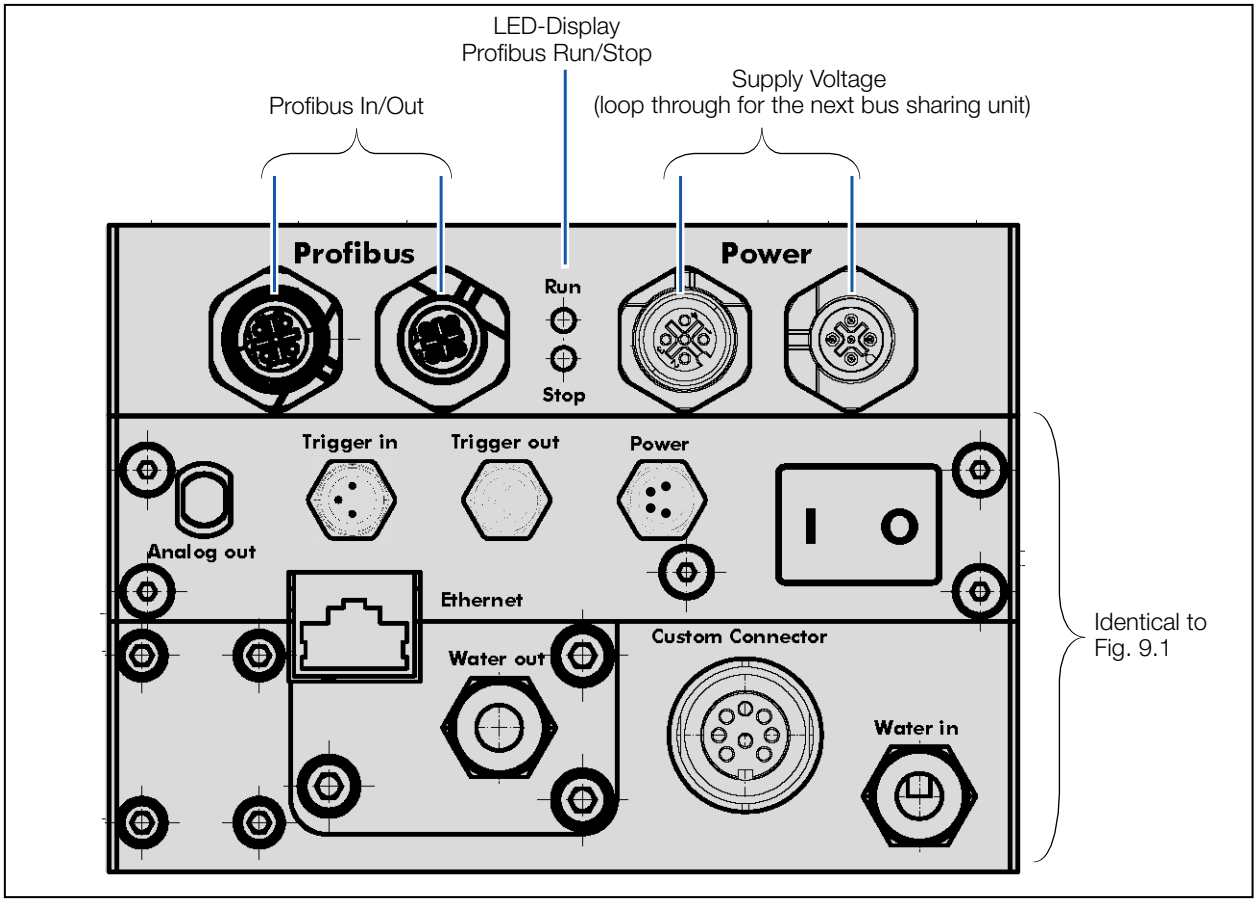
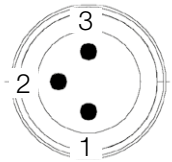


Fig. 9.2: Electrical connections MSM-C (with OPTION PROFIBUS)

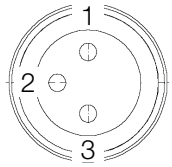
9.1 Analogue Out

Pin	Function
Inner Conductor	Analogue trigger signal –7,5 V ... +15 V
Housing	Shield

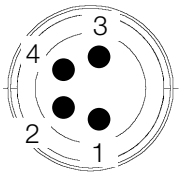
9.2 Trigger In

Pin Diagram Plug (view: connector side)		
	**Pin**	**Function**
	1	GND
	2	Trigger LVTTL (3.3 V)
	3	Not assigned

9.3 Trigger Out

Pin Diagram Socket (view: connector side)		
	**Pin**	**Function**
	1	GND
	2	Trigger out
	3	Not assigned

9.4 Power

Pin Diagram Plug (view: connector side)		
	**Pin**	**Function**
	1	+24 V
	2	RS485 (+)
	3	GND
	4	RS485 (–)

9.5 PROFIBUS-Data (OPTION)

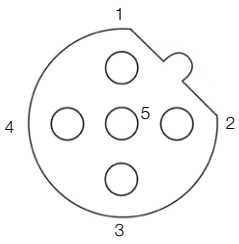
Pin Diagram Socket In (view: connector side)		
	**Pin**	**Function**
	1	+5 V
	2	Signal A
	3	ISOGND
	4	Signal B
	5	Not assigned
Socket Designation	Sensor-/actuator-socket, 5-pole, M12-SPEEDCON, B-coded, front panel-/Vorderwand-/screw mounting with M16-thread, positionable, with 0.5 m TPE-strand, 5 x 0.34 mm² (Phoenix Contact 1519998)	

Fig. 9.3: Pin assignment Profibus socket

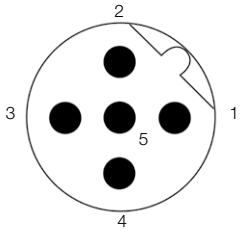
Pin Diagram Plug Out (view: connector side)		
	**Pin**	**Function**
	1	+5 V
	2	Signal A
	3	ISOGND
	4	Signal B
	5	Not assigned
Plug Designation	Sensor-/actuator-socket, 5-pole, M12-SPEEDCON, B-coded, front panel-/screw mounting with M16-thread, positionable, with 0.5 m TPE-strand, 5 x 0.34 mm² (Phoenix Contact 1520026)	

Fig. 9.4: Pin assignment Profibus plug

Suitable cable (male/female): Bus system cable, PROFIBUS, 2-pole, PUR halogen-free, violet RAL 4001, shielded, plug straight M12-SPEEDCON, B-coded, on socket straight M12-SPEEDCON, B-coded, cable-length 2 m (Phoenix Contact 1518135).

9.6 PROFIBUS-Supply Voltage (OPTION)

Just like the standard device, the PROFIBUS alternative is provided with voltage via the power-socket of the basic device. The supply voltage looped through the two M12 connectors (A-coding). The two connectors are internally connected 1:1.

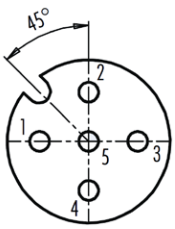
Socket Power In (view: connector side)		
	**Pin**	**Function**
	1	+24 V (actuator)
	2	+24 V (sensor)
	3	GND
	4	GND
	5	PE
Socket Designation	Sensor-/actuator-connector M12, screw cap, straight (Binder series 763, order no. 09-3441-578-05; Conrad order no.: 733797 - 62)	
Suitable Conenctor Cable	Binder series 763, L=5 m, order no. 78 3439 35 05	

Fig. 9.5: Pin assignment supply socket

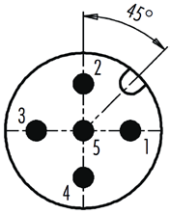
Plug Power Out (view connector side)		
	**Pin**	**Function**
	1	+24 V (actuator)
	2	+24 V (sensor)
	3	GND
	4	GND
	5	PE
Plug Designation	Sensor-/actuator connector M12, screw cap, straight (Binder Serie 763, order no. 09-3442-578-05; Conrad order no.: 734325 - 62)	
Suitable Connector Cable	Binder series 763, L=5 m, order no.: 78 3440 35 05	

Fig. 9.6: Pin assignment supply plug

9.7 Ethernet Connection (RJ-45)

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

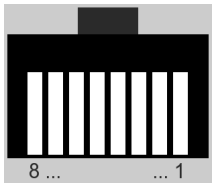


Fig. 9.7: Ethernet-connectior socket

9.8 Custom Connector

This safety circuit protects the measuring device from damages caused by switching of the laser in case of an error. The device can be damaged, if

- the voltage supply is not connected, switched off or interrupted
- the cooling water flow rate is too low

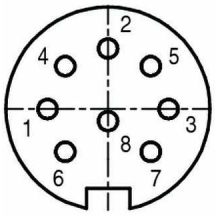
NOTICE

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 to 3, please ensure that the laser is turned off in case of an interruption of this connection.**

Pin Diagram Device Socket Custom Connector (view plug side)

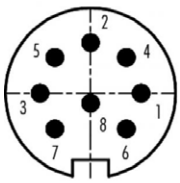


Pin	Function
1	Mutual Pin
2	If not ready for operation (interlock mode), bridged with pin 1
3	If ready for operation, bridged with pin 1
4	+24 V during operation
5	+24 V during operation
6	Not assigned
7	Not assigned
8	GND

Binder flange socket M16/IP40, series 581/680/682, 8-pole, order-no. 0904748008

A 5 m long interlock cable with suitable male angled connector and pigtails is included in the delivery:

Pin Diagram Custom Connector plug (view plug side)



Pin	Wire Color	Function
1	White	Mutual Pin
2	Blue	If not ready for operation (interlock mode), bridged with pin 1
3	Gray	If ready for operation, bridged with pin 1
4	Red	+24 V during operation
5	Pink	+24 V during operation
6	Brown	Not assigned
7	Yellow	Not assigned
8	Green	GND

Binder male angled connector, 8-pole, order-no. 0901537008

10 Mechanical Connections

10.1 Cooling Circuit System

NOTICE

Danger of damage due to overheating

If there is no water cooling or a water flow rate which is insufficient, there is a danger of overheating which can damage the device.

- **Do not operate the device without a connected water cooling. Ensure a sufficient water flow rate.**

NOTICE

Danger of damage due to condensed water

In case the temperature of the cooling water lies below the ambient temperature, condensed water can develop inside the device which endangers the optical components during the measuring operation.

- **Only operate the MSM-C in a non-condensing atmosphere. The temperature of the cooling water may not lie below the ambient temperature.**

10.1.1 Preconditions

The connections at the MSM-C are designed for hose outer diameters of 6 mm. For a reliable operation a water flow rate of a min. of 0.7 l/min and a maximum of 1.2 l/min is required.

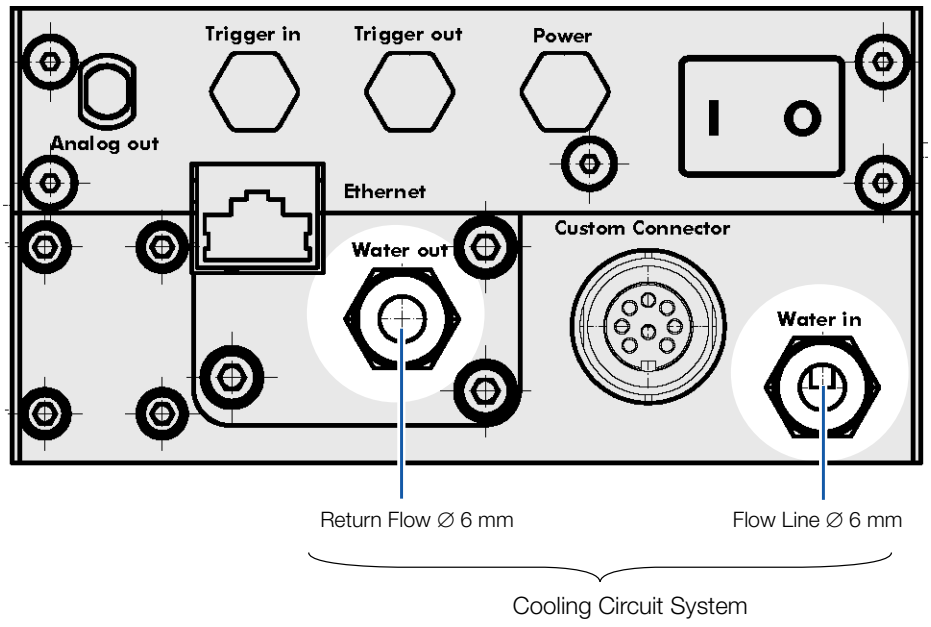


Fig. 10.1: Connections for the cooling circuit.

Only cool the device during a measurement operation. We recommend starting the cooling process approx. 2 minutes before the measurement and finishing it approx. 1 minute after the completion of the measurement.

NOTICE

Danger of damage due to overpressure

- **The maximum water inlet pressure must not exceed 2 bar.**

NOTICE

Danger of damage due to foreign particles

If you work with sealing tape when installing the cooling circuit (e.g. Teflon or hemp), you need to make sure that no particles get into the turbine! They could inhibit the operation or could stop the flow completely.

- **Before connecting your line system, please rinse it thoroughly.**

Do not add any additives to the cooling water, especially no anti-freeze agents. These could significantly change the thermal conductivity and this could then distort the measuring results.

NOTICE

Danger of damage due to different chemical potentials

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

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

NOTICE

Danger of damage due to dirt particles

Dirt particles in the cooling circuit can hinder the water flow which then results in an overheating of the measuring device.

- **Please build in a prefilter (filter fineness 50 µm) into the cooling circuit.**

10.1.2 Connection

1. Remove the sealing plugs of the cooling circuit and make sure you keep them in a safe place.
2. Connect the water flow line (water in) and the return flow (water out) of the device.

An operation with strongly deionized water (DI-water) is only possible with the respective connection parts - please get in touch with us before buying the device.

10.2 Compressed Air for Cyclone (OPTION)

NOTICE

Danger of damage for the optical components due to dirt particles

Contaminated compressed air can damage optical components of a measuring device permanently.

▶ **Compressed air has to be clean, dry and oil-free. We recommend an additional prefilter (typ. 0.01 µm).**

Compressed air is necessary to generate a rotating air stream in the cyclone which shall prevent dirt particles from getting inside.
Connect the compressed air supply via a plastic hose with an outer diameter of 4 mm. We recommend a flow rate of 3 ... 5 l/min.

11 Display

11.1 PROFIBUS Status-LEDs

LED	Color	Condition	Meaning
Run	green	glows	Profibus is connected
Stop	yellow	flashes	Profibus is not connected or there is a bus error

12 Software

For the configuration and the setting of the control parameters of the measuring device it is necessary to install the PRIMES-LaserDiagnosticsSoftware (LDS), which is included in the scope of delivery.

12.1 System Requirements

Operating System: Windows® Vista/7 /10
Processor: Intel® Pentium® 1 GHz (or a comparable processor)
Free Disc Space required: 15 MB
Monitor: 19“ screen diagonal is recommended, resolution min. 1024x768

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.X.XX.exe“ (X.XX is a place holder for the version number, e.g. v.2.97) and follow the instructions.

12.3 Starting the Software

Please do not start the software unless the measuring device has already been cabled and turned on.

Start the programme by double-clicking the LDS-symbol LDS in the new start menu or the desktop short-cut.

12.3.1 Graphical User Interface

First of all, 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 “measuring”).

