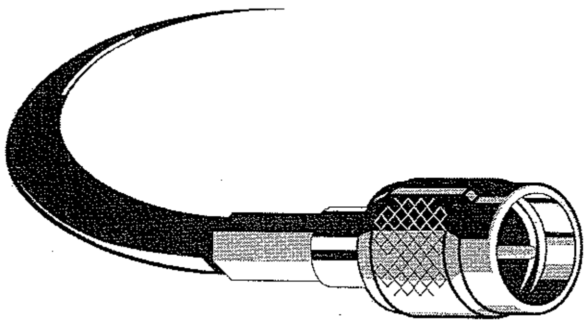
Polytec

Hardware Manual

Polytec Scanning Vibrometer

PSV 300



Controller	OFV-3001 S
Scanning Head	OFV-056

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

Controller

Manufactured by:
Polytec GmbH
D-76337 Waldbronn, Germany
Model No.: OFV−3001SF
Serial No. 1 97 1403
Mfg.-Date: 07.1997

Scanning Head

Manufactured by:
Polytec GmbH
D-76337 Waldbronn, Germany
Model No.: OFV−056
Serial No. 6 02 0858
Mfg.-Date: 05.2002

Pan-Tilt Head

Manufactured by:
Polytec GmbH
D-76337 Waldbronn, Germany
Model No.: PSV−Z−051
Serial No. 5 05 3796 0005
Mfg.-Date: 01.2006

Workstation

Manufactured by:
Polytec GmbH
D-76337 Waldbronn, Germany
Model No.: PSV−W−400M2
Serial No. 4 05 1399
Mfg.-Date: 09.2005

Sensor Head

Test Stand

Junction Box

Manufactured by:
Polytec GmbH
D-76337 Waldbronn, Germany
Model No.: PSV−Z−040 F
Serial No. 5 01 5392 0010
Mfg.-Date: 09.2001

Contents

1 Safety Information

1.1 Laser Safety

The light source of the PSV is a helium neon laser. It is important to understand that laser light has different properties than ordinary light sources. Laser radiation is generally extremely intense due to the beam's low divergence and great care should be taken when handling laser instruments that the direct or reflected beam does not enter the eye. To ensure this, the following precautions have been taken:

- In general, Polytec equipment complies with the standards **EN 60825-1** (DIN VDE 0837) and **CFR 1040.10** (US).
- The optical output of the laser is less than 1 mW providing the equipment is used in the manner for which it was intended. This means that the PSV conforms with **laser class II** and is generally very safe. Even when optimally focused, the laser radiation is not intense enough to harm the skin.
- The scanning head has been equipped with a **mechanical beam shutter** which can be used to block the laser beam during the warm-up phase or when the instrument is not in use, although switched on.
- The **emission indicator** on the scanning head indicates the activity of the laser and thus potential harm caused by emitted laser beams.
- The laser is switched on via a **key switch** on the controller. The key can only be removed when the controller is switched off.
- It is **not necessary to open** the housing of the scanning head when using the PSV as intended. Opening the housing will invalidate the warranty.

Please pay attention to the following **safety precautions** when using the PSV:

- Never look directly into the laser beam with the naked eye or with the aid of mirrors or optical instruments!
- Avoid staying in the scanning area! The laser beam can exit the scanning head at an angle of ±20°!
- Only switch the mechanical beam shutter to the ON position when you are making measurements!
- To position the scanning head, switch the beam shutter to the OFF position. Only when the head is roughly in place and has been fixed in a stable position, switch the beam shutter to ON.
- Do not use any reflective tools, watches etc. when you are working in the path of the laser beam!

1.2 Laser Warning Labels

1.2.1 EC Countries

The laser warning labels for the PSV in EC countries are shown in figure 1.1. Labels 2 and 3 are affixed in the language of the customer's country. Their position on the scanning head is shown in figure 1.2.

