Polytec

User Manual

Vibrometer Single Point Sensor Head

OFV-525

Warranty and Service

The warranty for this equipment complies with the regulations in our general terms and conditions in their respective valid version.

This is conditional on the equipment being used as it is intended and as described in this manual.

The warranty does not apply to damage caused by incorrect usage, external mechanical influences or by not keeping to the operating conditions. The warranty also is invalidated in the case of the equipment being tampered with or modified without authorization.

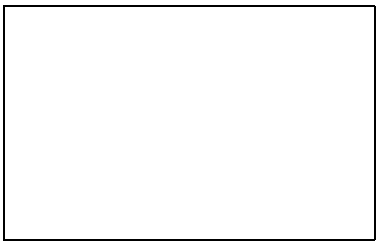
To return the equipment always use the original packaging. Otherwise we reserve the right to check the equipment for transport damage. Please mark the package as fragile and sensitive to frost. Include an explanation of the reason for returning it as well as an exact description of the fault. You can find advice on fault diagnosis in CHAPTER 6.

Trademarks

Brand and product names mentioned in this manual could be trademarks or registered trademarks of their respective companies or organizations.

Identification Labels

Sensor Head



Contents

1 Safety Information

1.1 General Safety Information

Notes

Please read this manual before using the instrument. It will provide you with important information on using the instrument and on safety. This will protect you and prevent damage to the instrument. Pay particular attention to the basic safety information in CHAPTER 1 and the information on installation, operation and maintenance in CHAPTER 3.

Please keep this manual in a safe place and make it available to people using the instrument. Never pass the instrument on without the manual.

In this manual the following graded safety and warning labels are used:

NOTE !

Identifies action required to simplify using the instrument!

CAUTION !

Danger from "Reason for Danger"! - Identifies the danger caused by an action which could result in damage to the instrument if it is not avoided!

WARNING !

Danger from "Reason for Danger"! - Identifies a possible danger resulting from an action which could lead to death or (serious) injury if it is not avoided!

Intended use

The instrument is intended for laboratory use and for use in an industrial environment. It may only be used within the limits given in the technical specifications (refer to CHAPTER 7).

Faultless and safe operation of the instrument depends on correct and proper transport and storage, installation and assembly as well as careful operation of the instrument.

When assembling, installing and operating the instrument, the safety and accident-prevention regulations for the respective use must be adhered to.

Qualification

This instrument may only be operated by persons who are familiar with electrical measurement equipment and have been instructed in the use of lasers. Please pay attention to the information on laser safety in SECTION 1.2.

Intervention for maintenance and repair work may only be carried out by the manufacturer himself or by qualified personnel authorized by the manufacturer.

Disposal

An instrument which is no longer required must be disposed of according to local regulations unless otherwise provided for by the manufacturer.

1.2 Information on Laser Safety

1.2.1 Safety Information

The light source of the instrument is a helium neon laser. It is important to understand that laser light has different properties from ordinary light sources. Laser light is generally extremely intense due to the beam's low divergence. When handling lasers, great care should be taken in any case to make sure that the direct or reflected beam does not enter the eye.

The protective measures taken described in the following support compliance with the safety standards for laser class 2:

NOTE !

Please see CHAPTER 7 for the detailed technical specifications!

- Polytec instruments generally comply with the standards **IEC** and **EN 60825-1**, and **US 21 CFR 1040.10** and **1040.11** respectively except for deviations pursuant to Laser Notice no. 50, dated 26 July 2001.
- The optical output power of the laser beam emitted from the sensor head is less than 1 mW provided the equipment is used in the manner for which it was intended. This means that the instrument complies with **laser class 2** and is generally very safe. It is thereby customary to assume that eyes are protected by prevention mechanisms including the blink reflex. This reaction offers appropriate protection under reasonably foreseeable operating conditions. This includes the use of optical instruments for observing the laser beam. Even when optimally focused, the laser beam is not intense enough to harm the skin.
- The sensor head is equipped with a **beam shutter** to block the laser beam during the warm-up phase, or when the vibrometer is not in use, although switched on.
- An **emission indicator** on the sensor head indicates the activity of the installed laser and thus the potential hazard of laser beams emitted.
- The laser is switched on using the **key switch** on the controller. The key can only be removed if the controller and therefore also the laser is switched off.
- The user **should not attempt** to open the housing of the instrument which contains the laser unit as he could be exposed to a higher level of laser energy that is potentially hazardous.

WARNING !

Danger from uncontrolled light emission! - Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

1.2.2 Safety Precautions

Pay attention to the following safety precautions when using the instrument:

- Only qualified and fully trained persons should be entrusted with setting up the instrument, adjusting and operating it!
- Avoid looking directly into the laser beam with the naked eye or with the aid of mirrors or optical instruments!

WARNING !

Danger from laser light! - It can be dangerous to look directly into the laser beam for any length of time.

NOTE !

Wear suitable laser protection glasses when you have to look at the target area of the laser beam long and hard to set it up!

- Never intentionally direct the laser beam at anyone!

WARNING !

Danger from laser light! - Do not use any reflective tools, watches etc. when you are working in the beam path of the laser!

- Only open the beam shutter when making measurements!
- To position the sensor head, always close the beam shutter. The beam shutter should not be opened until the sensor head has been roughly aligned and mounted securely!
- The laser beam should be terminated at the end of its intended path where this is practically possible.
- Instruments which are not in use should be stored in places which unauthorized persons do not have access to.

1.2.3 Laser Warning Labels

Warning labels The laser warning labels for the sensor head are shown in FIGURE 1.1. For the countries in the European Union (EU), labels **2** and **3** are affixed in the language of the customer's country (see right-hand-side).

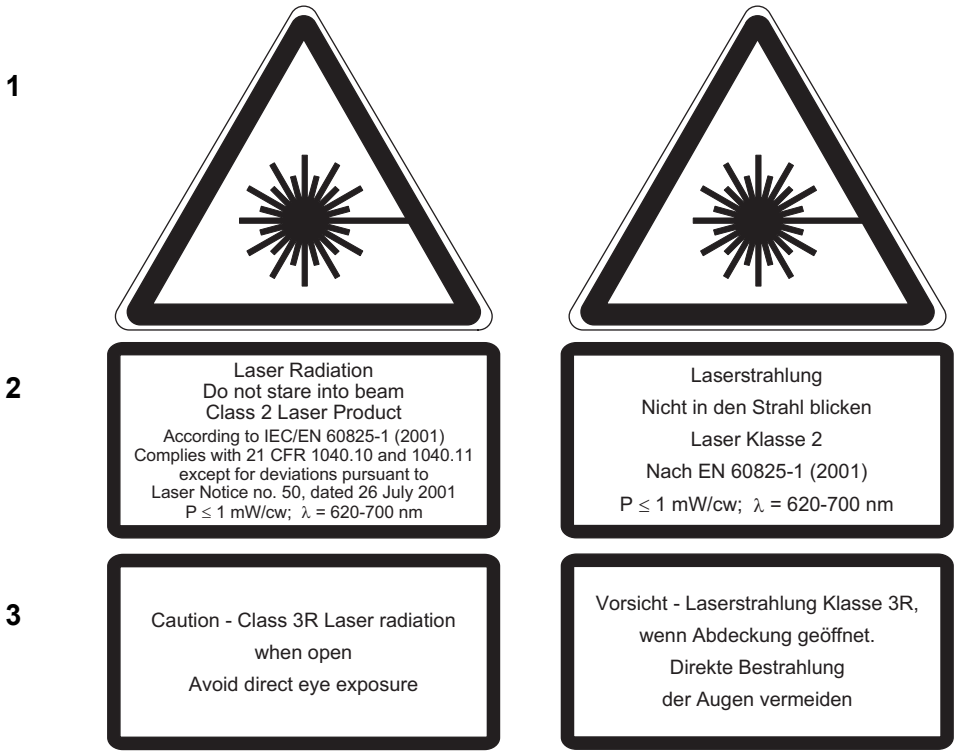


Figure 1.1: Laser warning labels for the sensor head

Position The position of the laser warning labels on the sensor head is shown in FIGURE 1.2.