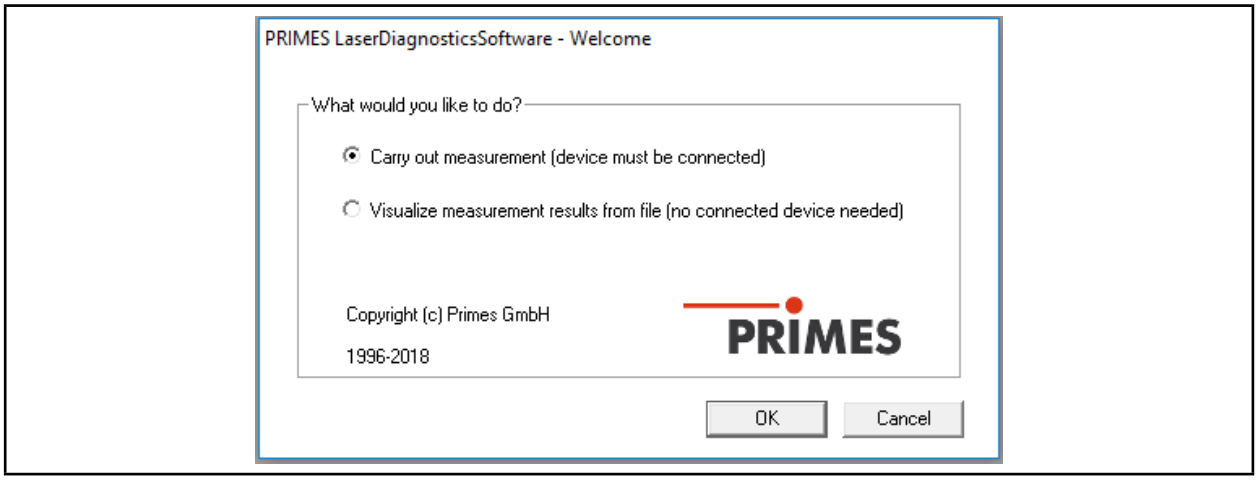


Fig. 12.1: Start window of the LaserDiagnosticsSoftware

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

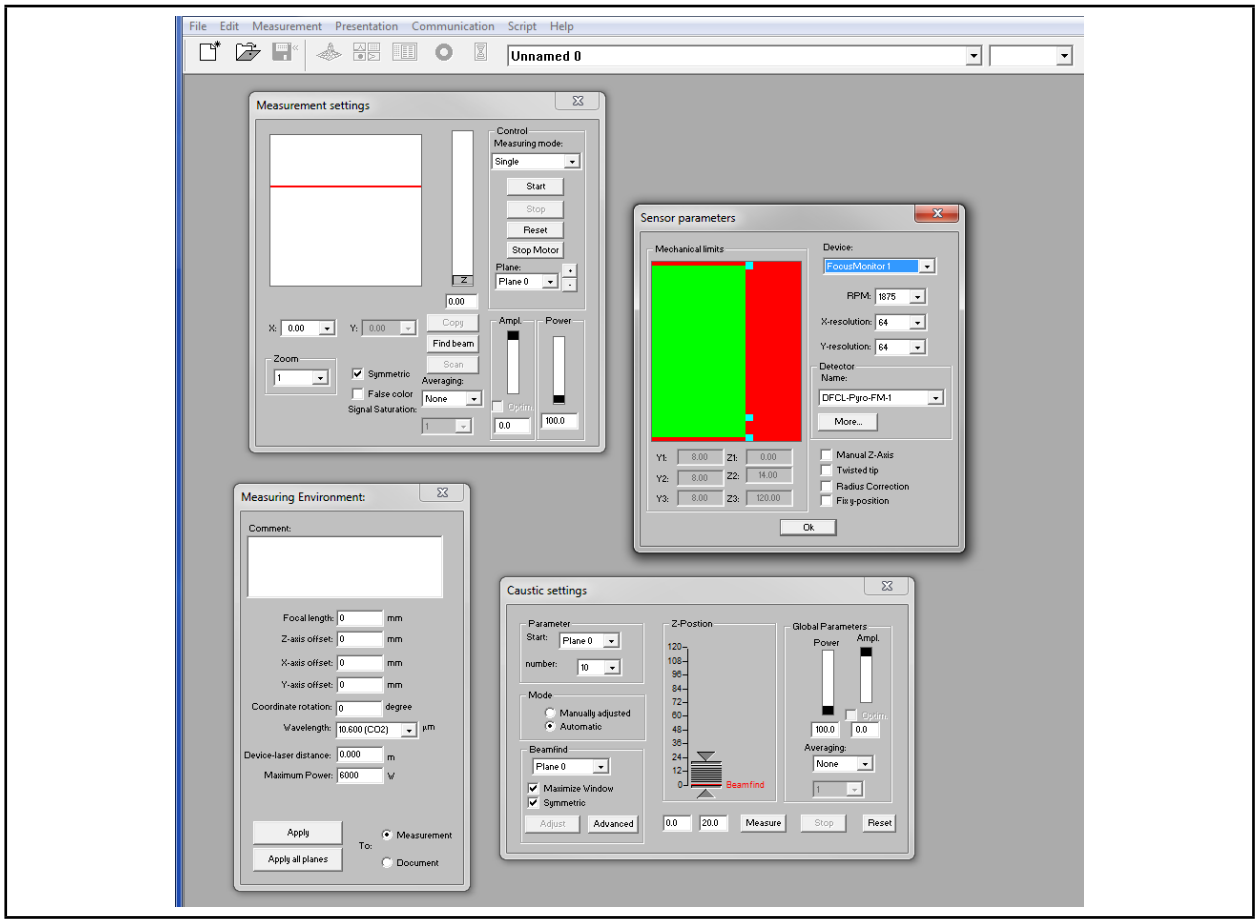


Fig. 12.2: The most important dialogue windows

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.
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 opened.

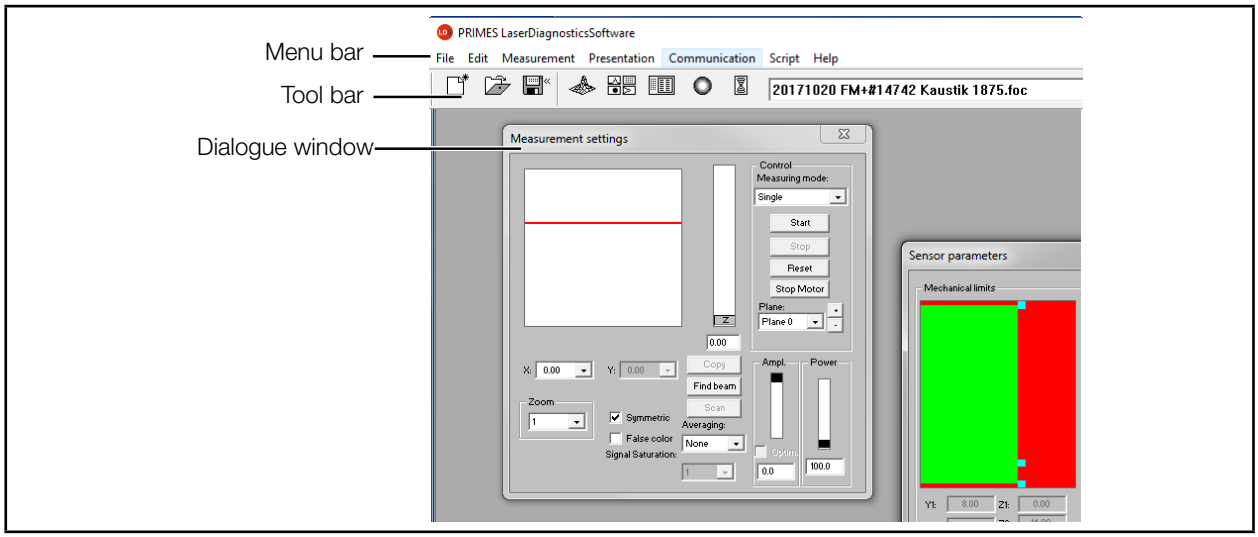
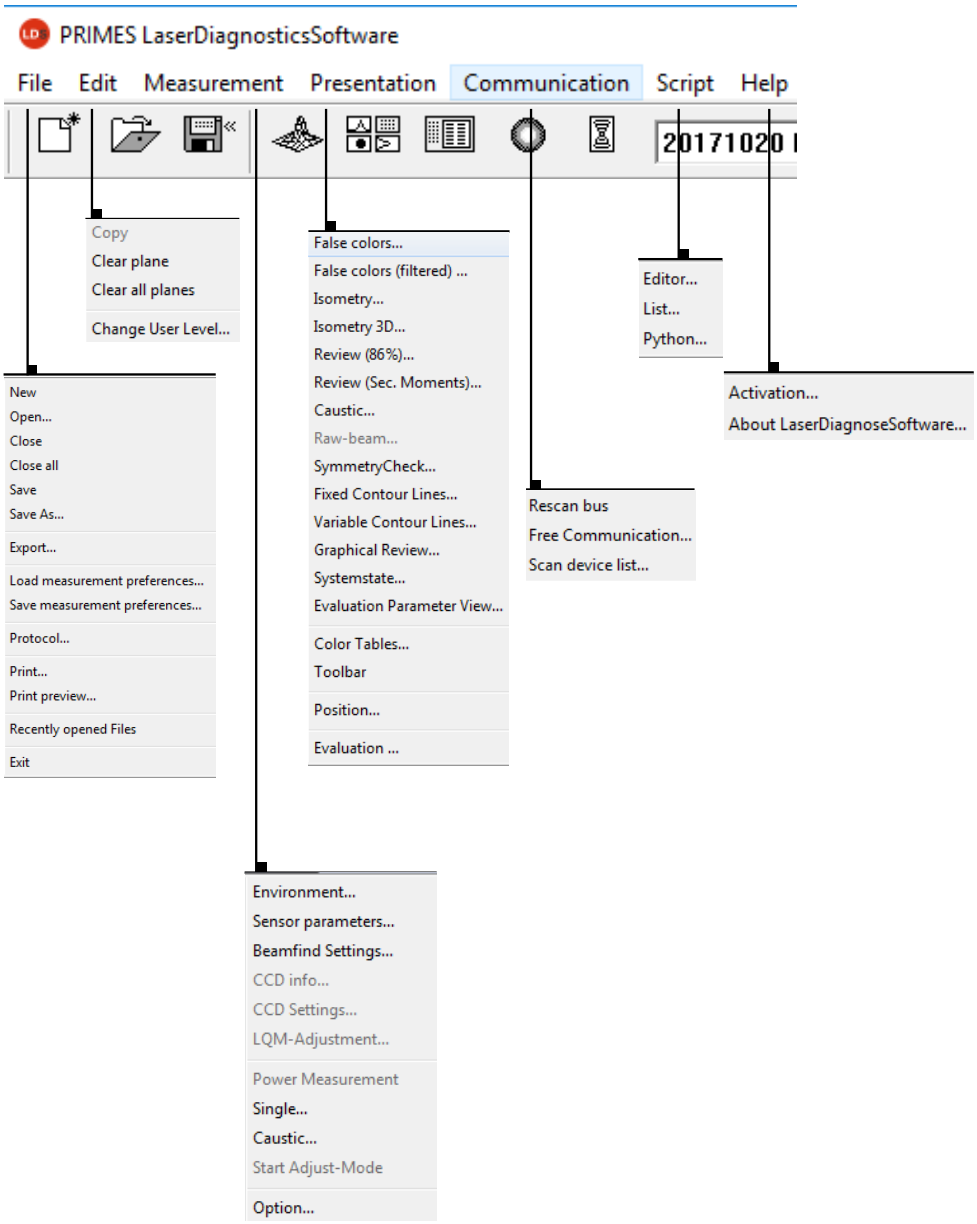


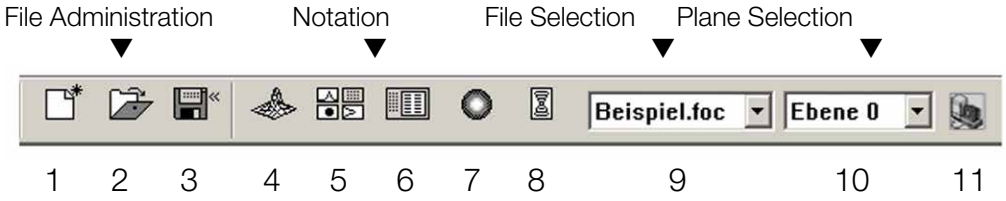
Fig. 12.3: The most important elements of the user interface

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 section 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 - Graphical symbols of the measuring devices available for the bus

12.3.2 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 the files opened.
Save	Saves the current file in .foc- or .mdf format
Save as	Opens the menu in order to store 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 record 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 the 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 set, e.g.: - The reference value for the laser power - The focal length - The wave length - Remarks
Sensor Parameters	The following device parameters can be set here for example: - The spatial resolution - The mechanical movement limits in z-direction - The selection of one of the measuring devices connected with the bus - The manual settings of the z-axis
LQM Adjustment	Not relevant for the MSM-C.
Beamfind Settings	Not relevant for the MSM-C.
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 Measurement	This menu item enables the start of single measurements, of the monitor mode and the video mode.
Caustic...	Not relevant for the MSM-C.
Start Adjustment Mode	Not relevant for the MSM-C.
OPTIONs	Enables the setting of device parameters.
Presentation	
False Colors...	False colors display of the spatial power density distribution.
False colors (filtered)...	Usage of a spatial filtration (spline function) on the false colors display of the power density distribution.
Isometry...	3-dimensional display of the spatial power density distribution.
Isometry 3D	Only active if this special function is unlocked. Allows a 3D display of caustic and power density distribution as well as an isophote display.
Review (86%)...	Numerical overview of measuring results in the different planes based on the 86% beam radius definition.
Review (2-Moment)...	Numerical review of the measuring results in the different planes based on the 2-moment beam radius definition.
Caustic...	Results of the caustic measurement and the results of the caustic fit - such as the beam propagation ratio k, focus position and focus radius.
Raw Beam...	Display of the retrograde calculation to the raw beam.
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 others, the radius, the x- and z-position above the z-position or 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., the diffraction phenomena in detail.
Tool Bar	To display or hide the tool bar.
Position	Moving the device into a defined position.
Evaluation...	Selection of the parameters which are to be evaluated.

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	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.
List	Shows a list of the windows opened. .
Python	Opens the script generator in order to control complex measuring procedures automatically.
Help	
Activation	Enables the activation of special functions.
About the LaserDiagnosticsSoftware	Provides information regarding the software version.

12.4 Main Settings in the Dialogue Windows

Due to the fact that the PRIMES LaserDiagnosticsSoftware is intended for different devices, the following chapter only refers to functions which are relevant for the MSM-C.

12.4.1 Sensor Parameters

The spatial resolution of the measurement is set from 32 x 32 pixels to 512 x 512 pixels. The resolution in y-direction stipulates the number of lines, and the resolution in x-direction stipulates the number of scanning points per line. The time for the data transfer depends on the data volume and the interface. The data volume increases with a higher resolution. The performance of the computer influences the data transfer time as well..