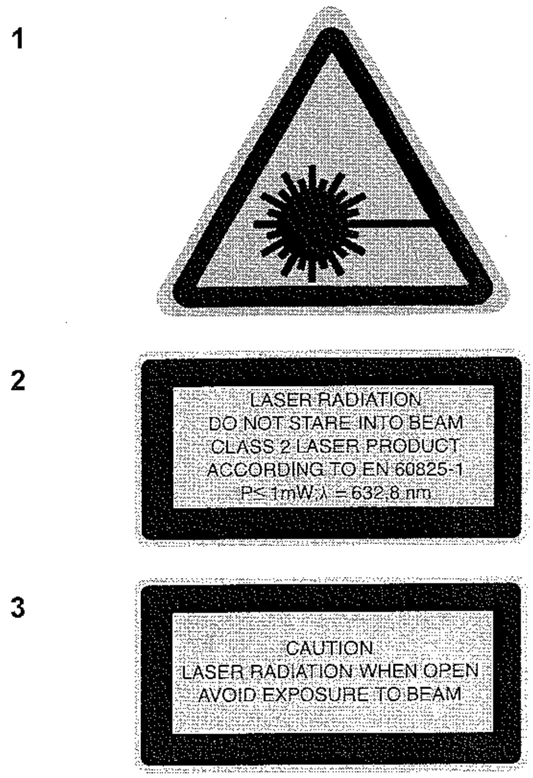


Figure 1.1: Laser warning labels for the PSV in EC countries

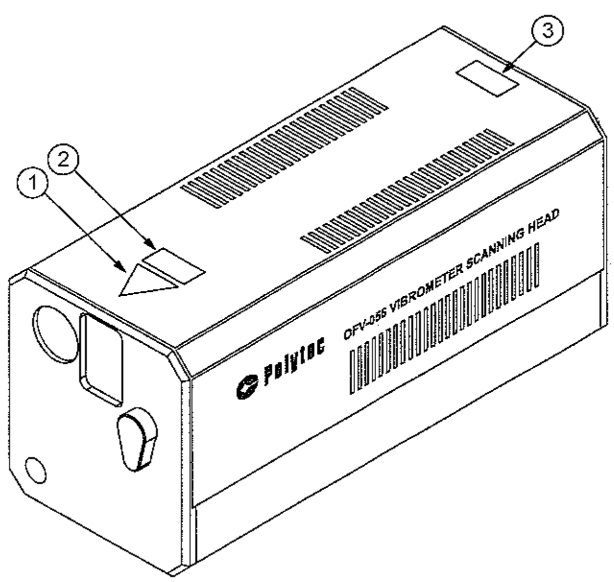


Figure 1.2: Position of the laser warning labels on the scanning head in EC countries

1.2.2 Non-EC Countries

The laser warning labels for the PSV in non-EC countries are shown in figure 1.3. Label **2** is affixed only within the USA. Their position on the scanning head is shown in figure 1.4.

1

CAUTION
LASER RADIATION
DO NOT STARE INTO BEAM
Helium Neon Laser
1 mW max / cw
CLASS II LASER PRODUCT

2

This equipment conforms
to provisions of
US 21 CFR 1040.10 and 1040.11

3

DANGER
Laser radiation when open
AVOID DIRECT EXPOSURE TO
BEAM

Figure 1.3: Laser warning labels for the PSV in non-EC countries

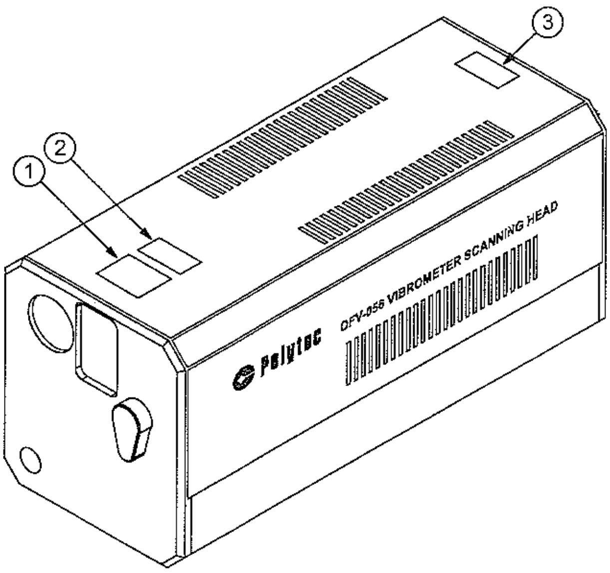


Figure 1.4: Position of the laser warning labels on the scanning head in non-EC countries

1.3 Electrical Safety

The PSV complies with the electrical safety class I. Electrical shock protection is achieved by a fully metallic housing connected to protective ground.

Please pay attention to the following **safety precautions** when using the PSV:

- The PSV controller and the workstation should only be connected via three pin mains cables to an AC mains supply 50/60 Hz with a grounded protective conductor with a nominal voltage which corresponds to the voltage set on the voltage selector.
- The mains voltage input of the workstation can also be designed as a wide range input like the junction box and therefore be connected to all mains voltages with nominal values between 100 V and 240 V.
- Defective mains fuses may only be replaced by fuses of the same kind with their rating given on the back.
- The PSV must not be used with open housing. As a general rule, before removing parts of the housing, the mains cable has to be unplugged.
- Air inlets and outlets must always be kept uncovered to ensure effective cooling. If the cooling fan stops working, the PSV is to be switched off immediately.