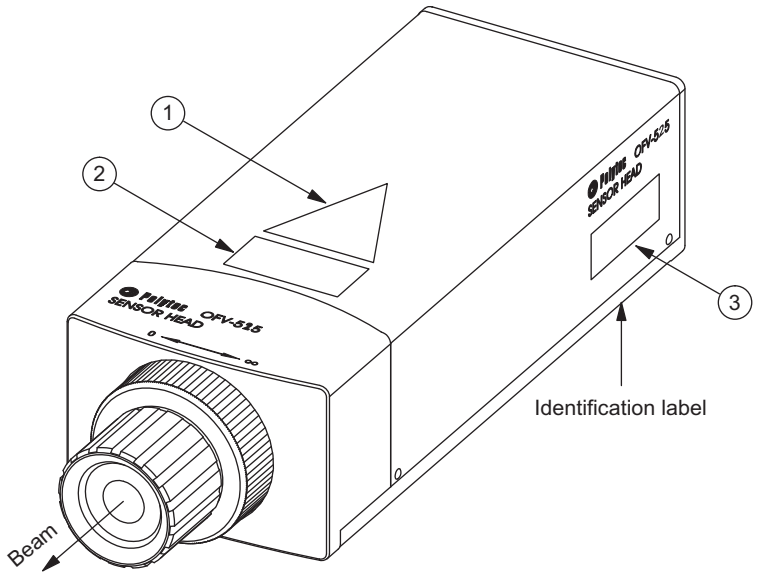


Figure 1.2: Position of the laser warning labels on the sensor head

1.3 Information on Electrical Safety

1.3.1 Safety Information

NOTE !

Please note that the information on electrical safety and EMV mentioned here only applies to controllers permitted by Polytec. You will find the corresponding declaration of conformity in the user manual of the controller.

The instrument complies with the electrical protection class 1 in accordance with the EU directive 2006/95/EEC (low voltage directive). With correct mains connection and intended use, exposure to electric current is prevented by the closed, grounded metal housing.

The instrument is subjected to the EU directive 2004/108/EG (EMC directive) and therefore complies with the limit values for emission and immunity of the standards they are based on (refer also to SECTION 7.1).

1.3.2 Safety Precautions

Pay attention to the following safety precautions when using the instrument:

- The controller is only to be connected up using a three-pin mains cable to AC systems 50/60 Hz with a grounded protective conductor with a nominal voltage of between 100 V and 240 V.
- Defective mains fuses in the controller may only be replaced by fuses of the same kind with the rating given on the back of the instrument.
- If the key switch on the controller used is not freely accessible, use the mains plug to disconnect the device in case of danger. This means that the mains plug needs to be freely accessible. Otherwise an additional disconnection device must be installed.
- The housing may not be opened when using the instrument as intended. Opening the housing will invalidate the warranty. None of the equipment may be operated with opened housing.

WARNING !

Danger from electrical current! - Intervention for maintenance and repair work may only be carried out by the manufacturer himself or by qualified personnel authorized by the manufacturer.

NOTE !

Before removing parts of the housing for servicing purposes for installation and servicing purposes, as a general rule the mains plug should always be unplugged.

- Air inlets and outlets must always be kept free to ensure sufficient cooling. If you notice that the cooling fan is not working, immediately switch the instrument off.

CAUTION !

Danger from heat accumulation! - If you mount the instrument into a switching cabinet, pay attention that the air inlets in the bottom plate must always be kept free!

2 Introduction

2.1 Area of Application

The single point sensor heads conform with the different requirements made of the vibrometer optics. For the sensor head a selection of lenses covers a wide range of stand-off distances. The single point sensor head OFV-525 is particularly suitable for long measurement distances. Focusing the laser beam with the sensor head OFV-525 can also be controlled remotely from the controller or from a PC. You can use the sensor head only with the controller OFV5000-S.

2.2 Operating Principle

The laser vibrometer uses the principle of the heterodyne interferometer to acquire the characteristics of mechanical vibrations or transient motion processes. With this type of interferometer, a high-frequency carrier signal is generated on the photo detector with the aid of a Bragg cell. To make the vibration measurement, the beam of a helium neon laser is pointed at the vibrating object and scattered back from it. Velocity and displacement amplitude of a vibrating object respectively generate a frequency or phase modulation of the laser light due to the Doppler effect. This modulation is recovered in the signal processing unit with the aid of suitable demodulators (or decoders). The velocity information is recovered from the frequency modulation of the Doppler signal, while the displacement signal can be reconstructed from the phase modulation available at the same time. A schematic layout of both signal paths is shown as a diagram in FIGURE 2.1.

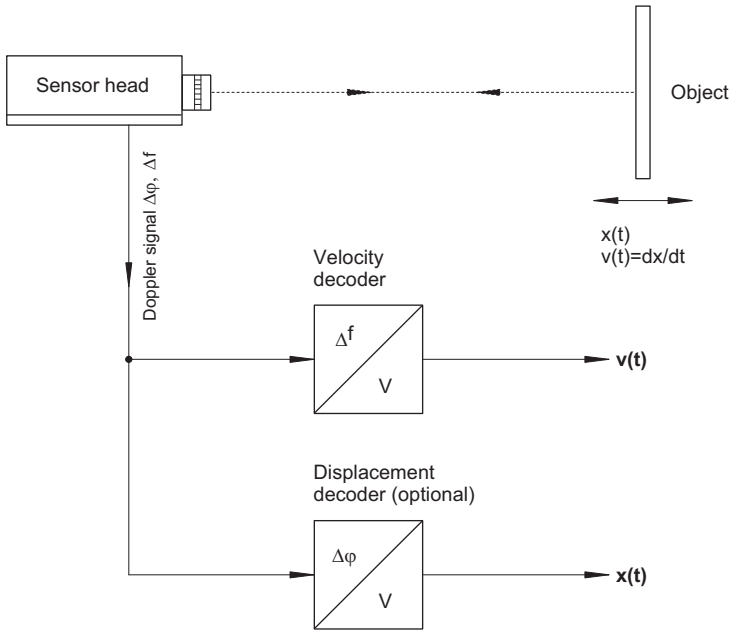


Figure 2.1: Signals in the vibrometer

3 First Steps

3.1 Unpacking and Inspection

Unpacking

The vibrometer is made up of the following components:

- Sensor head OFV-525
- Connecting cable from the controller to the sensor head (length 5 m)
- Controller

NOTE !

The controller is described in detail in a separate manual!

Optional:

- Tripod with pan-tilt stage VIB-A-T04
- Tripod with geared pan-tilt stage VIB-A-T05
- Tilt stage VIB-A-P01
- Traverse-tilt stages VIB-A-P02 and VIB-A-P06
- Tip-tilt stage VIB-A-P05 with targeting telescope
- Side exit adapter OFV-C-128

CAUTION !

Danger from hard jolting! - Protect the unpacked sensor head from being shaken as this can lead to the interferometer becoming misaligned!

CAUTION !

Danger from scratching! - Handle the front lens with great care! Dirt may only be removed carefully using a soft, dry cloth, an optics brush and bellows!

Inspection

Please pay attention to the following steps when unpacking:

1. Check the packaging for signs of unsuitable handling during transport.
2. After unpacking, check the sensor head for external damage (scratches, loose screws, damaged lenses etc.).
3. In the case of a wrong delivery, damage or missing parts, please inform your local Polytec representative immediately and give them the serial number of the sensor head. The identification label can be found on the back of the device and also on the inside cover of this manual.
4. Carefully retain the original packaging in case you have to return the instrument.

Install the vibrometer and carry out a first functional test as described in the controller manual.

3.2 Operating and Maintenance Requirements

Ambient conditions

The vibrometer can be operated in dry rooms under normal climatic conditions (refer to the specifications in CHAPTER 7). In particular the optical components in the sensor head are sensitive towards moisture, high temperatures, shocks and dirt.

If the vibrometer is taken into operation after being stored in a cold environment, a sufficient acclimatization period should be allowed before switching it on. Avoid condensation on the optical components caused by a rapid change in temperature.

Assembly

The sensor head should not be positioned provisionally but mounted properly on an optional adapter plate or a stable tripod using the mounting thread provided.

NOTE !

Before mounting the sensor head on an optional adapter plate, **remove** the rubber feet on the bottom side of the sensor head!

NOTE !

In addition, make sure that only the indicated mounting surface is used as a support (refer to FIGURE 7.3)! A distortion of the sensor head caused by additional touch points may affect the interferometer.

Cooling

It is very important to ensure that there is sufficient air circulation to cool the sensor head.

Connecting cable

As a general rule, the vibrometer may not be switched on until all connecting cables have been connected up. Make sure that all connectors are connected properly and firmly. Protect all connecting cables from mechanical damage and from high temperatures.