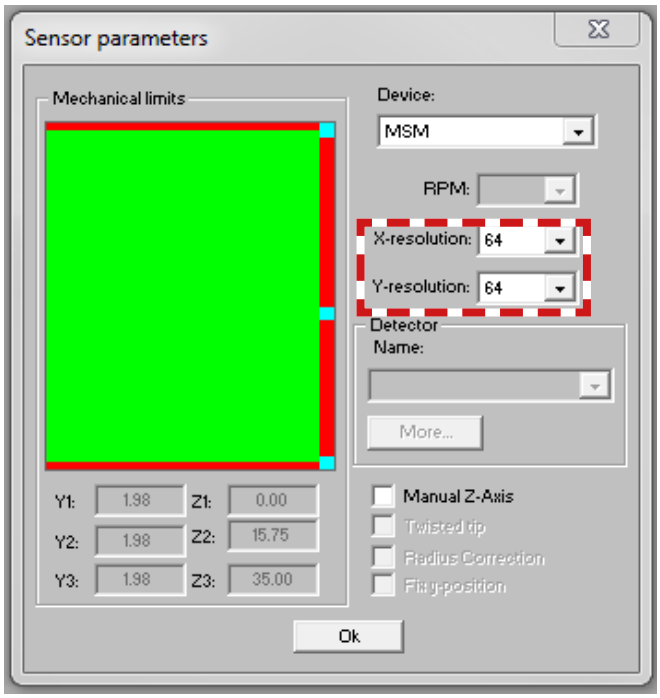


Fig. 12.4: Dialogue Window ***Sensor Parameters***

12.4.2 Measurement Settings

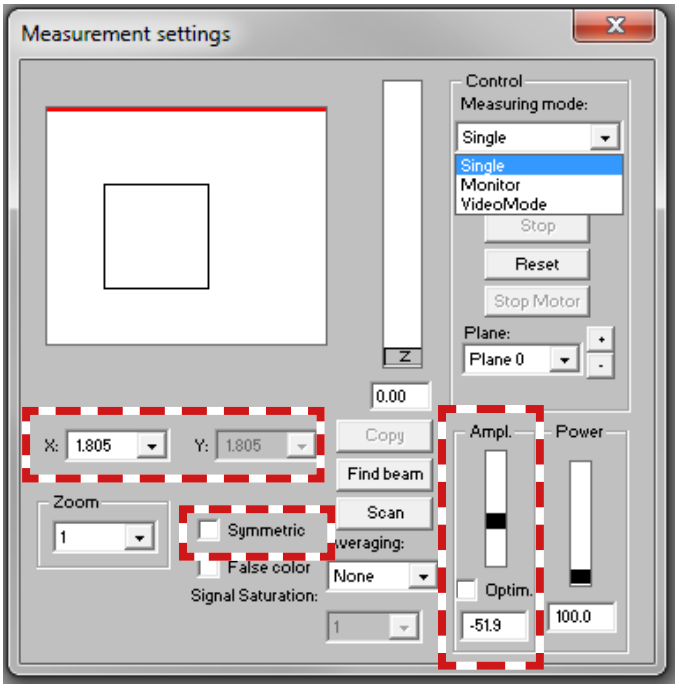


Fig. 12.5: Settings in the dialogue window ***Measurement Settings***

12.4.3 CCD-Settings

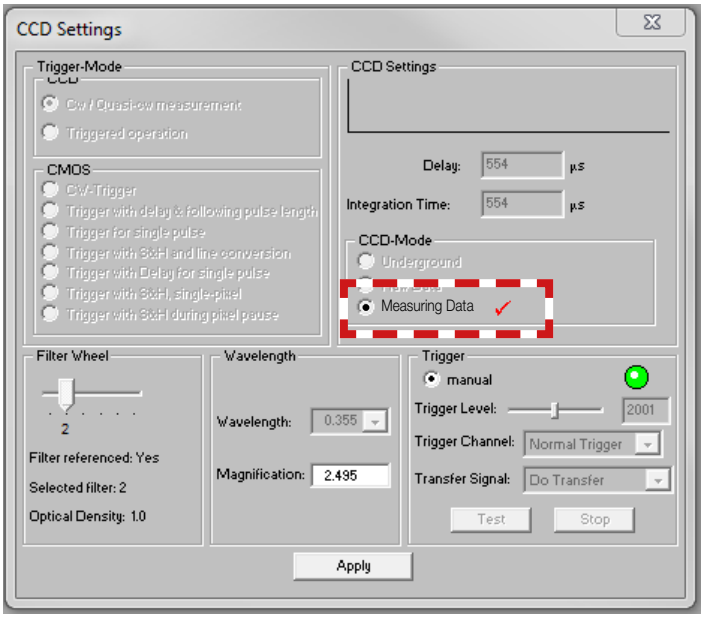


Fig. 12.6: Dialogue window ***CCD-Settings***

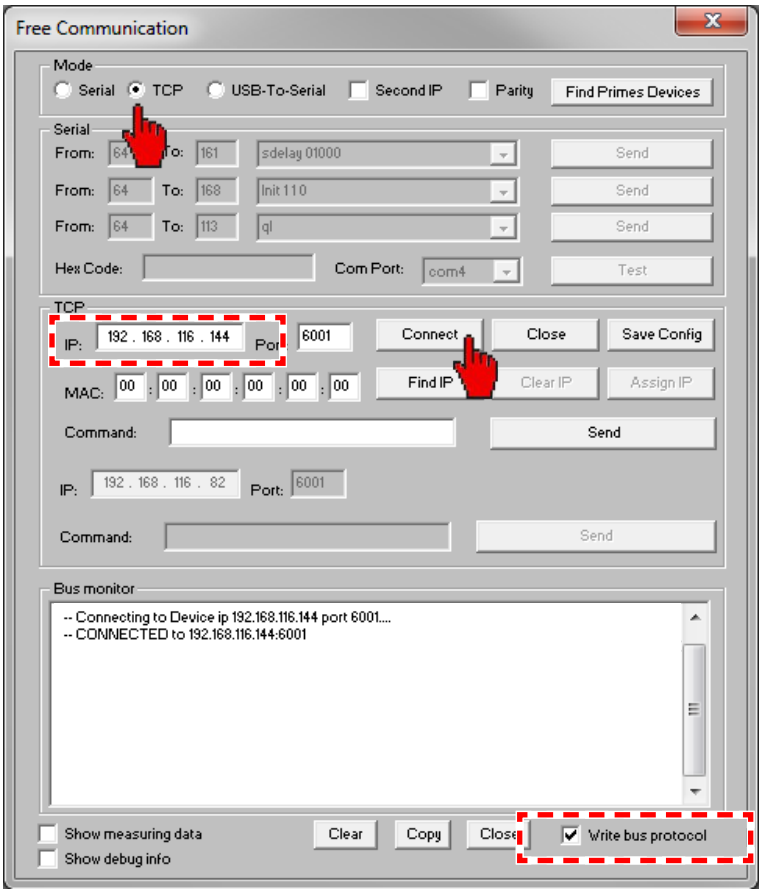
Further hints with regard to the settings can be found in chapter 13.2.2 on page 37.

13 Measurement Settings PROFIBUS (OPTION)

13.1 Changing the PROFIBUS Address

A PROFIBUS address is set ex works. This address is stated on the device. If necessary, it can be changed as follows:

1. Please install the LaserDiagnosticsSoftware (LDS) on your computer, which is connected with the device via the network connection.
2. Start the software and open the menu ***Communication>>Free Communication.***
3. Select“TCP“ in the field ***Mode***.
4. Type in the IP address of the device in the field ***TCP*** (the IP address is stated on the identification plate).
5. Click ***Connect.***
6. Activate the check box ***Write bus protocol*** (the protocol can be very useful in case of problems).

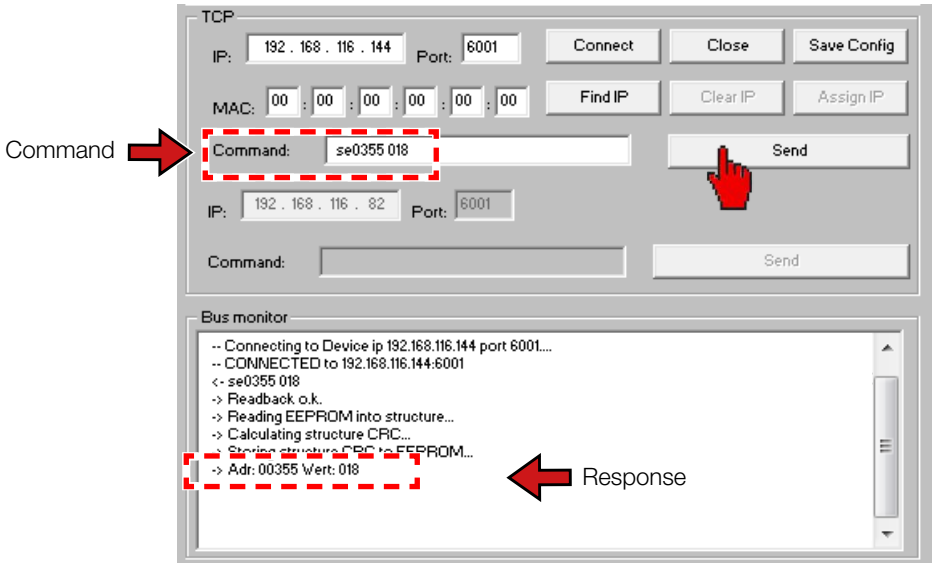


7. The following command has to be entered in the input field ***Command*** (please make sure that the blank space is typed in correctly✶):

se0355✶xyz

xyz is a placeholder for the PROFIBUS address which has to be typed in with three digits!

Example: The PROFIBUS address is supposed to be 18 → enter: **se0355 018**



8. Click ***Send.*** The response of the device appears in the bus monitor as follows:

Addr: 00355 Value: xyz

9. Turn the device off and on again. After the restart the PROFIBUS address is updated.

13.2 Preparing a Setup

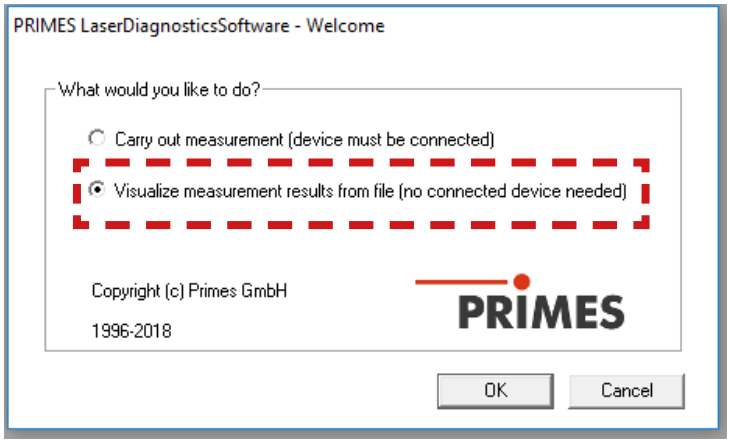
By means of the bits 256.0 to 256.3 different measurement settings (setups) can be stored. In order to carry out a measurement with the stored settings, the respective bit according to the setup has to be set to 1. If none of the bits is set to 1, the measurement is carried out with the parameters stipulated in the control system (address 256.5 to 276, see chapter 15.2 on page 49).

A setup is prepared by means of the PRIMES LaserDiagnosticsSoftware (LDS). Therefore, there has to be an Ethernet-connection between the MSM-C and the computer (or the network) and the software has to be installed on a Windows®-based computer (see chapter 12.2 on page 25).

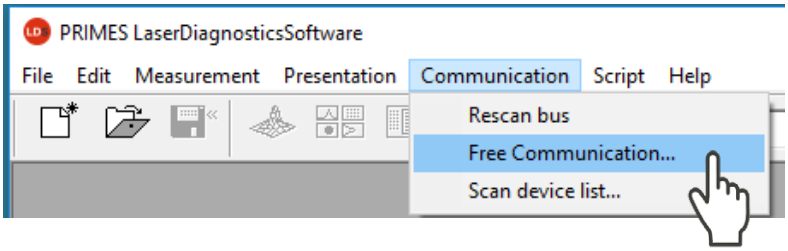
13.2.1 Establishing a Connection to the MicroSpotMonitor-Compact

Do not start the program until the device is cabled and the supply voltage is connected with it. .

1. Start the program by double-clicking the LDS symbol LDS in the start menu group or the desktop shortcut.
2. Choose the OPTION ***Depict available measuring result*** in the start window.



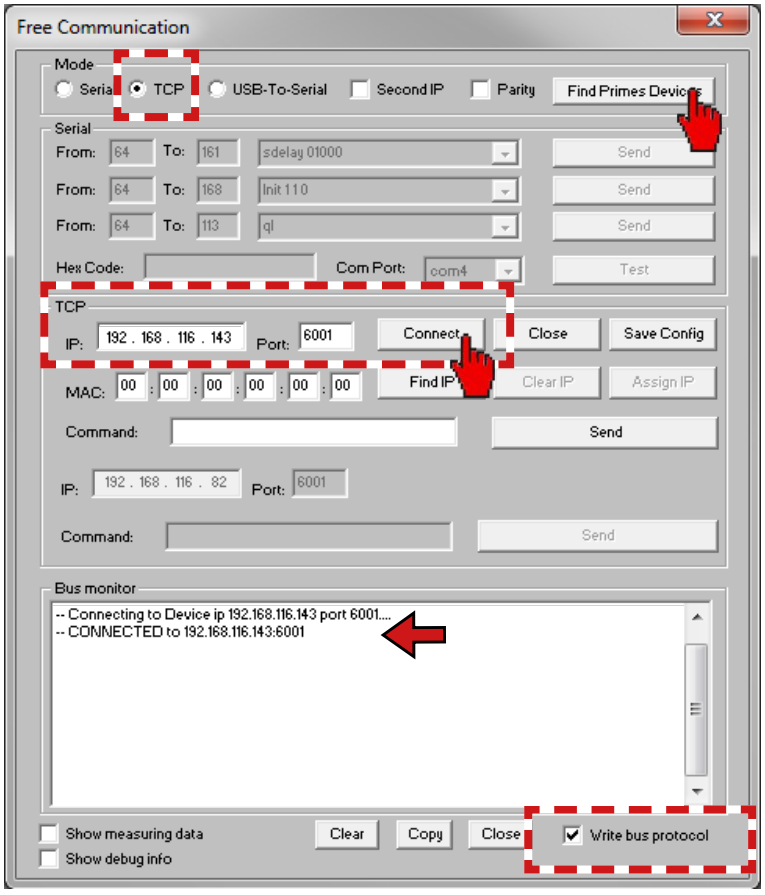
3. Select the menu ***Communication>>Free Communication***



4. Activate the OPTION ***TCP*** in the field ***Mode***, type in the IP address of the device (label on the device) and click the button ***Connect***.
5. Activate the check box ***Write bus protocol*** (right hand lower corner in the dialogue window).

With the function ***Write bus protocol*** the bus communication is displayed in the field ***Bus monitor***. The reports can be useful in order to solve possible problems.

In case of a successful connection the following message appears in the lower window range: “CONNECTED to 192.168.116.143“.

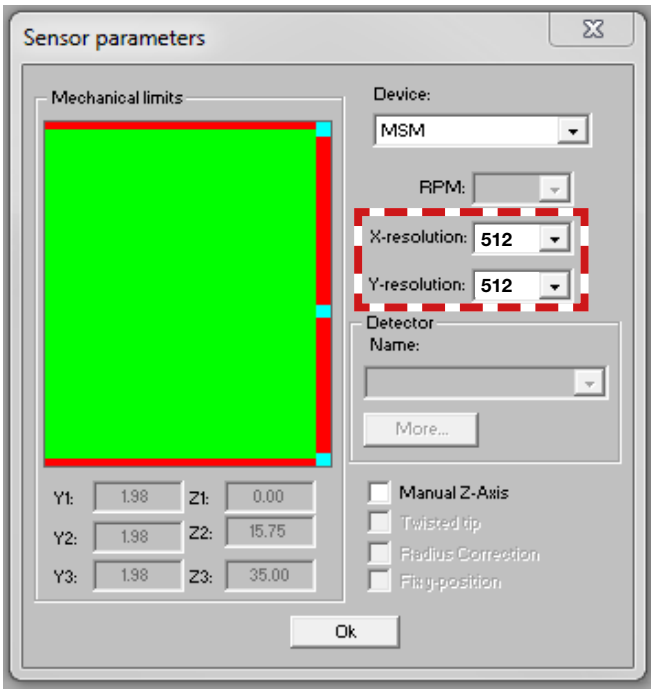


6. Click the button ***Find Primes Devices*** in the upper range of the window in order to include the MSM-C in the LDS session.

Now several dialogue windows appear on the graphical interface of the LDS.