2 Introduction

2.1 Area of Application and System Summary

The **P**olytec **S**canning **V**ibrometer **PSV** measures the two-dimensional distribution of vibration velocities on the basis of laser interferometry. The system components are shown in figure 2.1.

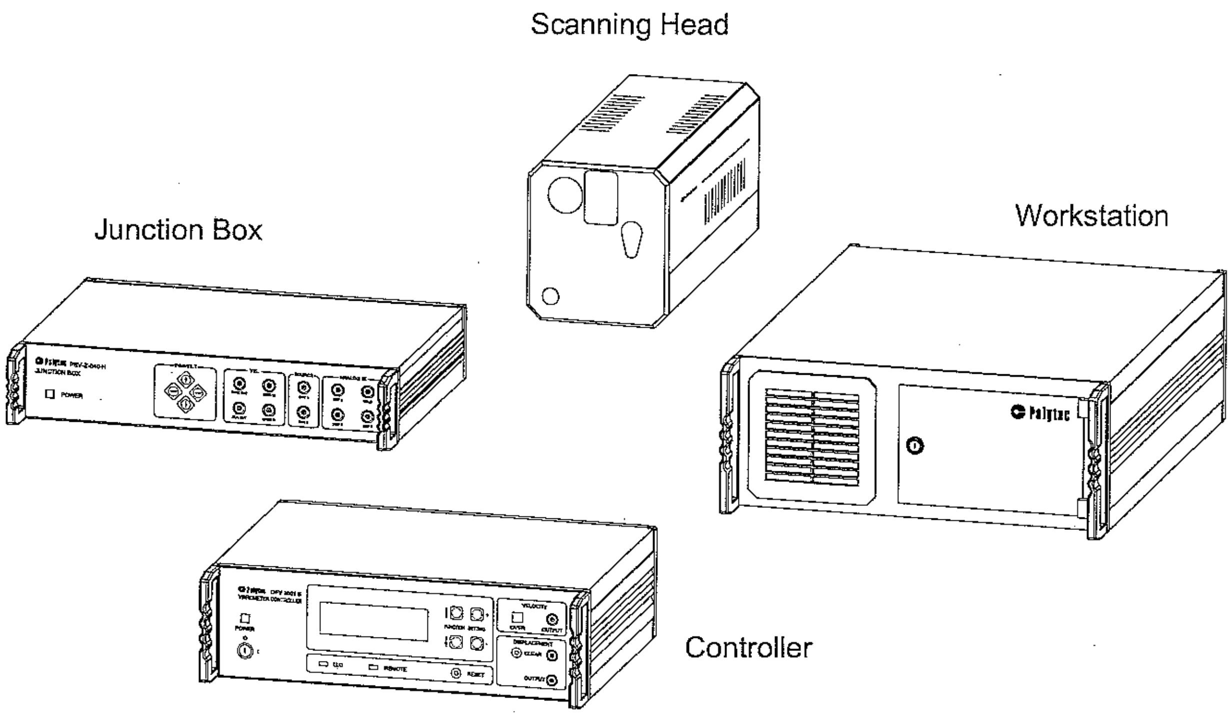


Figure 2.1: System components of the PSV

The interferometer signal is decoded in the **controller** with the velocity decoder. An analog voltage signal is thus generated which is proportional to the vibration velocity.

The **junction box** is the central connection point between the system components and provides the interfaces for peripheral devices.

The **scanning head** consists of the interferometer, the scanners to deflect the laser beam and a video camera to visualize the measurement object.

The measurement data is digitally recorded in the **workstation**. The software controls the data acquisition and offers user-friendly functions to evaluate the measurement data.

2.2 The Range of the PSV Models

The decoders and filters in the controller as well as the data acquisition board in the workstation determine the characteristics of the PSV. Depending on the application there are three different models on offer; their characteristics are summarized in table 2.1.