Warming-up

The helium neon laser in the sensor head will take a little while to reach the optimal operating temperature after it has been switched on. The vibrometer therefore reaches its optimal properties after a warm-up period of approx. 20 minutes. After that you can be sure that all components are working properly in accordance with the specifications. Less accurate measurements, such as to align the vibrometer for example, can however be carried out with usefully results before this warm-up period has expired.

Cleaning

The housing surface of the sensor head can be cleaned with mild detergent or disinfectant solutions. Organic solvents must not be used.

Optical components

Handle all optical components with great care. Dirt may only be removed carefully using a soft, dry cloth, an optics brush and bellows.

Opening the instruments

Opening up of the equipment without authorization is not necessary for its operation and will invalidate the warranty.

3.3 Control Elements

The views of the sensor head OFV-525 are shown in FIGURE 3.1.

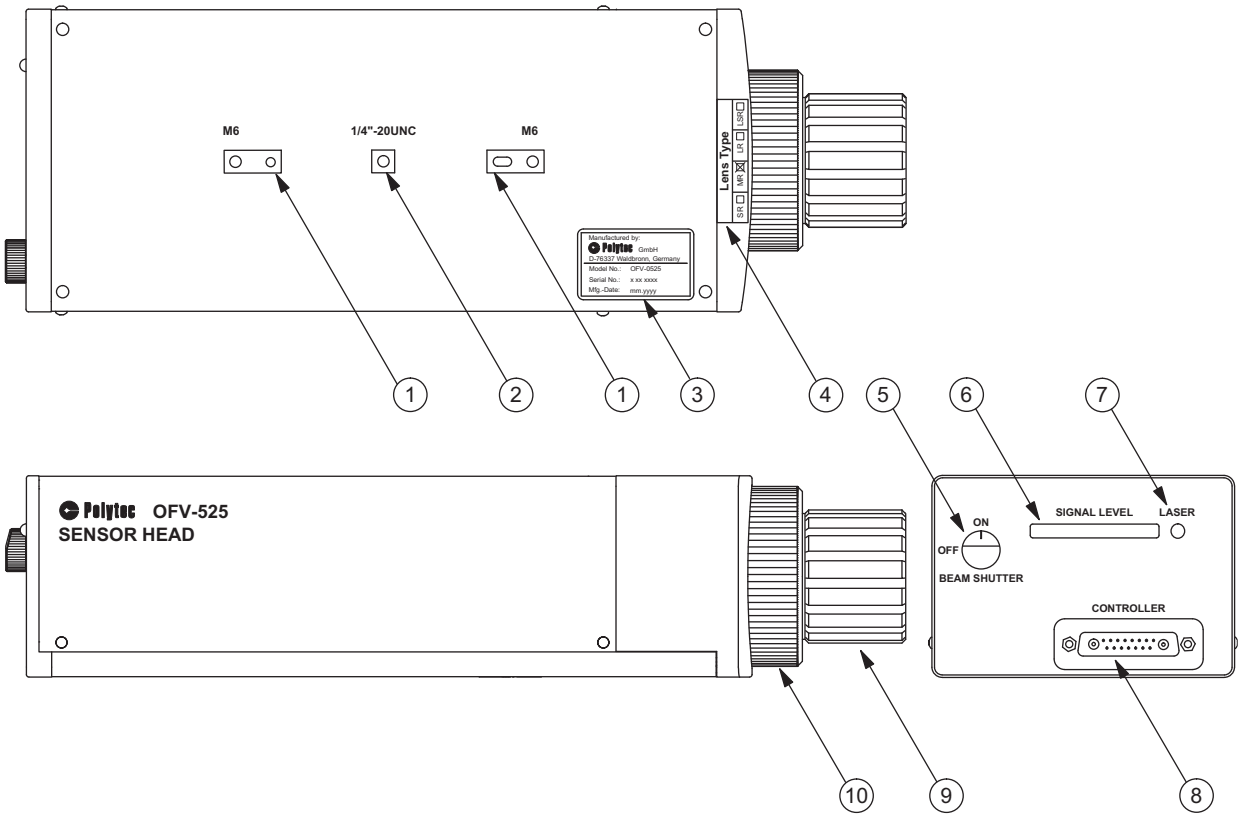


Figure 3.1: Views of the sensor head OFV-525

1 Mounting thread **M6** and drill holes

Using these two mounting threads the sensor head can be mounted on one of the optional adapter plates. The dimensions of the mounting threads and the drill holes can be found in the technical drawing in SECTION 7.2.

NOTE !

Before mounting the sensor head on an optional adapter plate, **remove** the rubber feet on the bottom side of the sensor head!

2 Mounting thread **1/4"-20UNC**

Using this mounting thread the sensor head can be mounted on camera tripods with thread basing on inch-system.

NOTE !

Before mounting the sensor head on an optional adapter plate, **remove** the rubber feet on the bottom side of the sensor head!

NOTE !

In addition, make sure that only the indicated mounting surface is used as a support (refer to FIGURE 7.3)! A distortion of the sensor head caused by additional touch points may affect the interferometer.

3 Identification label

On the identification label you will find, among other things, the serial number of the instrument.

4 Label for the front lens model

On this label is marked the front lens model which is installed.

NOTE !

If you exchange the front lens, you should adapt the label.

5 Rotary knob **BEAM SHUTTER ON/OFF** for the beam shutter

In position OFF the laser beam is blocked.

WARNING !

Danger from laser light! - Only open the beam shutter when you are making measurements!

6 Signal level display **SIGNAL LEVEL**

The length of the bar is a measure of the amount of light scattered back from the surface to be measured.

7 LASER-LED

The Led lights up, when the laser is switched on (key switch on the controller in position I), i.e. even if the beam shutter is closed (refer to SECTION 5.2).

8 CONTROLLER connection (Sub-D jack)

Connector for the connecting cable to the controller

9 Front lens

A label on the bottom side of the sensor head shows which front lens model is fitted. Exchange of the front lens is described in SECTION 5.8.

10 Focusing ring

Ring for manual focusing of the laser beam (refer to SECTION 5.5)

3.4 Installation

To install the sensor head, please proceed as follows:

Assembly

1. Mount the sensor head on a stable tripod or an optional adapter plate using the threads provided (refer to SECTION 3.2).

> **NOTE !**
>
> **Before** mounting the sensor head on an optional adapter plate, **remove** the rubber feet on the bottom side of the sensor head!

> **NOTE !**
>
> In addition, make sure that only the indicated mounting surface is used as a support (refer to FIGURE 7.3)! A distortion of the sensor head caused by additional touch points may affect the interferometer.

Preparing

2. Make sure that the key switch or the mains switch respectively on the controller is in position O and the beam shutter on the sensor head is in position OFF.
3. If applicable for your controller, check the setting on the mains voltage selector as well as the fuses on the back of the controller.

Cabling

4. Plug the connecting cable into the Sub-D jack CONTROLLER on the back of the sensor head and into the corresponding Sub-D jack on the back of the controller. Secure all the connections with the screws provided.

   All connections must be easy to plug in. If not, check the plugs for bent contact pins to avoid serious damage being incurred.
5. Use the mains cable to connect up the controller to an earthed socket.

Now carry out a first functional test as described in the user manual of the controller.

4 Setting up the Optimal Stand-Off Distance

4.1 Coherency between Stand-off Distance and Visibility Maximum

Visibility Maxima

The light source of the vibrometer is a helium neon laser. This is a multimode laser in which, depending on the laser cavity length, one or a maximum of two modes can exist. The laser cavity length can vary caused by small changes in temperature. Thus the laser changes between the status of having one or two modes. If two modes exist, interference effects cause the intensity of the resulting optical signal varying periodically with the stand-off distance.

The diagram in FIGURE 4.1 shows the signal level depending on the stand-off distance. In the special case of having two modes with equal magnitude (black line), you have the strongest loss of signal level if the object is located inside a visibility minimum. But generally there are two modes of different magnitudes. In this case the signal level is hardly fluctuating (gray line). If only one mode exists, the signal level is always maximum, independent from the stand-off distance (dashed gray line).

The stand-off distances at which the signal level is maximal are called visibility maxima. The visibility maxima recur every 204 mm (±1 mm) corresponding to the laser cavity length.