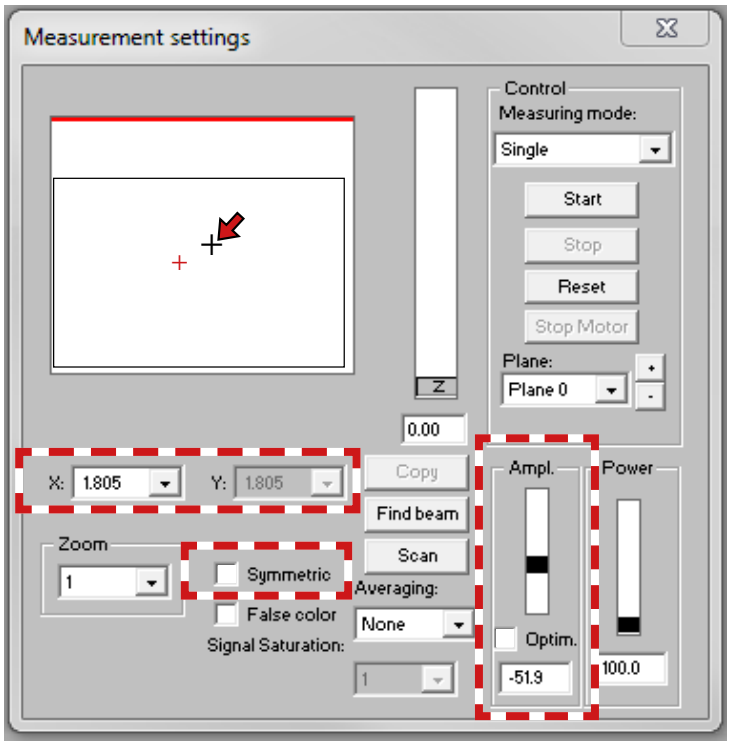
13.2.2 Setting of the Initial Configuration.

1. In the dialogue window ***Sensor parameters*** the resolution has to be set to 512 x 512.



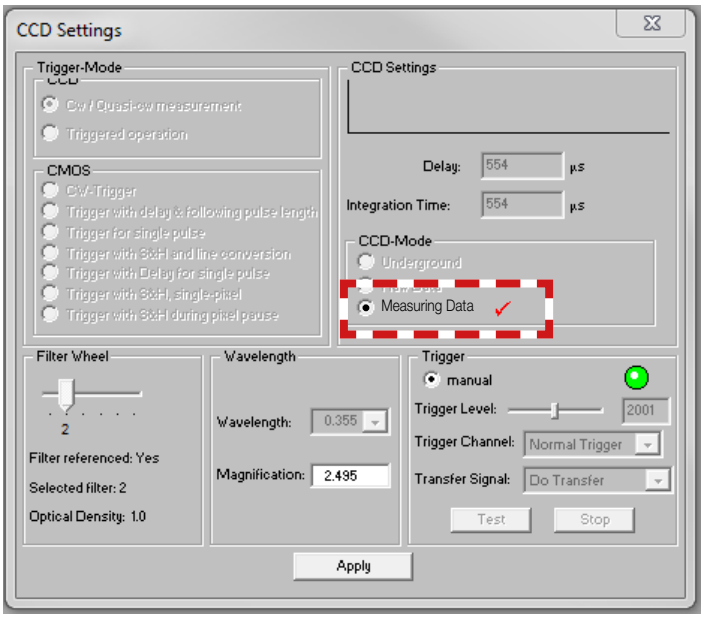
2. The following settings have to be made in the dialogue window ***Measurement settings***:

- Adjust the biggest window in x- and y-direction and drag it to the centre of the measurement range.



- Deactivate the check boxes ***Symmetric*** and ***Optim.***

- Select the OPTION ***Measuring Data*** in the dialogue window ***CCD settings.***

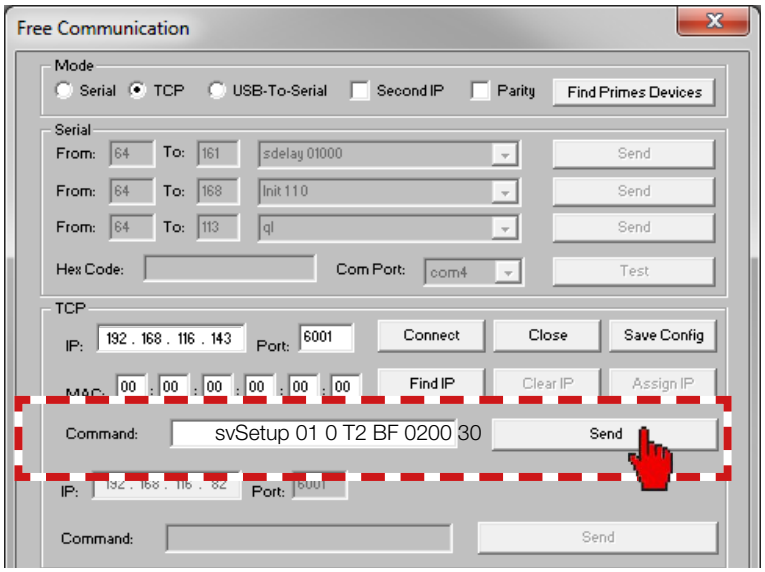


13.2.3 Saving the Initial Configuration

1. Select the menu ***Communication>>Free Communication***.
2. Enter the following command in the command bar (please make sure that the blank space ✶ is entered correctly):

svSetup✶01✶0✶T2✶BF✶0200✶30

3. Click the button ***Send.***



The first setup is now stored and you can carry out the first measurement.

13.2.4 Carrying out the First Measurement

1. Enter the following command in the command bar:

profiMeas✶1✶01

2. Click the button **Send.**

Now you can measure a single plane in the measurement mode ***Single measurement***.

3. Procedure: Click the button **Start** and trigger a laser pulse (300 – 500 ms) within 1 second.

The measuring result is now displayed. By means of the modulation bar you can see if the attenuation still has to be adapted. If so, please adjust the slide control accordingly or type in the value.

4. Enter the following command in the command bar:

svSetup✶01✶A0✶T2✶BF✶0200✶30

5. Please click the button **Send.**

If necessary, please repeat this procedure until the result is satisfactory.

The following modifications of the command syntax are possible:

• **Choosing the Evaluation Method**	
svSetup✶xx✶Ay✶T2✶BF✶0200✶30	
xx	Setup number (01; 02;03;04)
y	Evaluation algorithm (0 = 2. moments; 1= 86% power inclusion)
✶	blank space

• **Changing the Attenuation**	
svSetup✶xx✶amp✶ddd	
xx	Setup number (01; 02;03;04)
ddd	Attenuation in dB, multiplied by (–10)
✶	blank space

Example:

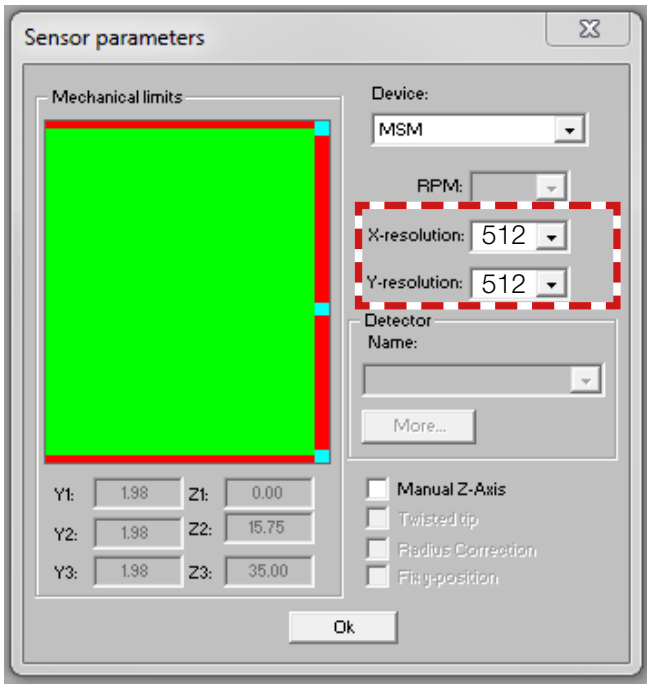
svSetup✶01✶amp✶350

xx	01 ... 04
ddd	000 ... 851 (accordingly 0 dB to –85.1 dB)
✶	blank space

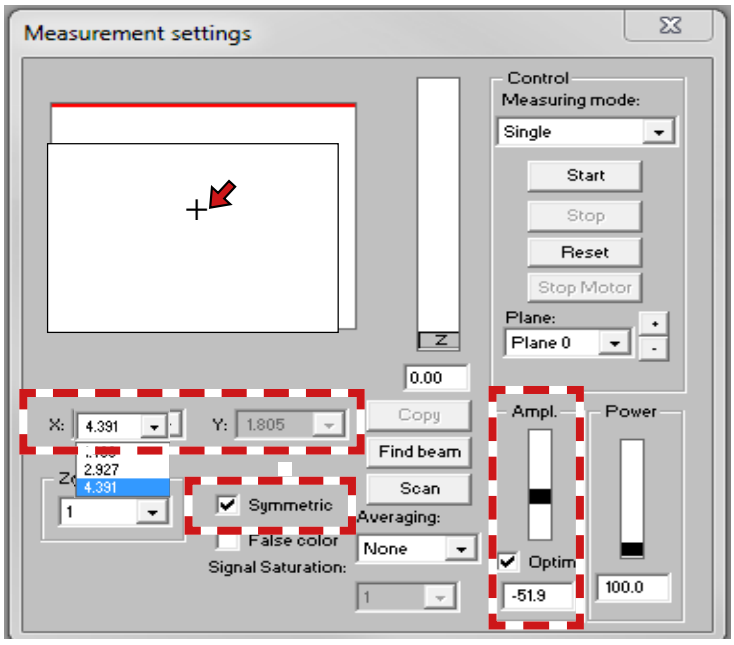
13.3 Displaying a Measurement Result with the LDS

The MSM-C offers the possibility to evaluate the last measurement initiated by the PROFIBUS by means of the LDS. The device must not be turned off after the measurement!

1. Connect the device with your computer via Ethernet.
2. Start the device search in the menu ***Communication>>Free Communication***.
3. In the dialogue window ***Sensor parameters*** the resolution stated in the PROFIBUS surroundings has to be selected.



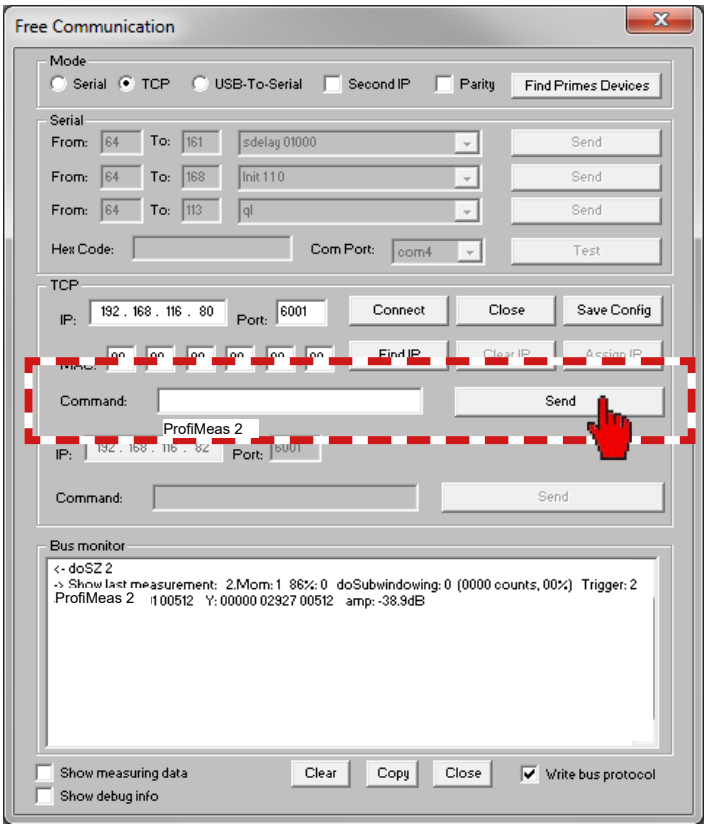
4. According to the previous configuration, the resolution is chosen in the dialogue window ***Measurement settings***. Then the ***Symmetric*** has to be deactivated and the maximum measuring window values in x- and y- direction are selected:



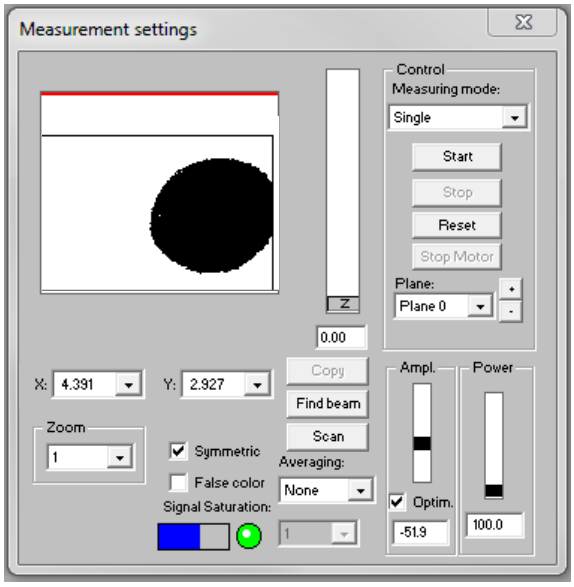
5. Enter the following command in the menu ***Communication>>Free Communication:***

profiMeas✶2✶0

then click ***Send***.



Due to the profiMeas-command no new measurement is triggered but the last measurement is recalled from the device.
Afterwards a measurement can be carried out in the dialogue window ***Measurement settings***. Then the measurement carried out last is displayed:

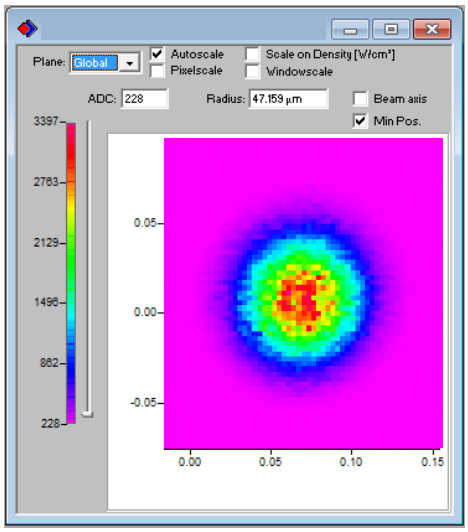


This measurement can now be further processed in the LDS. Via an external control parallel measurements are still possible.

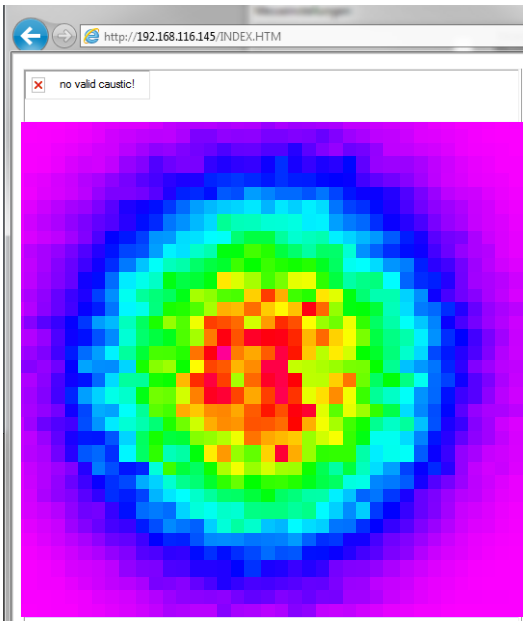
13.4 Displaying a Measurement Result in a Browser (OPTION)

As an OPTION, the MSM-C gives the possibility to display the last measurement in an arbitrary browser (Please note that the measuring results are deleted after a new start-up!). The measurement can be triggered via the software (LDS) or by the plant via the PROFIBUS.

Display in the measurement window of the LDS
The entire measurement window is displayed



Display in the browser window



If the beam search function **BeamFind** is activated in case of a measurement, the evaluated range around the beam is displayed. The section the beam was found in is amplified according to the browser window size. If the measurement is triggered without **BeamFind**, the entire measurement window content is displayed. In contrast to the display in the LDS with 10 bit, the measurement in the browser is only displayed with a color depth of 8 bit. It is therefore not comparable with the display of the LDS and is only intended for demonstration purposes!