Table 2.1: Summary of the PSV models

PSV Model		PSV 300-H High Performance	PSV 300-F High Frequency	PSV 300-U Universal
Controller	Velocity decoder	OVD-04+PLL-DC	OVD-04HF+PLL-DC	OVD-04(+PLL-DC)[1]
	Measurement ranges $\frac{mm}{s}$/V	1/5/10/25/125/ 1 000	1/5/10/25/125/ 1 000	(1/5)[1] 10/25/125
	Maximum frequency	250 kHz	1.5 MHz	250 kHz
	Filter	400 Hz...102 kHz	5/20/100 kHz	5/20/100 kHz
Digital signal processing	Data acquisition board	PCI-4452	PCI-6111	PCI-4451
	Internal function generator	PCI-6711		
	Maximum bandwidth	80 kHz	1 MHz	40 kHz
	Input channels simultaneously	4	2	2
	Output channels of the internal function generator	3	1	(1)[1]

[1] The information in brackets is optional.

3 First Steps

3.1 Operating and Maintenance Requirements

Operating environment The PSV can be operated in dry rooms under normal climate conditions (refer to specifications in chapter 7). In particular the optical components in the scanning head are sensitive to moisture, high temperature, jolting and dirt. A sufficient acclimatization period should be allowed for before switching the PSV on. Avoid condensation on the optical components caused by a rapid change in temperature.

Mains connection Before taking the PSV into operation, please ensure that the supply voltage set with the voltage selectors of the controller and the workstation corresponds with the local mains voltage. Only replace defective fuses by fuses of the same kind and equal rating.

The mains voltage input of the workstation can also be designed as a wide range input and therefore be connected to all mains voltages with nominal values between 100V and 240V.

Assembly The scanning head must not be positioned provisionally but mounted properly on a stable tripod using the threads provided.

Connecting cables As a general rule the PSV must not be switched on until all cables have been connected. Make sure that all jack connections are connected properly and firmly. Plug in the SCSI-type connectors of the acquisition cable with great care at the right angles. Only use original RS-232 cables from Polytec for the RS-232 connections (1:1 wired). Protect all cables from mechanical damage and from high temperatures.

Warming-up The helium-neon laser in the scanning head requires a certain period of time to reach optimum stability. The PSV should thus be switched on 30 minutes before the first measurements are made to ensure that it is in thermal equilibrium with the surroundings.

Cooling It is very important to ensure that there is sufficient air circulation to keep the system components cool. The air vents of the scanning head must never be covered up and the back panels of the electronics cabinets must be at least 50mm away from the wall.

Cleaning The housing surfaces of the instrument can be cleaned with mild detergent solutions. Organic solvents must not be used.

Pan-tilt stage Avoid any additional weight on the pan-tilt stage by placing objects on top of the scanning head or attaching things to it as this can put strain on the pan-tilt stage.

Installing other components Always contact Polytec prior to connecting any other hardware or software components to the PSV which are not part of it as this is likely to damage the system and could invalidate the warranty.

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

3.2 Unpacking and Inspection

Unpacking The PSV consists of the following components:

- controller OFV-3001 S
- scanning head OFV-056
- junction box PSV-Z-040 (-H, -F, -U)
- workstation with keyboard and mouse
- monitor with monitor cable and mains cable
- tripod with fluid stage OFV-S2
- umbilical cable
- interferometer cable
- video cable
- acquisition cable
- DIO/DAC cable
- BNC cable
- 2 RS-232 cables (1:1 wired)
- 3 mains cables
- PSV 300-H, -F: hand set PSV-Z-051

optional

- TFT monitor with monitor cable and mains cable
- heavy duty tripod with motorized pan-tilt stage, connector box and mains cable PSV-Z-017 (instead of the OFV-S2)
- PSV 300-H: generator cable for the internal function generator
- PSV 300-U: hand set PSV-Z-051
- coaxial unit OFV-056-C
- acoustic gate unit PSV-Z-EQ with BNC cable
- system cabinet PSV-Z-035
- hand set OFV-310
- vertical test stand PSV-Z-018

> **Caution!**
>
> Protect the unpacked scanning head from hard jolts as these can lead to misalignment of the interferometer!

Inspection Please pay attention to the following steps when unpacking the PSV:

1. Check the packaging for signs of unsuitable handling during transport.
2. After unpacking, check all components for external damage (scratches, loose screws etc.).
3. In the case of a wrong delivery, damage or missing parts, inform your local Polytec representatives immediately and give them the serial numbers of the instruments. The identification labels can be found on the back of the instruments and also on the inside cover of this manual.

4. Carefully retain the original packaging in case you have to return the PSV.

Install the PSV as described in section 3.4 and carry out a functional test as described in section 3.5.