Generally it is not necessary to search for the visibility maximum as the vibrometer is sensitive enough to make a measurement even close to the minimum. A visibility minimum is indicated during the warm-up phase by periodic fluctuation of the optical signal level. If you need an optimal resolution and sensitivity, you should select a stand-off distance close to the visibility maximum. As a rule of thumb it can be said that the resolution and the sensitivity just degrades insignificantly in the range of ±90 mm around the visibility maximum.

Stand-off distance

The stand-off distance is measured from the front edge of the focusing ring (refer to SECTION 4.1).

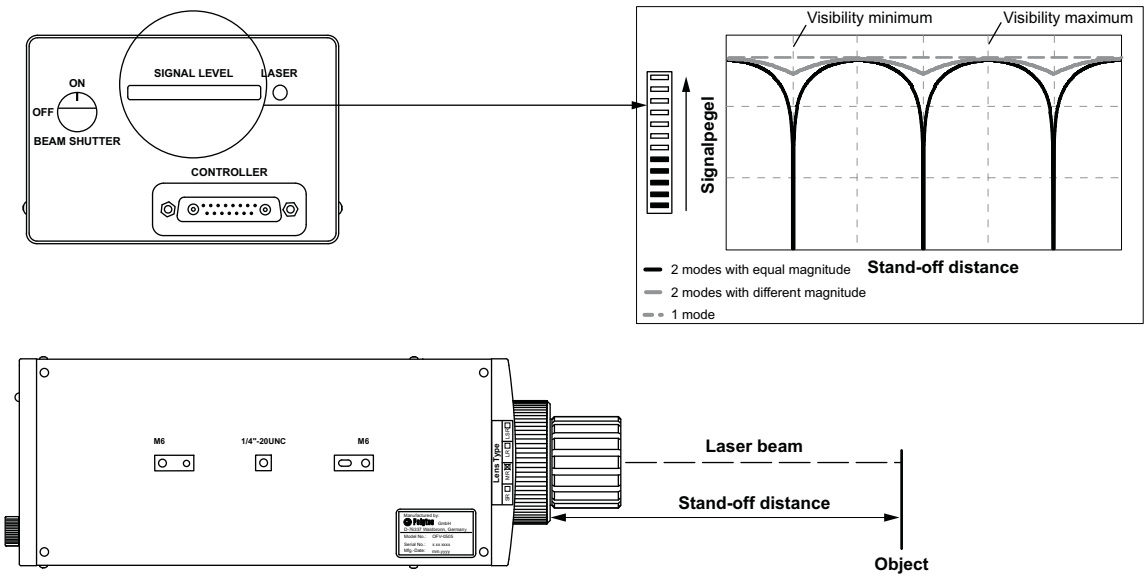


Figure 4.1: Measuring the stand-off distance

4.2 Stand-Off Distance for the Sensor Head

The optimal stand-off distances for the sensor head are shown in FIGURE 4.2.

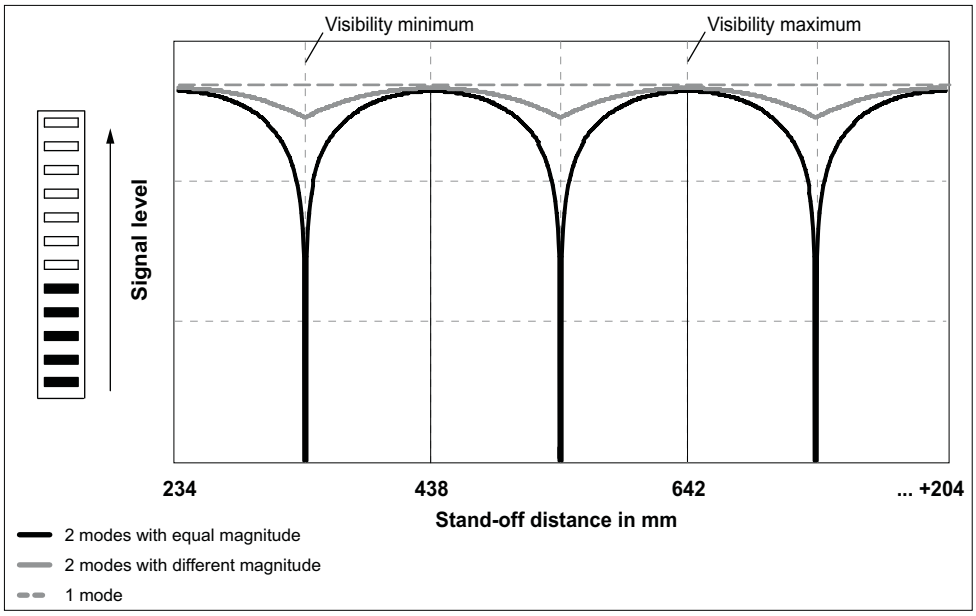


Figure 4.2: optimal stand-off distance

The visibility maxima for the sensor head are at:

Positions of the visibility maxima = 234 mm + (n x l) mm

n = 0; 1; 2; ... l = 204 mm ± 1 mm

i.e. for l = 204 mm the optimal stand-off distances are:
234 mm; 438 mm; 642 mm etc., refer also to SECTION 7.3 and SECTION 7.4.

5 Operating the Sensor Head

5.1 Switching On and Off

The vibrometer is switched on by using the key switch on the front panel of the controller. To do so, turn the key switch in position I. The LED POWER above the key switch lights up and shows that the controller is ready to operate.

Some vibrometers are switched on by using the mains switch on the back of the controller. To do so, press the mains switch in position I. The LED POWER on the front panel of the controller lights up and shows that the controller is ready to operate.

Providing the connecting cable from the controller to the sensor head has been correctly installed, the LED LASER on the back of the sensor head also lights up and shows that the sensor head is ready to operate and that the laser is active, even if the beam shutter is closed (refer to SECTION 5.2).

5.2 Blocking the Laser Beam

The sensor head is equipped with a beam shutter. This can be used to block the laser beam without switching off the laser. This keeps the system in a thermal equilibrium.

The rotary knob for the beam shutter is on the back of the sensor head and is labeled LASER ON/OFF. To block the laser beam, turn the knob clockwise until the mark points at OFF.

WARNING !

Danger from laser light! - Only open the beam shutter when you are making measurements!

WARNING !

Danger from laser light! - To position the sensor head, always close the beam shutter. The beam shutter should not be opened until the sensor head has been roughly aligned and mounted securely!

5.3 Indicating Laser Activity

On the back of the sensor head the Led LASER indicates the laser activity. The LED is lit when the laser is active (key switch on the front or respectively mains switch on the back of the controller is position I). The LED is lit regardless of whether the beam shutter is open or closed.

5.4 Positioning the Sensor Head

NOTE !

Before mounting the sensor head on an optional adapter plate, **remove** the rubber feet on the bottom side of the sensor head!

NOTE !

In addition, make sure that only the indicated mounting surface is used as a support (refer to FIGURE 7.3)! A distortion of the sensor head caused by additional touch points may affect the interferometer.

Tripod

Using the mounting thread 1/4"-20UNC you can mount the sensor head on commercially available camera tripods and position it.

Tip-tilt stage

If your vibrometer is equipped with a tripod and a tip-tilt stage VIB-A-P05, you can manually setup the sensor head very exactly and optimally adjust it to the object under investigation using the targeting telescope. See section SECTION A.2 on this.

Stand-off distance

During setup of the sensor head, please pay also attention to the information on optimal stand-off distances provided in CHAPTER 4.

5.5 Focusing the Laser Beam

To get the highest possible quality of the measurement signal, the laser beam has to be optimally focused. The laser beam is optimally focused when the diameter of the laser beam target area on the object is as small as possible. Due to overload effects on the target area, it is often difficult to ascertain when the smallest diameter has been reached. For this reason you can view the signal level display either on the sensor head. The more signal level is shown, the better the focus of the laser beam.

As the actual aim of focusing is to minimize the undesired noise signals, you can also orientate yourself directly towards the output signal from the controller when focusing. Observe the output signal e.g. on an oscilloscope while focusing the laser beam on the object under investigation. The better the focus of the laser beam, the smaller the amplitude of the noise. See the user manual of the controller on this.

OFV-525

There are different ways to focus the laser beam of the sensor head OFV-525:

- Manually with the focusing ring on the sensor head

Only for using the OFV-5000 controller:

- Remotely via the display of the controller
- Remotely with a PC via the interface RS-232 on the controller
- Automatically via the display of the controller

Manual Focusing

You can focus the laser beam manually by turning the focusing ring on the sensor head.