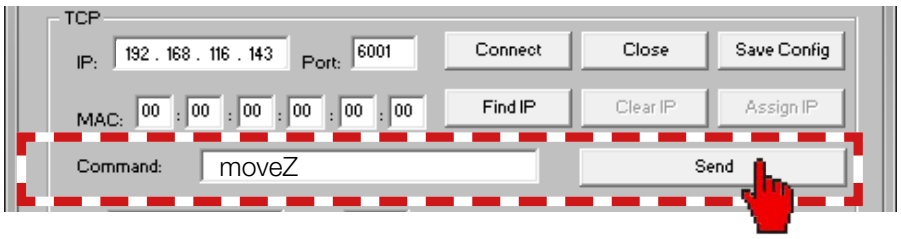
13.5 Caustic Measurement (OPTION PROFIBUS)

With the command „moveZ“ a caustic can be measured manually from the dialogue window ***Free Communication*** of the LDS in case of partially automated processes by the system control.

1. Select the menu ***Communication>>Free Communication***.
2. Enter the following command in the command line:

moveZ

3. Click the button ***Send***.



The command is acknowledged in the bus monitor.

By default, the signal bit 259.3 (see chapter „15.1 Inputs“ page 47) is set for 2 seconds when the command is sent. After this period has expired, it automatically drops again (other time intervals are possible upon request).

14 System Control

A PROFIBUS interface is OPTIONally available for an integration into a system control. Hence, the determined beam parameters are directly available for a further processing for the machine control.

14.1 Measurement Procedure Focus Measurement (untriggered)

System	MicroSpotMonitor-Compact
Sets parameters for measurement	
Sets command.start	
	Deletes status.ready
	Deletes status.measurement_finished
	Reads parameters for the measurement (from setup or PROFIBUS)
	Sets status.acknowledge
Turns on the laser	
Deletes command.start	
	Deletes status.acknowledge
	Sets status.measurement_running
	Starts measurement
	When the measurement is finished: deletes status.measurement_running
Turns off the laser (after the necessary exposure time)	
	Calculates parameters
	Writes parameters into PROFIBUS register
	Sets status.measurement_finished
	Sets status.ready
Reads results	

14.2 Measurement Procedure Focus Measurement (triggered)

System	MicroSpotMonitor-Compact
Sets parameters for the measurement	
Sets command.start	
	Deletes status.ready
	Deletes status.measurement_finished
	Reads parameters for the measurement (from setup or from PROFIBUS)
	Sets status.acknowledge
Deletes command.start	
	Deletes status.acknowledge
	Sets status.measurement_running
Turns on the laser	
	Laser is identified (trigger)
	Starts measurement
	When the measurement is finished: deletes status.measurement_running
Turns off the laser	
	Calculates parameters
	Writes parameters into PROFIBUS register
	Sets status.measurement_finished
	Sets status.ready
Reads results	

14.3 Timing-Diagram of the Focus Measurement

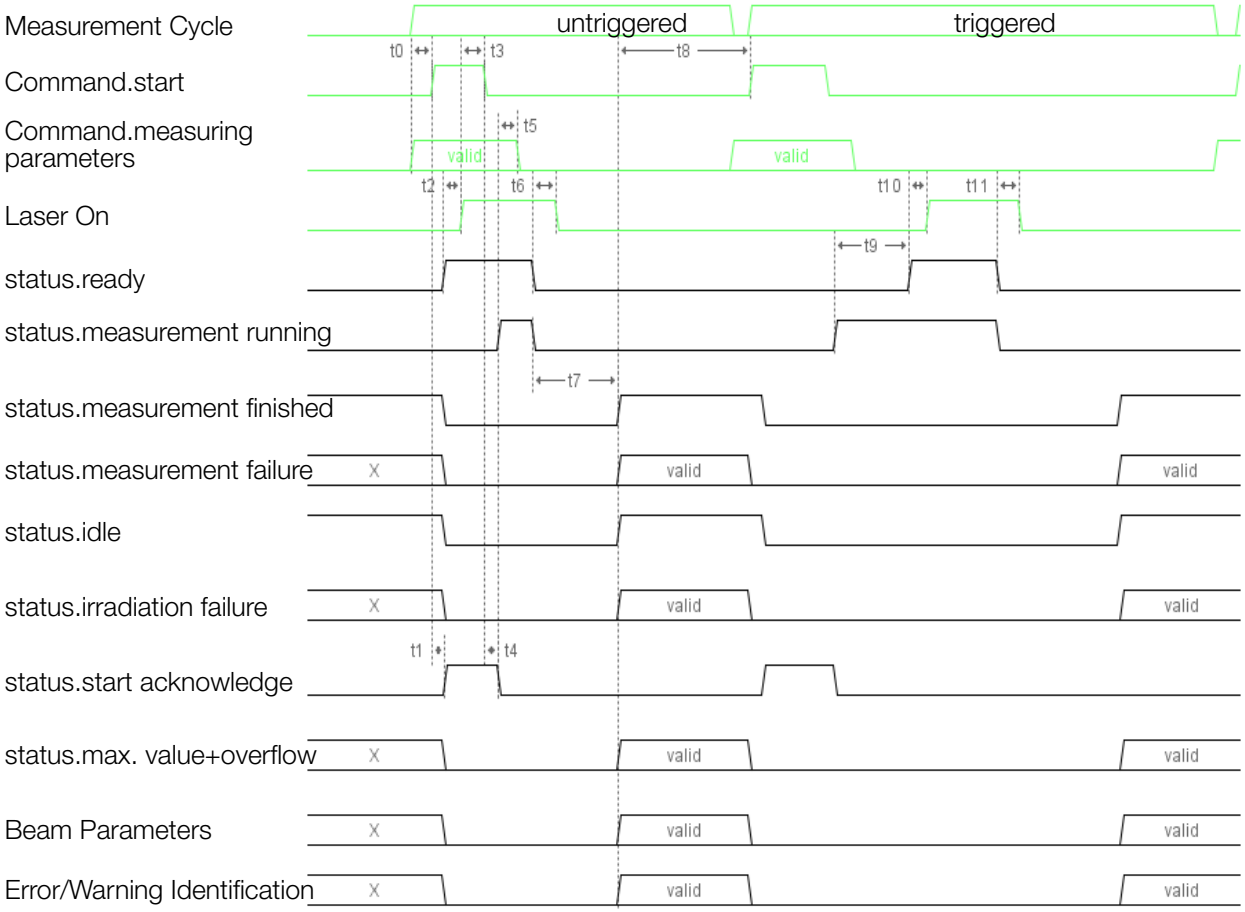


Fig. 14.1: Timing-Diagram untriggered and triggered measurement

- t0: The measurement parameters (setup-no. or detailed measurement parameters) have to be set before the flag “start“ is set.
- t1: As a confirmation that the start command and the measurement parameters were received, the flag “start acknowledge“ is set, “idle“ and “finished“ is deleted. Moreover, the result registers, the error flags and the error identifications are deleted.
- t2: In case of the untriggered measurement, the flag “ready“ is set simultaneously as a sign that the laser can be turned on.
- t3: When “ready“ is set, the laser pulse should be triggered “Laser on“. Only then the flag “start“ may be deleted as this is when the measurement starts (this is only valid for the untriggered measurement; in case of a triggered measurement, the “start acknowledge“ be directly be confirmed by deleting the “start“ flag).
- t4: When “start“ is deleted again, the “start acknowledge“ is deleted and “measurement running“ is set.
- t5: When “start acknowledge“ is deleted again, it is ensured that the measurement parameters were read in; they can then be changed arbitrarily (e.g. as a preparation for the next measurement).
- t6: When the actual measurement is finished “measurement“ and “ready“ are deleted. From this point on the laser pulse “Laser on“ can be turned off, as it is no longer needed for the following calculations.
- t7: When the calculations are finished (or a fatal error has occurred), the flags “finished“ and “idle“ are set. If the flag “measurement failure“ is set, a fatal error has occurred and the measurement or the calculation was cancelled. The reason of the error is coded in the register “error identification“. In case “measurement failure“ is not set, both the measurement and the calculation were carried out successfully and the results can be found in the “beam parameters“ result registers. The maximum value of the raw data and a marking concerning the number of pixels which were oversteered is coded in the high byte

of the status word. Possibly, the flag “irradiation failure“ is set; in this case, a non-fatal error has occurred (measurement over- or understeered, beam is located at the edge of the measuring window). The reason is coded in the register “warning identification“. However, beam parameters were determined, which are available in the result registers.

- t8: Results as well as error flags and identifications remain existent until the next measurement is initiated with “start“.
- t9: In case of the triggered measurement, the measuring procedure is started after deleting “start“ and runs until the device is ready for operation and waits for the trigger (laser identified).
- t10: Then “ready“ is set as a sign that the laser is supposed to be turned on now “laser on“. The laser pulse should not be triggered before as it might already be over when the device is finally ready for operation.
- t11: In this case, as well, “measurement“ and “ready“ are deleted after the measurement. From this moment on the laser pulse “laser on“ can be turned off.

15 Profibus-Parameter Set

15.1 Inputs

In	Address	RegAdr		Unit/Rep.Rate		Length	Type	Block Size
Version (read only)	256	0	Device-/Softwarerevi-sion	fix	Info on device	2 byte	word	20 byte
Status (read only)	258.0	1 high	Ready for Measure-ment	> 1Hz	Ready for measurement after start acknowledge	1 byte	bool	
	258.1		Measurement running	> 1Hz	Measurement running; wait		bool	
	258.2		Measurement finished	> 1Hz	Measurement finished; no statement concerning suc-cess		bool	
	258.3		Measurement failure	> 1Hz	Status last measurement; iO/niO		bool	
	258.4		Idle	> 1Hz	Ready for operation		bool	
	258.5		Irradiation failure	> 1Hz	Error concerning the evalua-tion of the last measurement		bool	
	258.6		start acknowledge	> 1Hz	Incoming command identified		bool	
	258.7		Setup Params read	> 1Hz	Parameters for storage in setup were read in (accord-ing to Read Setup Params); when flag (according to Save Setup Params) is 0 again, the parameters were stored in setup		bool	
	259.0	1 low				1 byte	bool	
	259.1						bool	
	259.2						bool	
	259.3		New plane	2 s	Device is ready, the external z-axis can be moved		bool	
	259.4						bool	
	259.5						bool	
	259.6						bool	
	259.7						bool	
Warnings and errors (read only)	260.0	2 high	Group reporting gen-eral warnings		Group error	1 byte	bool	
	260.1						bool	
	260.2		Group reporting warn-ing single measure-ment		Group error		bool	
	260.3						bool	
	260.4		Group reporting error hardware		Group error		bool	
	260.5		Group reporting error parameter selection		Group error		bool	
	260.6		Group reporting error single measurement		Group error		bool	
	260.7						bool	
	261	2 low				1 byte	byte	
	262	3	Warning identification general	per measure-ment cycle	Warnings that do not refer to single measurement or caus-tic (e.g. applying a setup)	2 byte	word	
	264	4	Warning identification single plane	per measure-ment cycle	Warning identification for the last measurement (see table)	2 byte	word	
	266	5				2 byte	word	

In	Address	RegAdr		Unit/Rep.Rate		Length	Type	Block Size
	268	6	Error identification hardware	per measurement cycle	Error detection of the hardware	2 byte	word	
	270	7	Error identification parameter	per measurement cycle	Error detection parameter of the measurement requirements	2 byte	word	
	272	8	Error identification single plane	per measurement cycle	Error detection for the last measurement (please see table)	2 byte	word	
	274	9				2 byte	word	
Variables; single plane (read only)	276	10	Beam radius	m*E-7 /per measurement cycle	Combined beam radius after selected evaluation method	2 byte	word	64 byte
	278	11	beamradius_x	m*E-7 /per measurement cycle	Beam radius according to selected evaluation method in x-direction	2 byte	word	
	280	12	beamradius_y	m*E-7 /per measurement cycle	Beam radius according to selected evaluation method in y-direction	2 byte	word	
	282	13	beamposition_x	µm /per measurement cycle	Beam position according to selected evaluation method in x-direction	2 byte	word	
	284	14	beamposition_y	µm /per measurement cycle	Beam position according to selected evaluation method in y-direction	2 byte	word	
	286	15	angle x	°*E-2 / per measurement cycle	angle y equals angle x +90°	2 byte	word	
	288	16+17	Beam volume	ADC counts	Beam volume of the distribution in ADC values	4 byte	lword	
	292	18+19				4 byte	lword	
	296	20	Modulation: max. value of the raw data	per measurement cycle	Signal control of the last measurement cycle	2 byte	word	
	298	21 high	% of the beam oversteered (i.e. raw data == 4095)	% / per measurement cycle	Proportion of the oversteered signal in % of the beam surface according to selected evaluation method; when no beam is found: % of the measurement window surface	1 byte	byte	
	299	21 low	Fill factor	% / per measurement cycle		1 byte	byte	
	300	22	ROI window position x	µm /per measurement cycle		2 byte	word	
	302	23	ROI window position y	µm /per measurement cycle		2 byte	word	
	304	24	ROI window size x	µm /per measurement cycle		2 byte	word	
	306	25	ROI window size y	µm /per measurement cycle		2 byte	word	
	308	26	ROI resolution x	Pixel		2 byte	word	
	310	27	ROI resolution y	Pixel		2 byte	word	
	312	28	Attenuation used	dB * (-10) / per measurement cycle	Attenuation used for the last measurement (comp. LDS)	2 byte	word	
	314	29+30	Exposure time used	µsec / per measurement cycle	Exposure time used for the last measurement (comp. LDS)	4 byte	lword	
	318	31+32				4 byte	lword	
	322	33-41			Reserve	18 byte		

15.2 Outputs

Out	Address			Unit/Rep. rate		Length	Type	Block Size
Command (set by ProfiBus)	256.0	0 high	Automatic measurement left / setup 1		Requirements of an already configured, saved setup; Regarding the handling please see the respective instructions; only set 1 bit at a time		bool	4 byte
	256.1		Automatic measurement right / setup 2				bool	
	256.2		Online measurement left / setup 3				bool	
	256.3		Online measurement right / setup 4				bool	
	256.4		Start measurement		Requirement measuring procedure; wait for 256.6 as an answer		bool	
	256.5						bool	
	256.6						bool	
	256.7		Reset		Resetting the error; set to idle-mode		bool	
	257.0	0 low	Measuring mode 0		Selection of the used measuring data: 0|0 -> conventional measurement; 1|0 -> only raw data measurement; 0|1 -> only underground measurement; 1|1 -> raw data + underground; is ignored in case of a simplified measurement		bool	
	257.1		Measuring mode 1				bool	
	257.2		Evaluation algorithm 0		Selection evaluation procedure: 0|0 -> 2. moments-method; 1|0 -> 86%-method		bool	
	257.3		Evaluation algorithm 1				bool	
	257.4		Flag integration time unit		Requirements of the used parameters for the exposure time control: 0 -> dB; 1 -> µs		bool	
	257.5		Flag exposure automatic		Measurement with optimizer: 0 -> no; 1 -> yes; is ignored in case of a simplified measurement		bool	
	257.6						bool	
	257.7		Flag simplified measurement		Preselection measuring mode: 0 -> conventional; 1 -> simplified		bool	
	258.0	1 high	Flag external trigger		Usage external trigger: 0 -> no; 1 -> yes;		bool	
	258.1		Trigger mode 0		Selection trigger mode: 0|0 -> cw-measurement; 1|0 -> classical trigger, 2 pulses necessary; with exposure time adaption more; 0|1 -> simplified measuring procedure without exposure time adaption, only one pulse necessary		bool	
	258.2		Trigger mode 1				bool	
	258.3		Read setup params		Reads the measuring parameters for the storage as online measurement (left or right activated)		bool	
	258.4		Save setup params		Saves the measuring parameters (<- provided measuring parameters of the automatic measurement) in the activated online measurement (left or right)		bool	
	258.5						bool	
	258.6						bool	

Out	Address			Unit/Rep. rate		Length	Type	Block Size
	258.7						bool	
	259.0	1 low					bool	
	259.1						bool	
	259.2						bool	
	259.3						bool	
	259.4						bool	
	259.5						bool	
	259.6						bool	
	259.7						bool	
Single plane global settings (write only)	260	2	BeamFind counts	counts	Setting for BeamFind: ADC-values above zero level for beam detection; default: 200; == 0 for fixed measuring window	2 byte	word	32 byte
	262	3	BeamFind percent	%	Setting for BeamFind: % of the max. signal height for beam detection; default: 30; == 0 for fixed measuring window	2 byte	word	
	264	4+5	Trigger delay	µsec	Time delay between the detected trigger signal and the start of the measurement	4 byte	lword	
	268	6	Trigger level (0-4095)	counts	Trigger level according to LDS in cts	2 byte	word	
Single plane variable (write only)	270	7	Attenuation (start value)	dB * (-10)	Start value for attenuation with an activated optimizer; 257.5 (not simplified measurement); otherwise set value for measurement; 0dB < t < -83.5dB (target: -20 to -60dB)	2 byte	word	
	272	8+9	Exposure time (start value)	µsec	Start value for exposure time with activated optimizer; 257.5 (not simplified measurement); otherwise set value for measurement; 12 µs < t < 217000 µs	4 byte	lword	
	276	10				2 byte	word	
	278	11	Deflection position	µm		2 byte	word	
	280	12	Resolution_x	Pixel	Resolution in x-direction (32; 64; 128; 256; 512)	2 byte	word	
	282	13	Resolution_y	Pixel	Resolution in y-direction (32; 64; 128; 256; 512)	2 byte	word	
	284	14	Window size_x	µm /per measurement cycle	Setting for measuring window size in x-direction; depending on resolution and opt. system; max. window size without opt. system	2 byte	word	
	286	15	Window size_y	µm /per measurement cycle	Setting for measuring window size in y-direction; depending on resolution and opt. system	2 byte	word	
	288	16	Window position_x	µm /per measurement cycle	Setting for measuring window position in x-direction; depending on the measuring window size and opt.system	2 byte	word	
	290	17	Window position_y	µm /per measurement cycle	Setting for measuring window position in y-direction; depending on measuring window size and opt. system	2 byte	word	

15.3 Setup Storage

In order to prevent an accidental writing of a setup, 2 Bits and a Handshake procedure are used to effect the svSetup.