WARNING !

Danger from laser light! - Avoid looking directly into the laser beam with the naked eye or with the aid of mirrors or optical instruments!

When you are looking onto the front panel of the sensor head, the following applies:

- To focus on infinity: Turn clockwise (to the right)
- To focus close-up: Turn counterclockwise (to the left)

Remote Focusing

You can focus the laser beam remotely:

- Via the display of the controller as described in the user manual of the controller
- Via the RS-232 interface on the controller as described in the separate manual

Automatic Focusing (Autofocus)

When switching on the vibrometer the sensor head OFV-525 is focused automatically. You can also focus the laser beam automatically via the display of the controller or using interface commands as described in the manual of the controller.

NOTE !

You can focus the sensor head OFV-525-KA automatically only via interface commands.

OFV-503

You can only focus the laser beam manually by turning the focusing ring on the sensor head.

WARNING !

Danger from laser light! - Avoid looking directly into the laser beam with the naked eye or with the aid of mirrors or optical instruments!

When you are looking onto the front panel of the sensor head, the following applies:

- To focus on infinity: Turn clockwise (to the right)
- To focus close-up: Turn counterclockwise (to the left)

5.6 Locking the Manual Focus

The laser beam can at any time be focused manually directly using the focusing ring on the sensor head. This manual focus can be locked remotely from the controller for the sensor head OFV-525. This stops you unintentionally defocusing the laser beam. The focusing ring on the sensor head can then still be rotated, but this rotation has no longer any effect on the optics in the sensor head and thus on the focus of the laser beam.

To lock the manual focus via the controller refer to the user manual of the controller.

5.7 Using the Signal Level Display

The signal level display helps you to optimize the focus of the laser beam. The signal level is shown on the back of the sensor head as a 10-part bar display.

5.8 Exchanging the Front Lens

By using different front lenses for the sensor head the vibrometer can be optimally adapted to different ranges of stand-off distances and to different requirements of the depth of field. The longer the focal length of the objective the higher is the signal level at the same stand-off distance whereas the depth of field decreases (refer to diagrams in FIGURE 7.1 and FIGURE 7.2).

The signal level decreases if the vibrometer is defocused. In the following the depth of field is defined as the distance, at which the signal level is less than 3 dB in respect to the value when the vibrometer is optimally focused.

Front lens models

As a general rule the sensor head is equipped with the standard front lens **OFV-LR** (Long Range) that is suitable for stand-off distances from 530 mm to over 100 m.

But the following front lens models are available on request:

- **OFV-SR** (Short Range) for stand-off distances from 60 mm to 5 m
- **OFV-MR** (Mid Range) for stand-off distances from 185 mm to over 10 m
- **OFV-SLR** (Super Long Range) for stand-off distances from 1800 mm to over 300 m

A label on the bottom side of the sensor head shows the front lens model which is fitted.

The components of the front lens mount are shown in FIGURE 5.1.

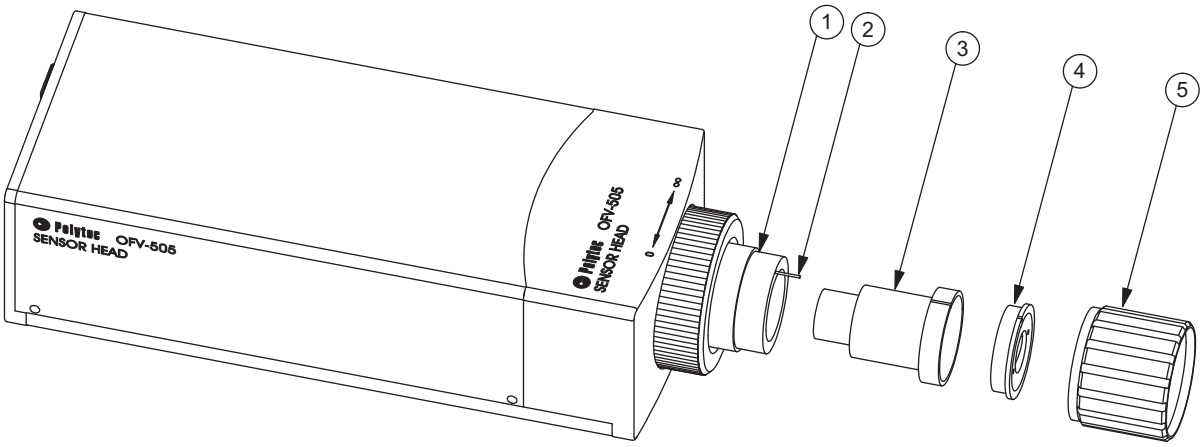


Figure 5.1: The components of the front lens mount

Exchange

To exchange the front lens, proceed as follows:

CAUTION !

Danger from contamination! - Make sure that everything is kept clean and take great care when exchanging the front lens so that no dirt gets into the housing and the optical components are not damaged!

1. Turn the threaded cover **5** counterclockwise until it can be removed.
2. Remove the mount **4** for the λ/4 plate and put it aside.
3. Carefully pull the front lens **3** out of the lens mount **1**.
4. Carefully put the new front lens into the lens mount. Turn it in the lens mount until the pin **2** of the lens mount slots into place into the slit of the front lens.
5. Put the λ/4 mount **4** into the front lens in such a way that the pin **2** of the lens mount slots into place in the slit of the λ/4 mount.
6. Turn the threaded cover **5** on the lens mount until it is securely seated and hand-tighten the cover.

6 Fault Diagnosis

Simple tests are described in the following for you to carry out yourself in the case of malfunction. In the case of more difficult problems with the individual functions, please contact our service personnel. The tests described here are not meant to lead you to carry out maintenance work yourself, but to provide our service personnel with information which is as accurate as possible.

Checking the vibrometer is limited to such tests in which the housing does not have to be opened. Opening the housing without authorization invalidates the warranty.

If required, please contact our service department. Based on your fault description, further procedure will be determined.

If the vibrometer has to be sent back for repair, always use the original packaging and enclose an exact description of the fault.

Please use the corresponding checklist in the user manual of your controller if you contact Polytec or your nearest representative.

6.1 No Laser Beam

If no laser beam is emitted, please check the following:

1. Has the connecting cable between the controller and the sensor head been installed correctly?
2. Have the plugs on the connecting cable been screwed in?
3. Does the LED LASER on the back of the sensor head light up?

WARNING !

Danger from electrical current! - Working on an open housing can lead to personal injury !

NOTE !

Before checking the fuses, as a general rule the mains plug must be disconnected!

If the LED is not lit up, it can be assumed that there is a fault in the mains supply of the controller. Disconnect the mains plug and check the fuses on the back of the controller. Please note that there are two active fuses which can both lead to failure.

4. Is the beam shutter on the back of the sensor head in position ON?
5. After approximately 20 minutes operation, does the housing of the sensor head feel warm to the touch as normal, indicating that the laser beam is operating?

6.2 No Measurement Signal

If the laser beam is emitted but there is no measurement signal, please check the following: To do so, proceed as follows:

1. Put the reflective film in the beam path according to the information on optimal stand-off distances given in CHAPTER 4.

2. Focus the laser beam on the reflective film. Does the signal level display light up?

   If the signal level display does not light up, then the input section of the controller is faulty.

If the malfunction can not be sorted through the tests described above, then proceed with the fault diagnosis as described in the user manual of your controller.

7 Technical Specifications

7.1 Standards Applied

Laser safety:	IEC/EN60825-1:2003-10 (Safety of Laser Products, complies to US 21 CFR 1040.10 and 1040.11, except for deviations pursuant to Laser Notice no. 50, dated 26 July 2001)
Electrical safety:	IEC/EN 61010-1:2002-08 (Safety requirements for electrical equipment for measurement, control and laboratory use)
EMC:	IEC/EN 61326 -1:2006-10 (EMC requirements on Emission and Immunity - Electrical equipment for measurement, control and laboratory use)
Emission:	FCC Class B IEC/EN 61000-3-2 and 61000-3-3
Immunity:	IEC/EN 61000-4-2 to 61000-4-6 and IEC/EN 61000-4-11

NOTE !

The standards about electrical safety and EMC above are only valid with from Polytec licensed controllers. You will find the corresponding declaration of conformity in the user manual of the controller.

7.2 General Data

Laser

Laser type:	helium neon
Wavelength:	633 nm
Cavity length:	204 mm ±1 mm
Laser class:	2
Laser power:	< 1 mW

Electrical Data

Power consumption:	approx. 15 W
Carrier frequency:	80 MHz

Ambient Conditions

Operating temperature:	+5°C...+40°C (41°F...104°F)
Storage temperature:	−10°C...+65°C (14°F...149°F)
Operating altitude:	max. 3048 m (10000 ft)
Relative humidity:	max. 80 %, non-condensing

Housing

Dimensions: refer to SECTION 7.4

Weight: 3.4 kg

7.3 Optics

Characteristics

Front lens[1]		Short Range (SR)	Mid Range (MR)	Long Range (LR)	Super Long Range (SLR)
Focal length	[mm]	30	60	100	200
Minimum stand-off distance[2]	[mm]	60	185	530	1800
Aperture diameter ($1/e^2$)	[mm]	3.4	6.8	11.3	22.6
Spot diameter (typ.)	[µm]				
@ 100 mm		25	-	-	-
@ 200 mm		49	25	-	-
@ 500 mm		121	54	18	-
@ 1000 mm		245	112	62	-
@ 2000 mm		500	235	135	60
@ 3000 mm		750	356	210	96
@ 5000 mm		1260	604	356	168
every additional meter plus		240	126	74	36
Depth of field[3] (2 m distance)	[m]	1	0.2	0.1	0.03
Visibility Maxima[4]	[mm]	234 mm + (n · l); n = 0, 1, 2, ...; l = 204 mm ±1 mm			

[1] A label shows which front lens model is installed. The label for the front lens is affixed on the bottom side of the sensor head (refer to FIGURE 7.2)

[2] Measured from the front side of the focusing ring. The maximum stand-off distance depends on the backscattering properties of the object and can be up to 300 m on a reflective surface.

[3] Max. loss of signal of the focusing ring is 3 dB

[4] Measured from the front side of the focusing ring.

Characteristic Diagrams of the Front Lens Models

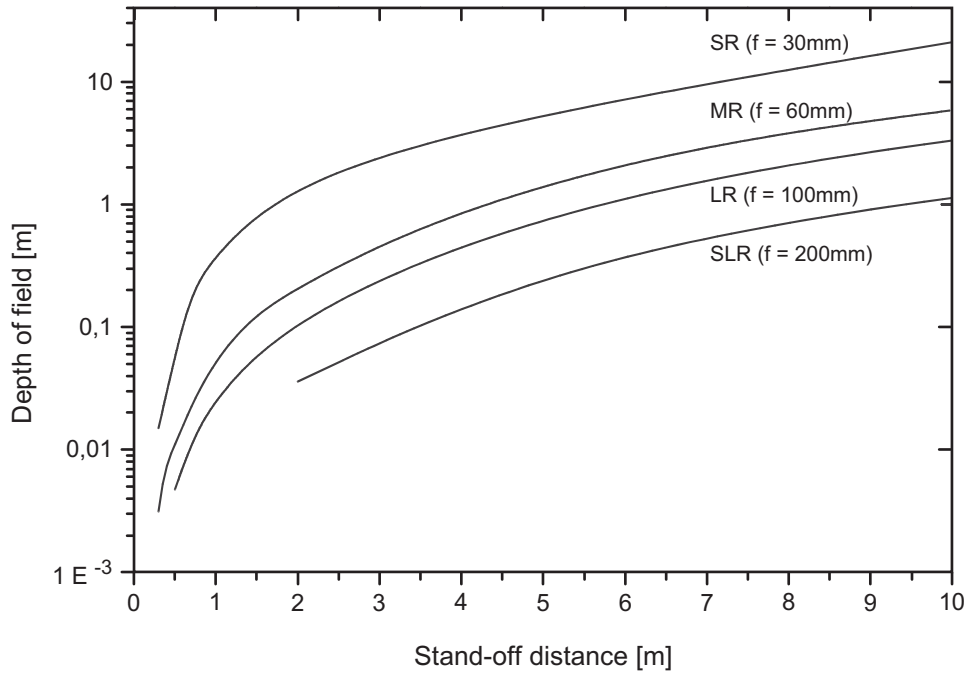


Figure 7.1: Depth of field subject to the stand-off distance

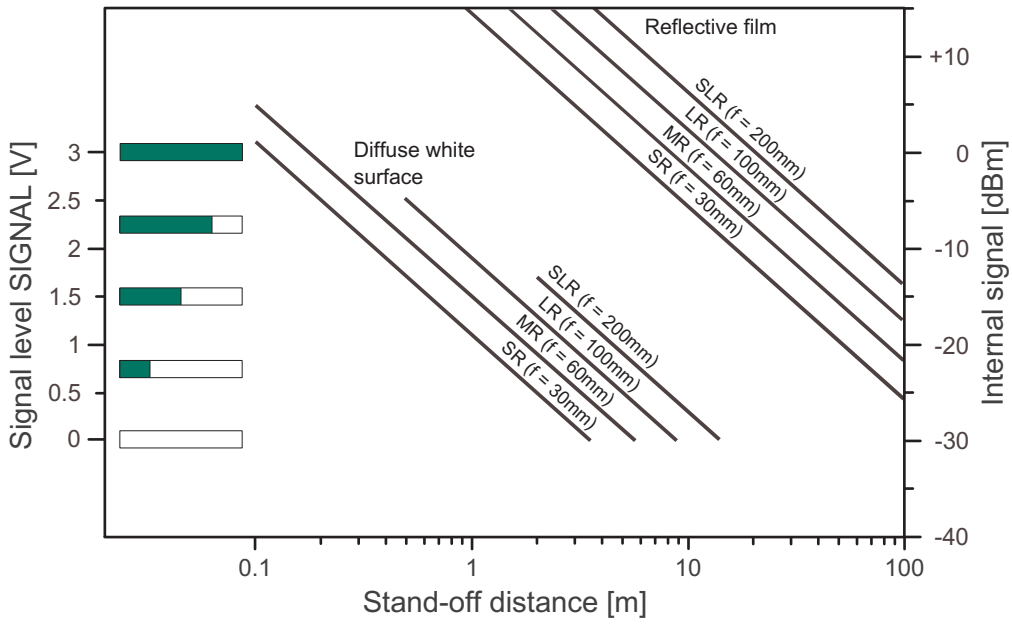


Figure 7.2: Signal level subject to the stand-off distance, measured on a diffuse white surface and 3M Scotchlite Tape® (reflective film)

Table of the Visibility Maxima

Visibility maxima (in mm) for l = 204 mm					
234	1866	3498	5130	6762	8394
438	2070	3702	5334	6966	8598
642	2274	3906	5538	7170	8802
846	2478	4110	5742	7374	9006
1050	2682	4314	5946	7578	9210
1254	2886	4518	6150	7782	9414
1458	3090	4722	6354	7986	9618
1662	3294	4926	6558	8190	...