1. The system sets the parameters which are to be stored in the Out-range as well as the setup-number and the flag “read setup params“; the parameters “save setup params“ and “start measurement“ have to be 0.
2. The MSM-C reads the parameters and then acknowledges by setting “setup params read“ in the In-range to 1.
3. The system deletes “read setup params“ and sets “save setup params“.
4. The MSM-C then stores the setup in EEPROM and then deletes “setup params read“ as a signal to the system that the process is complete.

15.4 Error Flags

15.4.1 Error Detection Hardware (are not deleted in case of a reset)

Error	Identification
Xilinx or ExtXi-Error	0x0001
EE-CRC not correct	0x0002

15.4.2 Error Detection Parameter Selection

Group reporting ”Error Parameter Selection“ is set.
”Measurement Failure” is set.

Error	Identification
Window (in X) too small	0x0001
Window (in Y) too small	0x0002
Window (in X) too big/too far to the right	0x0004
Window (in Y) too big/too far to up	0x0008
Resolution (in X) too small	0x0010
Resolution (in Y) too small	0x0020
Resolution (in X) too high (for LDS)	0x0040
Resolution (in Y) too high (for LDS)	0x0080
Resolution (in X) too high	0x0100
Resolution (in Y) too high	0x0200
Smallest y-window at x_anz==1024	0x0400
Too many pixels for array sample_data	0x0800
Attenuation too strong	0x1000
Integration time or delay too big	0x2000
Inadmissible BeamFind parameter	0x4000
Other inadmissible parameter	0x8000

15.4.3 Error Detection Single Plane Measurement

Group reporting ”Error Single Plane Measurement” is set
”Measurement Failure” is set

Error	Identification
Trigger-Timeout occurred	0x0001
Upstream Measurement Error	0x0002
Raw Data Measurement Error	0x0004
Underground Measurement Error	0x0008
Measurement Timeout	0x0010
	0x0020
	0x0040
	0x0080
Calculation Timeout	0x0100
No Beam Found in BeamFind	0x0200
	0x0400
	0x0800
Volume negative	0x1000
beamdata.r2E < 0 (2. Moment)	0x2000
beamdata.x2E < 0 (2. Moment)	0x4000
beamdata.y2E < 0 (2. Moment)	0x8000

15.5 Warnings

15.5.1 Warning Identification Single Plane Measurement

Group reporting ”Warning Single Plane Measurement“ is set
”Irradiation failure“ is set

Warning	Warning Condition	Identification	No.
Beam at Left Edge	Calculated Subwindow or pos_x - r at left edge	0x0001	34
Beam at Right Edge	Calculated Subwindow or pos_x + r at right edge	0x0002	35
Beam at Lower Edge	Calculated Subwindow or pos_y - r at lower edge	0x0004	36
Beam at Upper Edge	Calculated Subwindow or pos_y + r at upper edge	0x0008	37
Oversteered	Raw data maximum (4095 Counts) >5%; Reference surface: Calculated beam surface (in case beam radius could not be measured, otherwise: Subwindow, in case Beam-Find was successful; otherwise: window surface)	0x0010	38
Understeered	Raw Data < 2500 counts	0x0020	39

16 Maintenance and inspection

The operator is responsible for determining the maintenance intervals for the measuring device.
PRIMES recommends a maintenance interval of 12 months for inspection and validation or calibration.
If the device is used only sporadically, the maintenance interval can also be extended up to 24 months.

16.1 Exchanging the protective window

The measuring objective of the MicroSpotMonitor MSM can be optionally delivered with a protective window or a protective window with cyclone. The protective window in the beam entrance is a wearing part and can be replaced if necessary. Low levels of contamination of the protective window can be carefully removed when cooled with Isopropanol (observe the manufacturer‘s safety instructions). In case of heavy, non-removable contamination or damage, the protective window must be replaced with a new one.

The protective window is coated with an antireflex coating and has low reflection values of less than 1%. To avoid increased reflection values, use only original PRIMES protective windows.

Protective window diameter	30 mm
Glass thickness	1.5 mm
Order number	801-004-054

16.1.1 Safety instructions

DANGER

Severe eye or skin injury due to laser radiation

If the protective window is not correctly positioned, reflections can cause directional laser radiation.

- **Make sure that the new protective window is settled flat in the groove of the protective window holder.**

CAUTION

Burns due to hot components

After a measurement the protective window is hot!

- **Do not replace the protective window directly after a measurement.**
- **Let the device cool down for an adequate period of time. The cooling ime varies depending on the laser power and the irradiation time.**

CAUTION

Burns due to hot components

The protective window is hot after a measurement!

- **Do not change the protective window directly after a measurement.**
- **Allow the device to cool down for an appropriate time. The cooling time varies depending on the laser power and irradiation time.**

The protective window is located in the protective window holder of the measuring objective below the retaining ring or cyclone. The retaining ring or the cyclone are attached to the protective window using a spring-loaded bayonet lock with three locking pegs.

16.1.2 Replacing the protective window

1. Follow the safety instructions in chapter „16.1.1 Safety instructions“ page 53.
2. Push the retaining ring down against the protective window holder, turn it counterclockwise until it stops and lift the retaining ring up and off.
3. Remove the old protective window from the protective window holder (e.g. with a suction cup) and dispose of it.
4. Carefully place the new protective window into the protective window holder.
5. Position the locking pegs of the retaining ring in the openings of the bayonet lock.
6. Push the retaining ring down and turn it clockwise until it stops.

- The bayonet lock is locked.

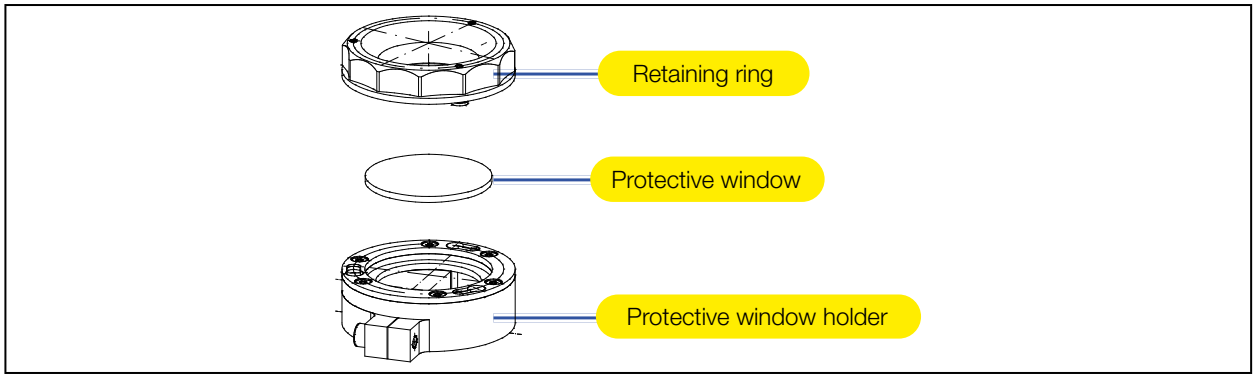


Fig. 16.1: Components of the protective window holder

16.1.3 Replacing the protective window for cyclone

1. Follow the safety instructions in chapter „16.1.1 Safety instructions“ page 53.
2. Remove the compressed air hoses around the cyclone if necessary.
3. Push the cyclone down against the protective window holder, turn it counterclockwise until it stops and lift it up and off.
4. Remove the old protective window from the protective window holder (e.g. with a piece of adhesive tape) and dispose of it.
5. Carefully place the new protective window into the protective window holder.
6. Position the locking pegs of the cyclone in the openings of the bayonet lock.
7. Push the cyclone down and turn it clockwise until it stops.

- The bayonet lock is locked.

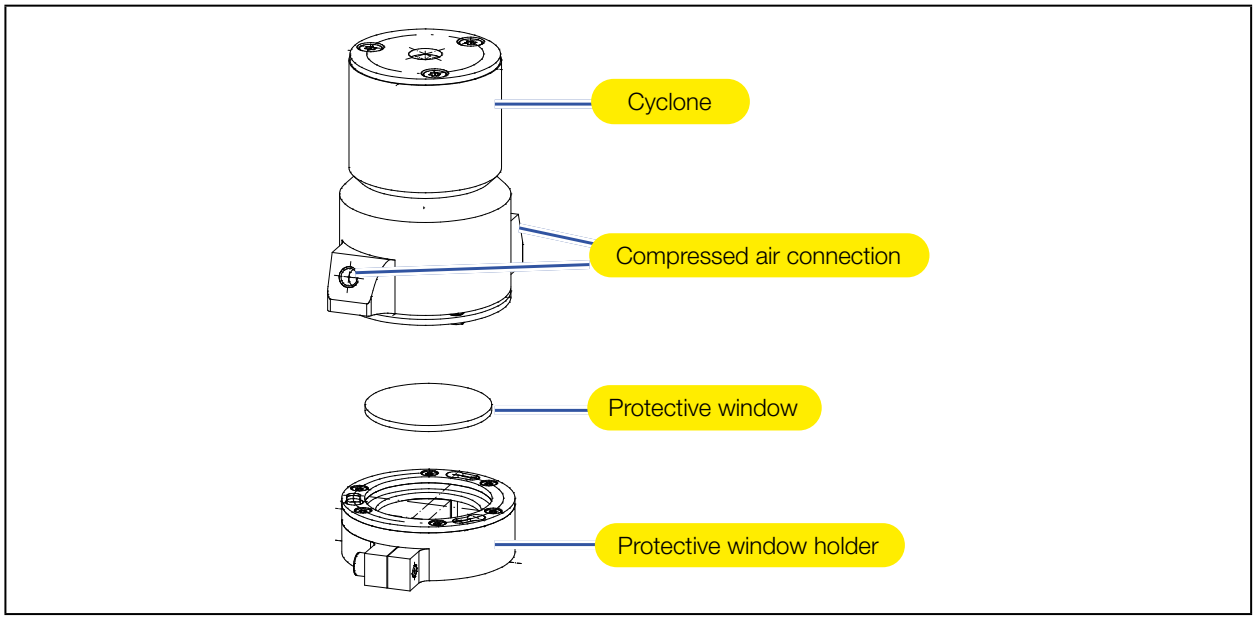


Fig. 16.2: Components of the protective window holder with cyclone

17 Storage

NOTICE

Danger of damage due to freezing cooling water

A storage or transport at a temperature that is close to or below the freezing point can lead to device damages if the cooling circuit is not completely empty.

▶ **Empty the cooling circuit completely!**

Empty the cooling circuit completely by blowing it out with compressed air. Connect the compressed air with the water inflow (Water In).

18 Measures for the product disposal

As a B2B device, this PRIMES measuring device is subject to the European Waste Electrical and Electronic Equipment (WEEE) Directive and the corresponding national laws. The WEEE directive obliges the operating company to dispose of the device in an environmentally sound manner, not with household waste, but in a separate WEEE collection.

PRIMES gives you the opportunity to return your PRIMES measuring device for free disposal within the scope of the Waste of Electrical and Electronic Equipment (WEEE Directive). This service does not include shipping costs. You can send PRIMES measuring devices to be disposed of within the EU to our address:

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

If you are located outside the EU, please contact your local PRIMES distributor to discuss the disposal procedure for your PRIMES measuring device.

PRIMES is a registered manufacturer in the German “Used Appliances Register“ stiftung elektro-altgeräte register (stiftung ear). Our number is: WEEE-reg.-no. DE65549202.

19 Technical Data

Supply Data	
Supply Voltage, DC Max. Power Input	24 V ± 5 % 500 mA
Cooling Circuit Cooling Water Flow Rate Recommended Filter with Filter Unit	 0.7 ... 1.2 l/min 50 µm
Cooling Water Temperature T_{in} [1]	dew-point temperature < T_{in} < 30 °C
Maximum water inlet pressure	2 bar
Compressed Air (cleaned, water free) Flow Rate	 3 ... 5 l/min
Characteristics Measurement	
Max. Beam Diameter	20 ... 600 µm
Wave Length Range	1030 ... 1090 nm (see Laser power)
Max. Laser Power [2]	1.0 kW
Max. Energy Density Pulse [3] (at a Pulse Duration of 10 ns) Max. Power Density CW-Operation	 3 J/cm² 1 MW/cm²
Communication	
Ethernet PROFIBUS Safety Circuit (Interlock)	100 Mbit - Pins 1, 2, 3 potential free
Ambient Conditions	
Service Temperature Range Storage Temperature Range	+15 ... +40 °C +5 ... +50 °C
Reference Temperature	+22 °C
Admissible Relative Air Humidity (non-condensing)	80 %
Measures and Weight	
L x W x H (without cables and plugs) Standard with Beam Diffraction PROFIBUS	 231 x 120 x 60 mm 275 x 120 x 127 mm 281 x 120 x 85 mm
Weight, approx. Standard with Beam Diffraction PROFIBUS PROFIBUS Overhead Mounting 170	 2.6 kg 3.1 kg 3.1 kg 7.4 kg
Protection	
Protection Category	IP40
Protection Class	III

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

[2] Max. 10 mW up to 1 kW average power multi-mode (up to 100 W average power single-mode).

[3] Max. Energy Density = 3 J/cm² · $\sqrt{\frac{\Delta t_{puls}}{10\ ns}}$

20 Declaration of Conformity

Original EG Declaration of Conformity

The manufacturer: PRIMES GmbH, Max-Planck-Straße 2, 64319 Pfungstadt, Germany,
hereby declares that the device with the designation:

MicroSpotMonitor-Compact (MSM-C)

Types: MSM-C

is in conformity with the following relevant EC Directives:

- EMC Directive EMC 2014/30/EU
-Low voltage Directive 2014/35/EU
- Directive 2011/65/EC on the restriction of the use of certain hazardous substances (RoHS) in electrical and electronic equipment
- Directive 2014/32/EC on measuring instruments

Authorized for the documentation:
PRIMES GmbH, Max-Planck-Straße 2, 64319 Pfungstadt, Germany

The manufacturer obligates himself to provide the national authority in charge with technical documents in response to a duly substantiated request within an adequate period of time.