7.4 Dimensions

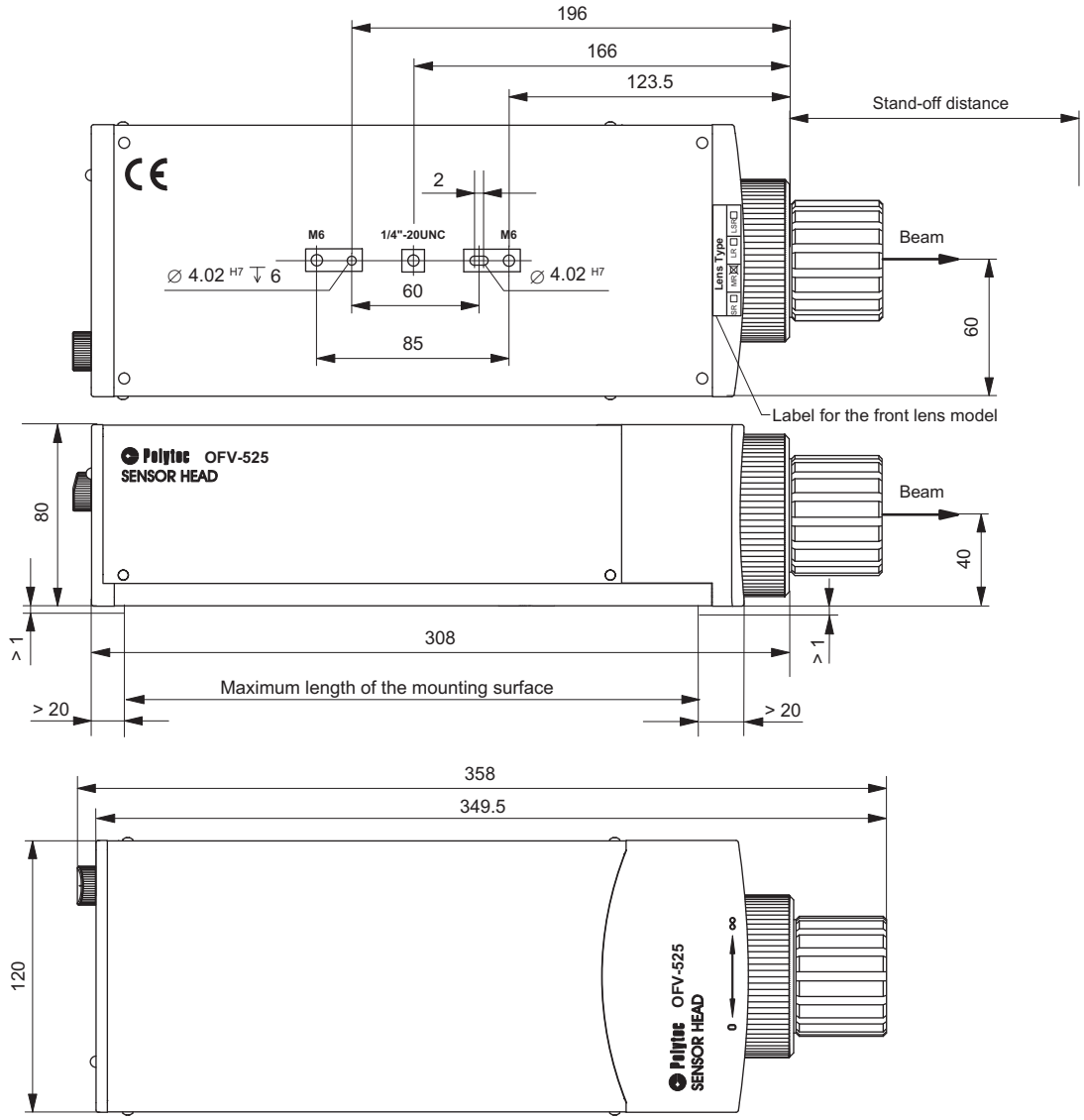


Figure 7.3: Views of the sensor head (Dimensions not specified are given in mm)

NOTE !

Before mounting the sensor head on an optional adapter plate, **remove** the rubber feet on the bottom side of the sensor head!

NOTE !

In addition, make sure that only the indicated mounting surface is used as a support (refer to FIGURE 7.3)! A distortion of the sensor head caused by additional touch points may affect the interferometer.

Appendix A: Optional Accessories for the Sensor Head

A.1 Side Exit Adapter OFV-C-128

Using the side exit adapter OFV-C-128 the laser beam can be deflected by 90 degrees. Thus the use of the sensor head OFV-525 on otherwise inaccessible parts is allowed. The telescopic front tube can be rotated by 360 degrees and it can be extended from 297 mm to 377 mm. The maximum of visibility lies between 70 mm and 150 mm from the protective window, depending on the telescopic extension. The side exit adapter is shown in FIGURE A.1.

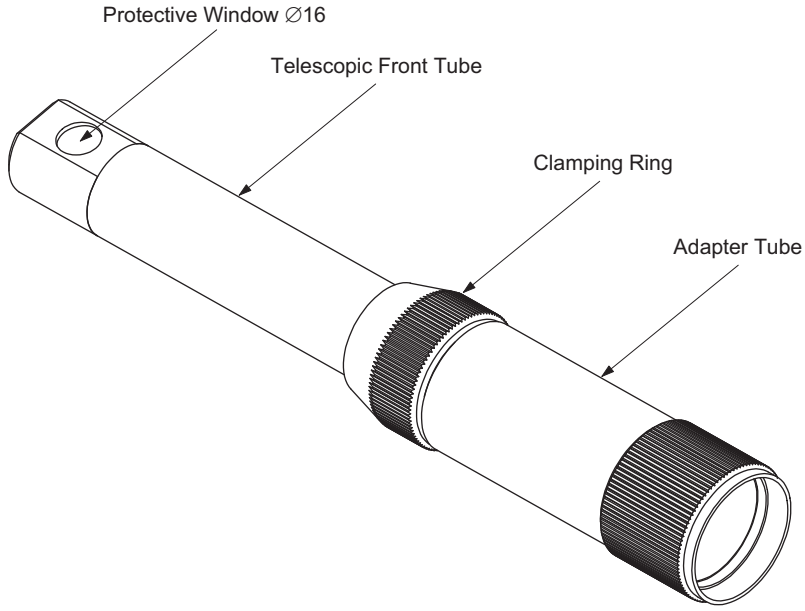


Figure A.1: Side exit adapter OFV-C-128

The high sensitivity of the sensor head OFV-525 is maintained because a high reflectivity mirror is used and the protective window is tilted.

CAUTION !

Danger from contamination! - Always take great care to keep the protective window clean!

Assembly

To mount the side exit adapter, proceed as follows:

1. Turn the threaded cover on the front lens of the sensor head anti-clockwise until it can be removed.

2. Screw the side exit adapter on the front lens in its place. Please store the threaded cover in a safe place to be used again when returning to normal operation.

3. To extend or rotate the telescopic front tube, release the chromium-plated clamping ring one or two turns. Position the tube as required and tighten the clamping ring again before taking the sensor head into operation.

A.2 Tip-Tilt Stage VIB-A-P05 with Targeting Telescope

The VIB-A-P05 is a tip-tilt assembly which allows fine positioning of the laser beam when working at long distances. With this unit the laser beam can be tilted ±1.5 degrees in horizontal direction and ±1 degree in vertical direction (refer to the dimensions in FIGURE A.3). The telescope is fitted with an interference filter for the laser wavelength (633 nm) to enhance the spot in the daylight. The ready assembled tip-tilt stage is shown in FIGURE A.2.

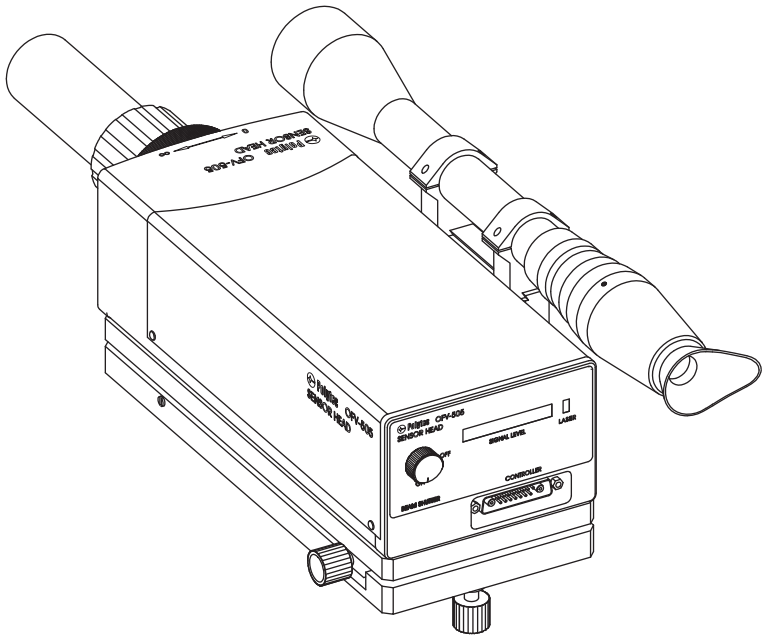


Figure A.2: Tip-tilt stage VIB-A-P05 with fitted targeting telescope and sensor head

The underside of the assembly has standard M6 and 1/4” threads as well as the mountings for the quick release plate for Manfrotto tripod systems (refer also to FIGURE A.3).