Pfungstadt, June 21, 2022

Dr. Reinhard Kramer, CEO

UKCA Declaration of Conformity

The manufacturer: PRIMES GmbH, Max-Planck-Straße 2, 64319 Pfungstadt, Germany,
hereby declares that the device with the designation:

MicroSpotMonitor-Compact (MSM-C)

Types: MSM-C

is in conformity with the following relevant UK Regulations:

- Electromagnetic Compatibility Regulations 2016
- Electrical Equipment (Safety) Regulations 2016
- The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012
- Measuring Instruments Regulations 2016

Authorized for the documentation:
PRIMES GmbH, Max-Planck-Straße 2, 64319 Pfungstadt, Germany

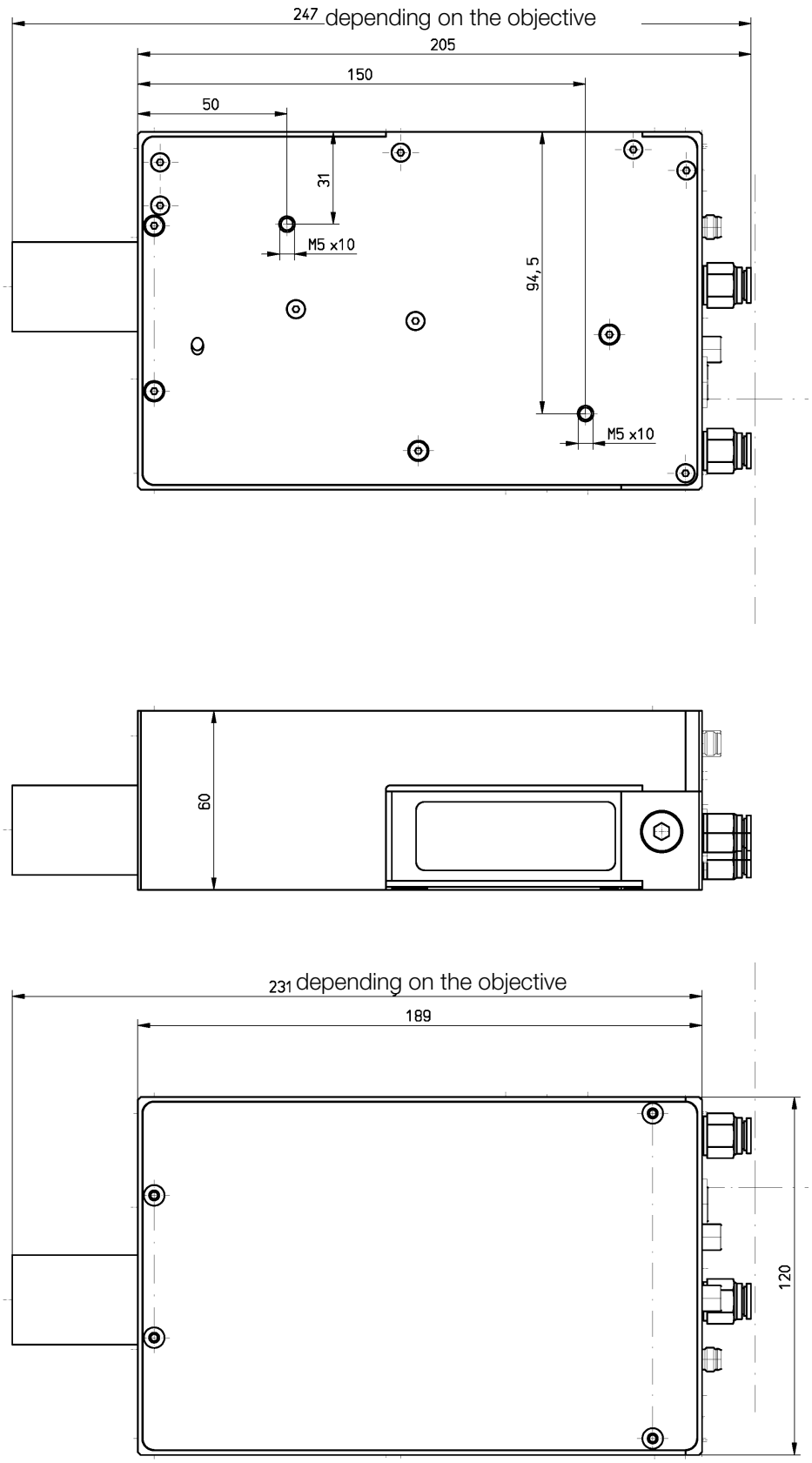
The manufacturer obligates himself to provide the national authority in charge with technical documents in response to a duly substantiated request within an adequate period of time.

Pfungstadt, June 21, 2022

Dr. Reinhard Kramer, CEO

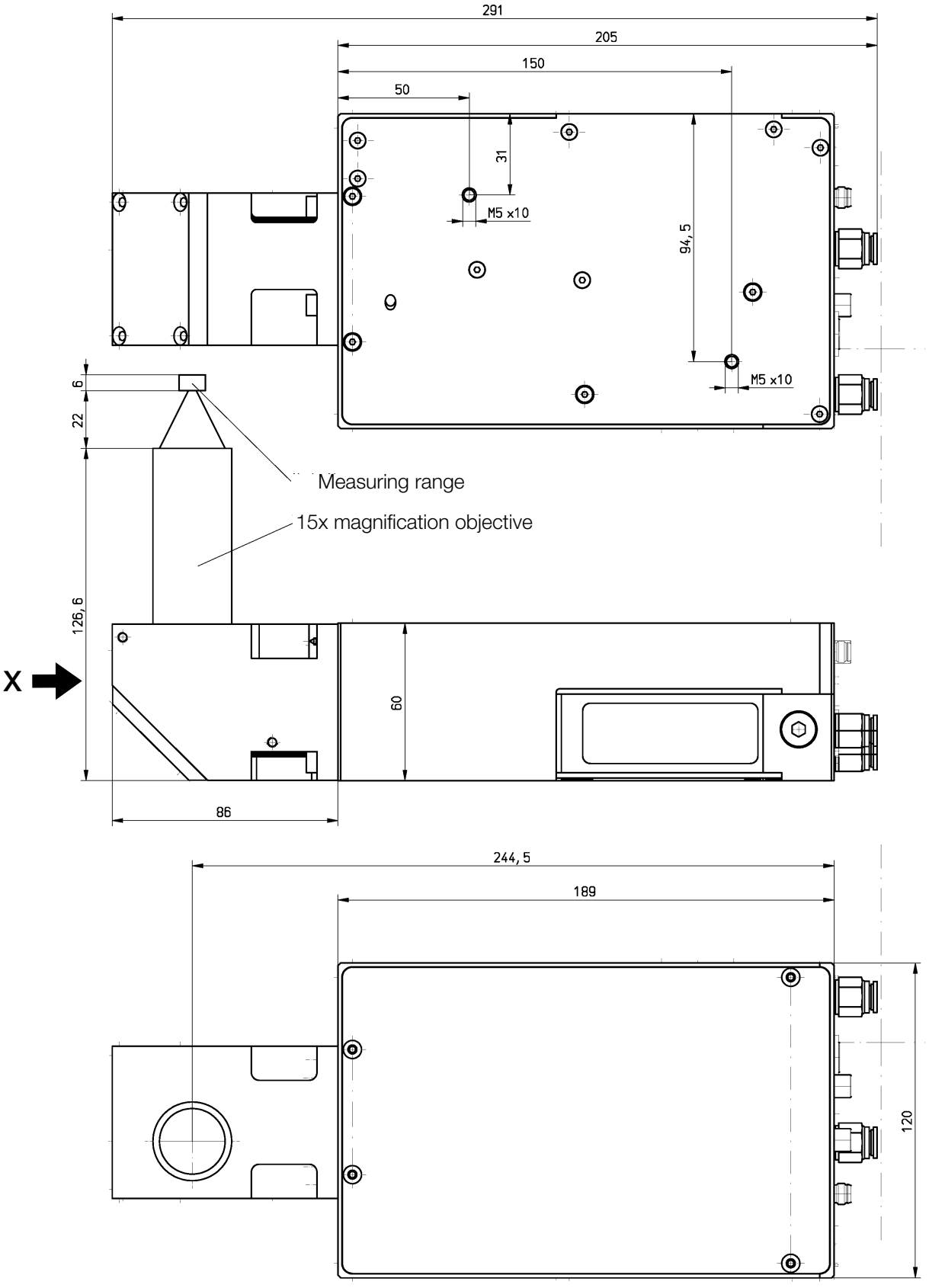
21 Dimensions

21.1 MSM-C Standard



(All dimensions in mm)

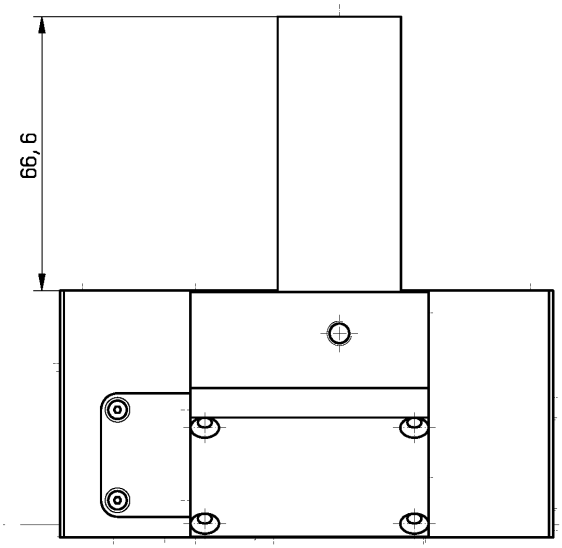
21.2 MSM-C Standard with Beam Deflection



(All dimensions in mm)

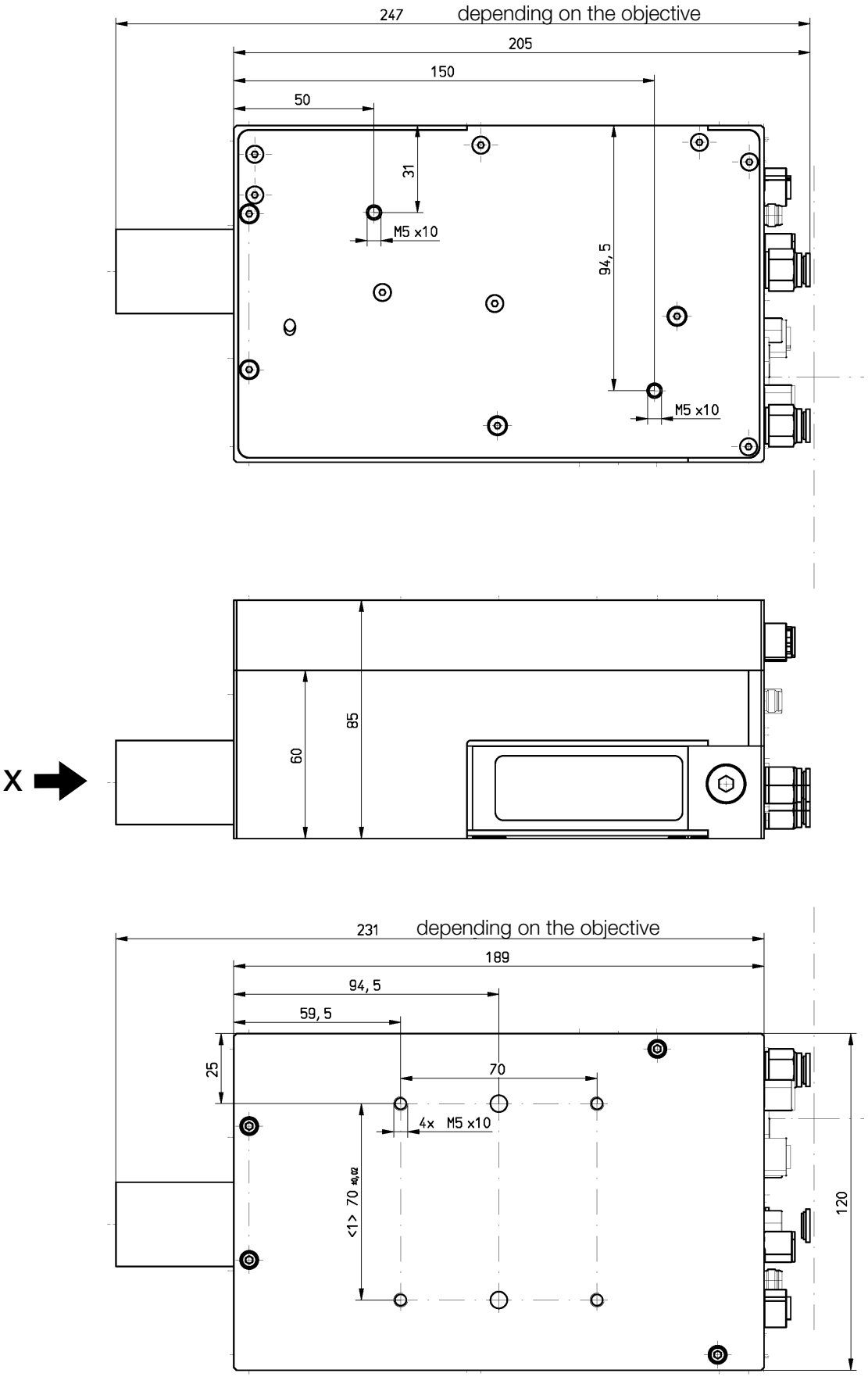
MSM-C Standard with Beam Deflection (Continuation)

View X



(All dimensions in mm)

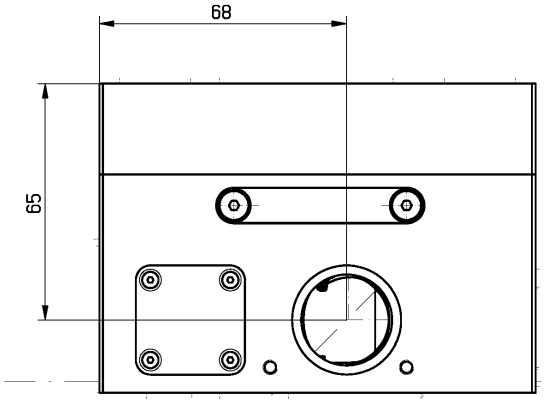
21.3 MSM-C PROFIBUS



(All dimensions in mm)

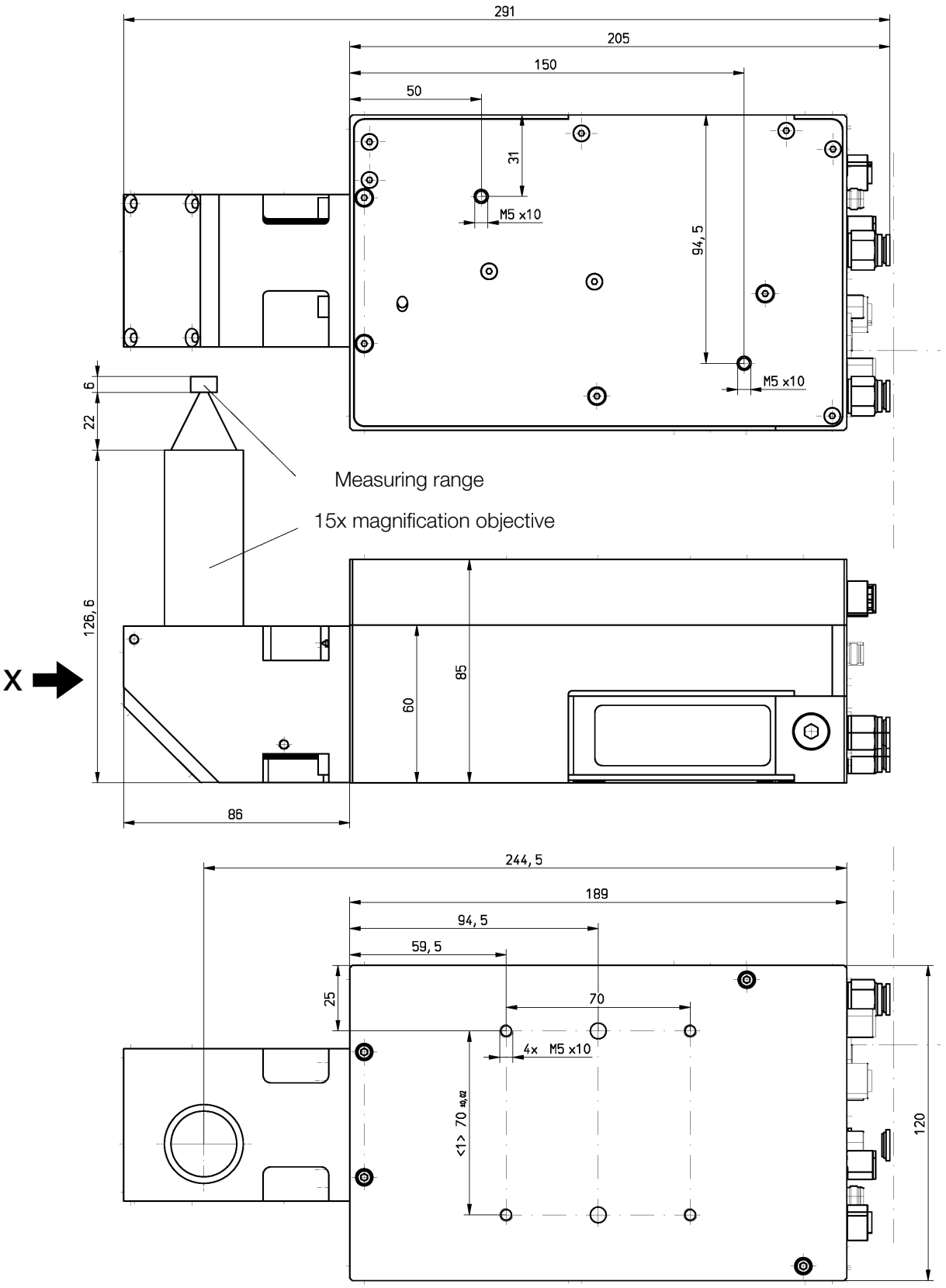
MSM-C PROFIBUS (Continuation)

View X



(All dimensions in mm)

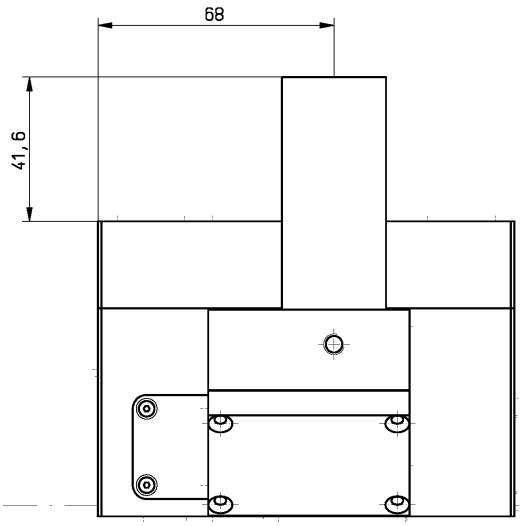
21.4 MSM-C PROFIBUS with Beam Deflection



(All dimensions in mm)

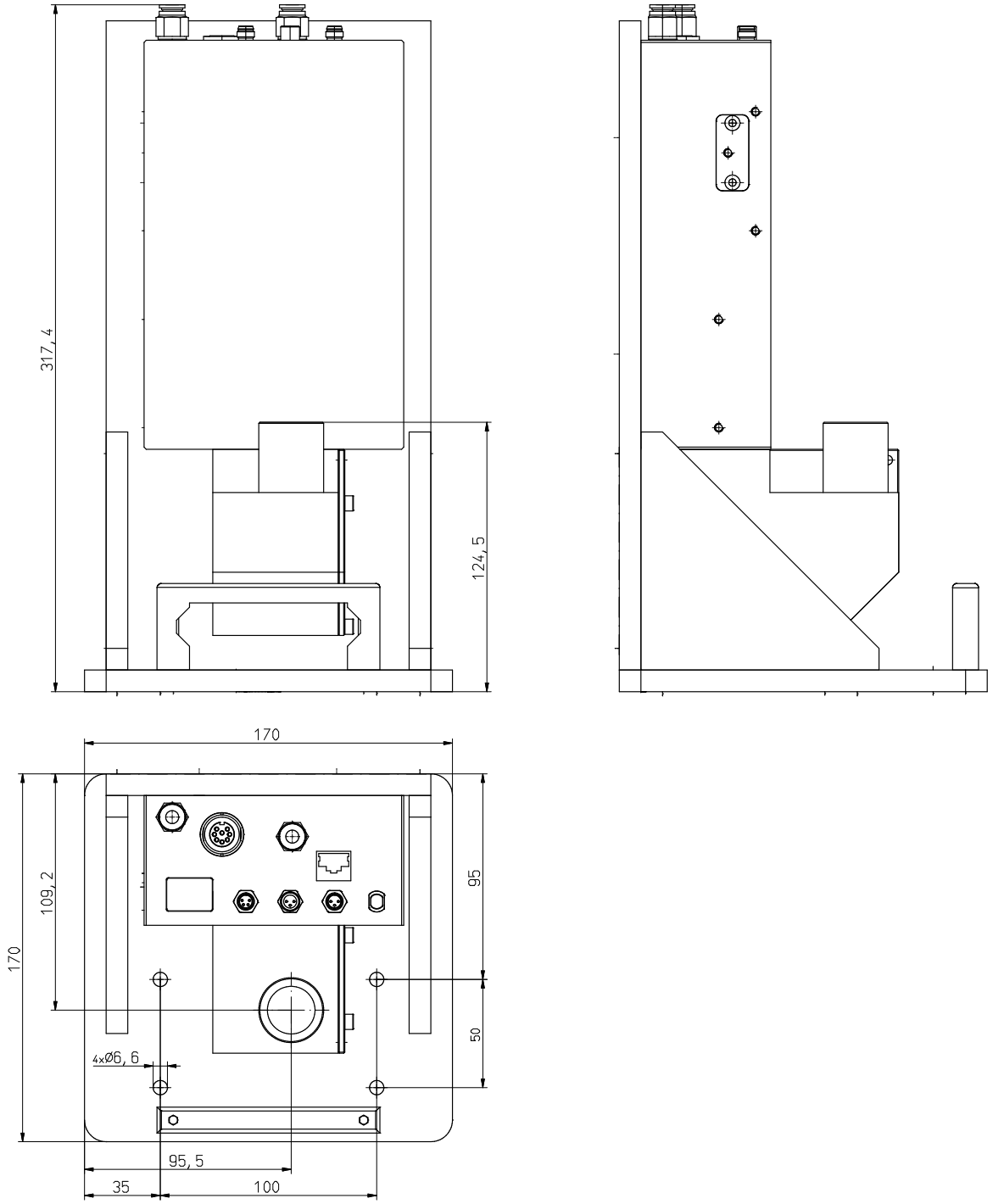
MSM-C PROFIBUS with Beam Deflection (Continuation)

View X



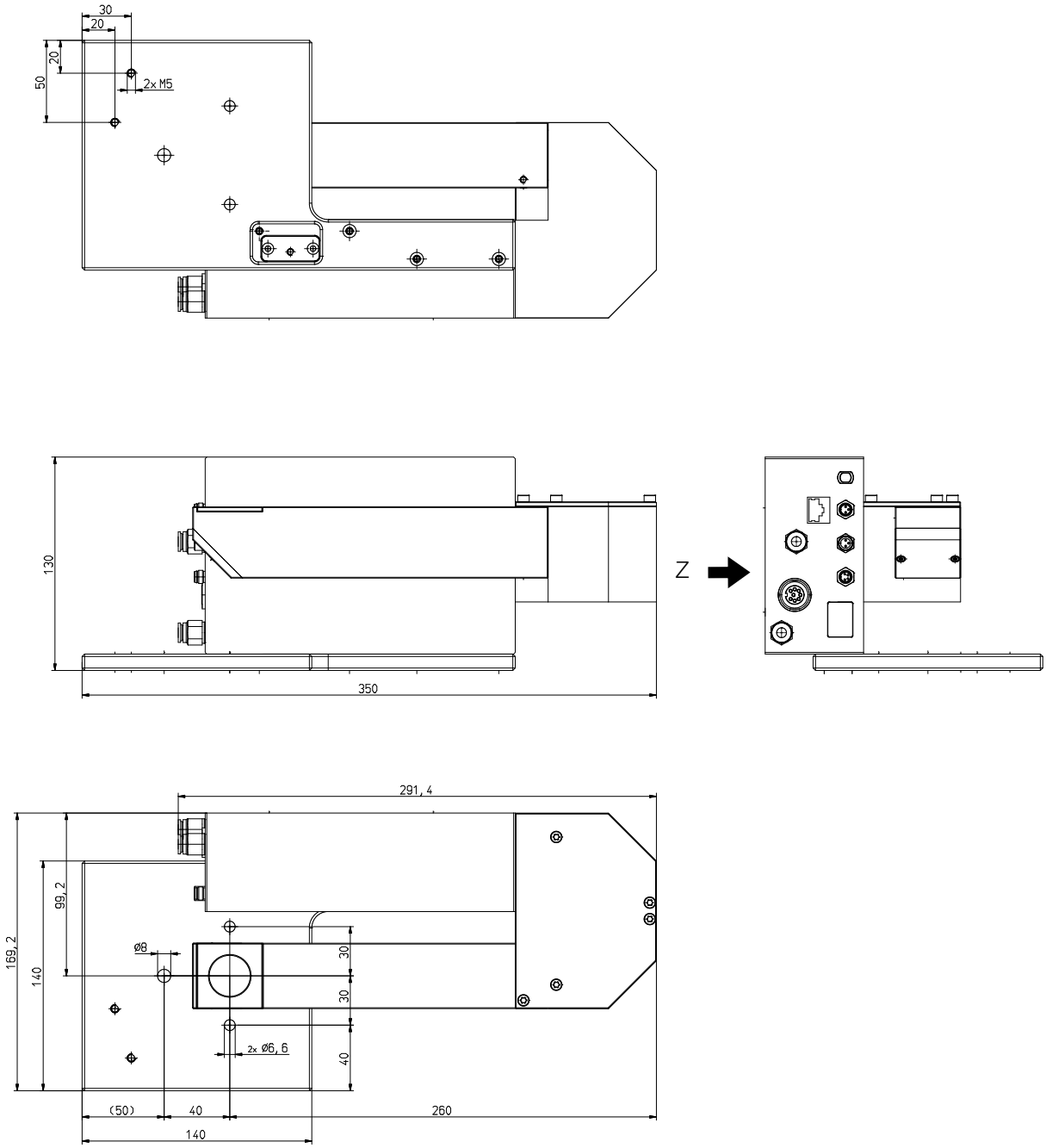
(All dimensions in mm)

21.5 MSM-C Overhead



(All dimensions in mm)

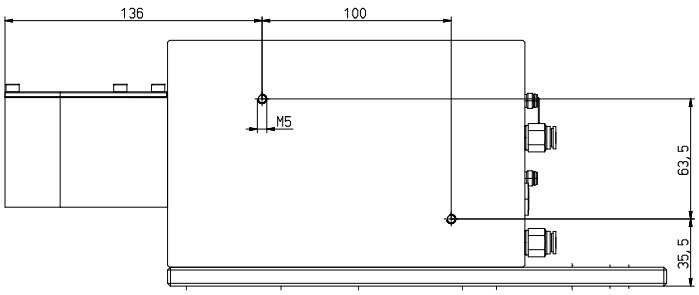
21.6 MSM-C Periscope



(All dimensions in mm)

MSM-C Periscope (Continuation)

View Z



(All dimensions in mm)

22 Accessories

22.1 Neutral density filters

In the scope of delivery of the MSM-C, a dummy insert without a neutral glass filter is installed in the filter slot OPTIONally neutral density filter inserts with different filter densities are available (see Tab. 22.1 on page 69).
The filters in these inserts are movably mounted and can be positioned outside the beam path if necessary.

Neutral density filter	OD1	OD2	OD3	OD4	OD5
Order number	801-020-020	801-020-021	801-020-022	801-020-023	801-020-024

Tab. 22.1: Order numbers of the neutral density filters

22.1.1 Exchanging the Neutral Density Filter insert

DANGER

Severe eye or skin injuries due to laser radiation

During the measurement the laser beam is guided through the device. Thereby scattered or directed reflection of the laser beam occur inside of the device (laser class 4).

- **The filter slot of the MSM-C must always be sealed in measuring operation.**

NOTICE

Damaging/Destruction of the of the neutral density filter

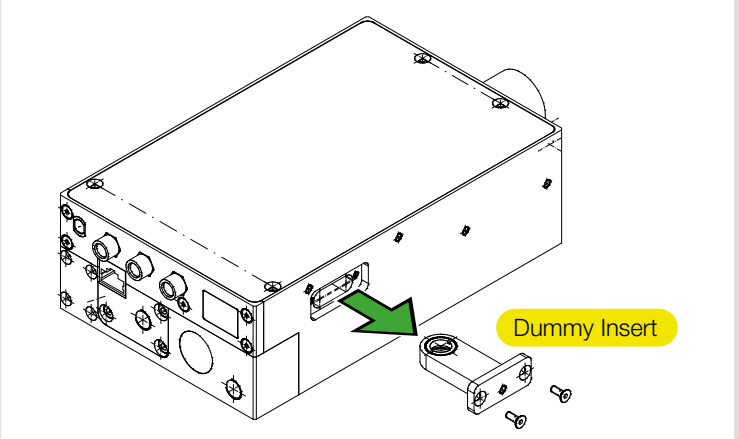
Contamination can lead to damage of the neutral density filter during measuring operation. Contamination can also lead to incorrect measurements.

- **During exchanging protect the neutral density filter from contamination.**
- **Only replace the neutral density filters in a dust-free environment.**
- **Do not touch the filter glass with bare fingers!**

To change the insert, you will need a Torx T8 screwdriver.

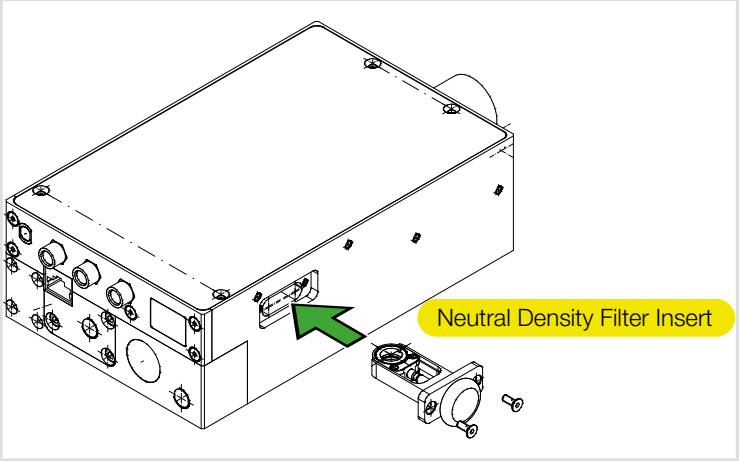
Dismounting

1. Turn the laser off.
2. Loosen and remove the fixing screws of the dummy insert.
3. Pull the dummy insert out of the housing.



Mounting

1. Push the neutral density filter insert up to the stop into the slot.
2. Screw in the fastening screws and tighten them.



Handling

The neutral density filter can be positioned inside or outside the beam path via the integrated slide, without dismounting the insert (see Fig. 22.1 on page 70).

The neutral density filter is positioned inside the beam path

The neutral density filter is positioned outside the beam path

Fig. 22.1: Positioning of the neutral density filter