Technical Specifications

Tilt in horizontal direction:	±1.5°
Tilt in vertical direction:	±1°
Weight tip-tilt stage:	2.4 kg
Weight incl. targeting telescope:	3.0 kg
Dimensions:	refer to FIGURE A.3

Dimensions

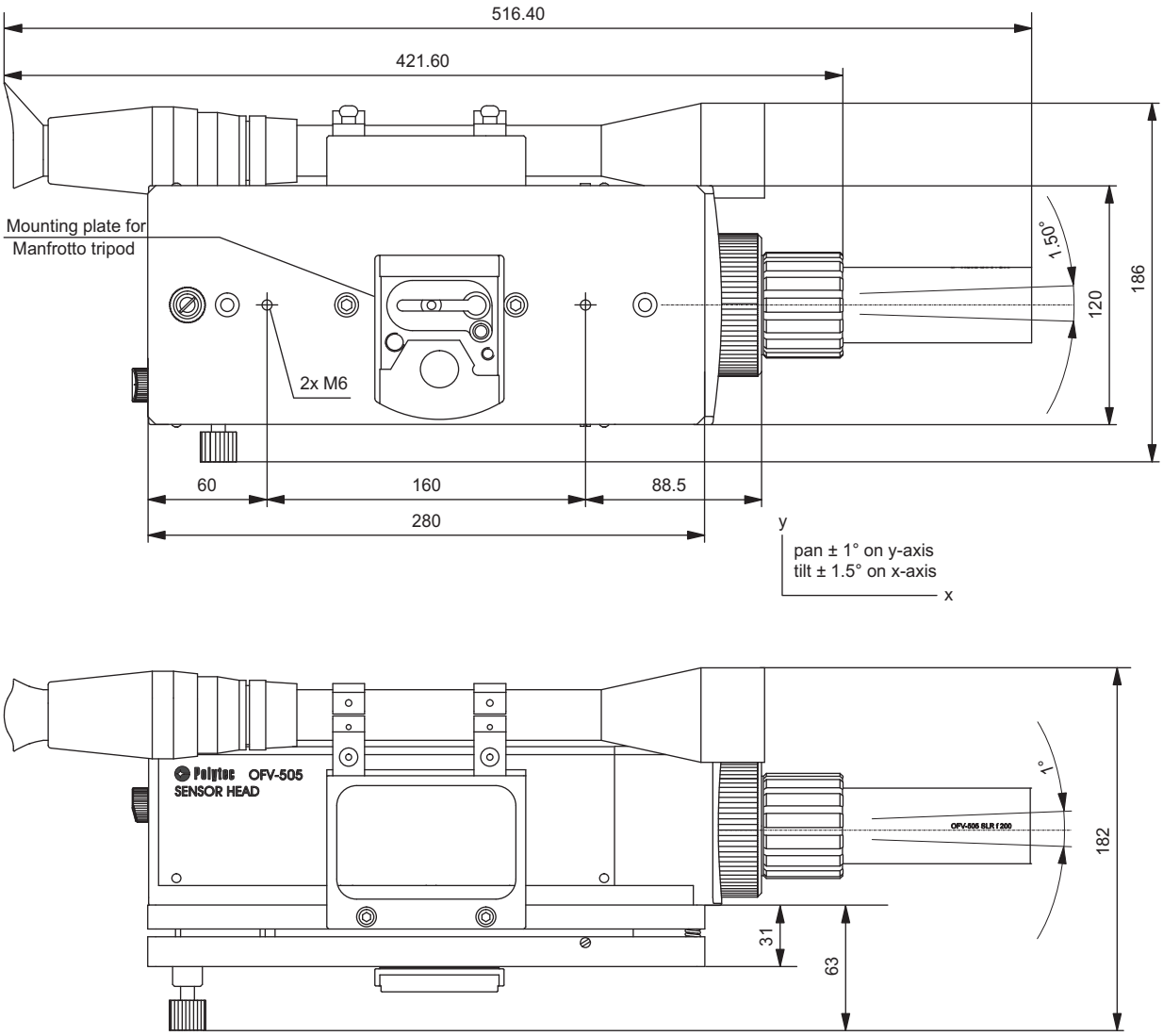


Figure A.3: Bottom view and side view of the VIB-A-P05 with fitted targeting telescope and sensor head (Dimensions not specified are given in mm)

Appendix B: Basics of the Measurement Procedure

B.1 Theory of Interferometric Velocity and Displacement Acquisition

Optical interference can be observed when two coherent light beams are made to coincide. The resulting intensity e.g. on a photo detector varies with the phase difference φ between the two beams according to the equation

$$I(\varphi) = \frac{I_{max}}{2} \cdot (1 + \cos\varphi) \qquad \text{Equation B.1}$$

The phase difference φ is a function of the optical path difference L between the two beams according to

$$\varphi = 2\pi \cdot \frac{L}{\lambda} \qquad \text{Equation B.2}$$

whereby λ is the laser wavelength.

If one of the two beams is scattered back from a moving object (the object beam), the path difference becomes a function of time L = L(t). The interference fringe pattern moves on the detector and the displacement of the object can be determined using directionally sensitive counting of the passing fringe pattern.

The velocity component in the direction of the object beam is a function of the path difference L according to

$$\frac{dL(t)}{dt} = v(t) \cdot 2 \qquad \text{Equation B.3}$$

For a constant movement v

$$\left|\frac{dL(t)}{dt}\right| = \frac{\lambda}{2\pi} \cdot \left|\frac{d\varphi}{dt}\right| = f_D \cdot \lambda = |v| \cdot 2 \qquad \text{Equation B.4}$$

applies with

$$f_D = 2 \cdot \frac{|v|}{\lambda} \qquad \text{Equation B.5}$$

Thus a constant movement of the object causes a frequency shift at the object beam which is called Doppler shift f_D. Superimposing object beam and internal reference beam, i.e. two electromagnetic waves with slightly different frequencies, generates a beat frequency at the detector which is equal to the Doppler shift. The ratio B.5 to determine the velocity is, however, independent of its sign. The direction of the velocity can be determined by introducing an additional fixed frequency shift f_B in the interferometer to which the Doppler shift is added with the correct sign.

Thus the resulting frequency at the detector f_{mod} is given by

$$f_{mod} = f_B + 2 \cdot \frac{v}{\lambda} \qquad \text{Equation B.6}$$

Interferometers of this type which are directionally sensitive are described as heterodyne.

B.2 Optical Configuration in the Sensor Head

In Polytec's vibrometers, velocity and displacement measurement is carried out using a modified Mach-Zehnder interferometer. The optical configuration in the sensor head OFV-525 is shown schematically in FIGURE B.1.

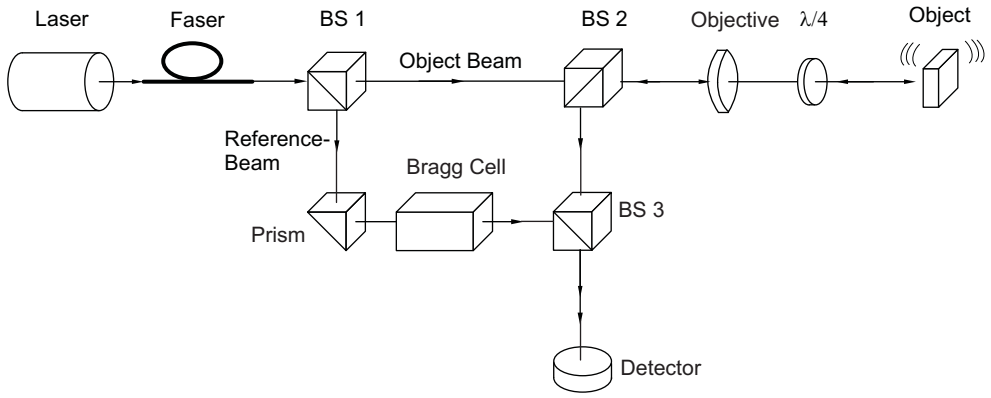


Figure B.1: Optical configuration of the interferometer in the sensor head OFV-525

The light source is a helium neon laser which provides a linear polarized beam. The polarizing beam splitter BS1 splits the beam into the object beam and the reference beam.

The object beam passes through the polarizing beam splitter BS2 as well as a λ/4 plate, is then focused by the lens on the object and scattered back from there. The polarizing beam splitter BS2 then functions as an optical directional coupler together with the λ/4 plate, and deflects the object beam to the beam splitter BS3. The interference signal occur out of the optical path difference between reference and laser beam. The distance to the object goes into the optical path difference with a factor of 2. The objective displays the object at the camera. If the spot diameter on the object is minimal, the video image is sharply focused.

The Bragg cell in the reference arm of the interferometer generates the additional frequency offset to determine the sign of the velocity.

The resulting interference signal of the object beam and reference beam is converted into an electrical signal in the photo detector and subsequently decoded in the controller.

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