3.3 Control Elements

3.3.1 Controller

Front panel The front panel of the controller is shown in figure 3.1.

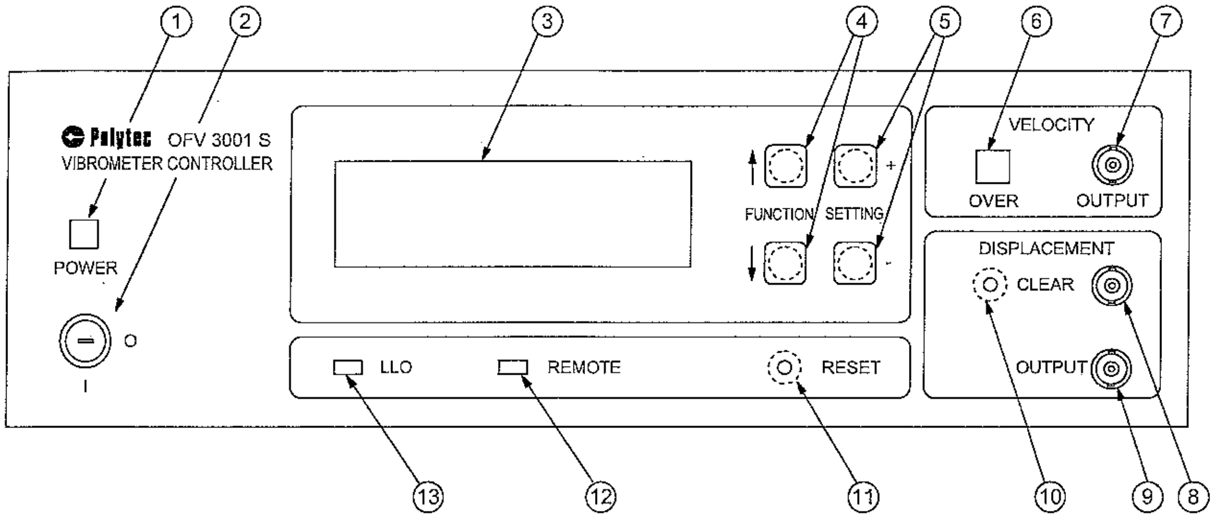


Figure 3.1: Front view of the controller

1 POWER LED

The LED lights up when the key switch on the controller is turned to position I and indicates that the controller is ready to operate.

2 Mains switch

This key switch disconnects the vibrometer from the mains (position O) and is used to turn it off in the case of danger.

Caution!
Always connect all connecting cables **before** switching the controller on!

3 Liquid Crystal Display (LCD) with background lighting

This display shows the settings of the controller. The organization of the display and how to use it to operate the controller without the software are described in section 5.12.

4 FUNCTION keys

These keys do not have a function, when the controller is operated via the software. When the controller is operated without the software, the cursor is moved up and down on the display using the ↑ and ↓ keys (refer to section 5.12.1).

5 **SETTING** keys

These keys do not have a function, when the controller is operated via the software. When the controller is operated without the software, these keys are used to change the settings (refer to section 5.12.1).

6 **OVER** indicator for the velocity

The LED lights up when the output voltage exceeds either the positive or negative full scale range (peak) of the velocity decoder. If it lights up permanently, the next highest range must be selected (refer to section 4.2.1).

7 Analog voltage output for the **VELOCITY** signal (BNC jack)

The voltage at this output is proportional to the instantaneous vibration velocity of the object to be measured. The voltage is positive if the object is moving towards the scanning head.

8 **CLEAR** socket for the displacement decoder (BNC jack)

This socket allows synchronized resetting of the optional displacement decoder. This input is only active if a displacement decoder is installed.

9 Analog voltage output for the **DISPLACEMENT** signal (BNC jack)

The voltage at this output is proportional to the instantaneous displacement of the object to be measured. The output is only active if a displacement decoder is installed.

10 **CLEAR** key for the displacement decoder

Using this key the optional displacement decoder can be reset manually.

11 **RESET** key

The controller processor can be reset using this key.

12 **REMOTE** LED

The LED lights up if the controller is being operated remotely via one of the interfaces. Manual operation with the keys ↑, ↓, +, – on the front panel is also possible, however, manual settings are not transferred to the software.

13 **LLO** LED

This LED lights up when the status **L**OCAL **L**OCK **O**UT has been activated via the software. The keys ↑, ↓, +, – on the front panel are then deactivated and the controller is operated exclusively via the software.

Back panel The back panel of the controller is shown in figure 3.2.

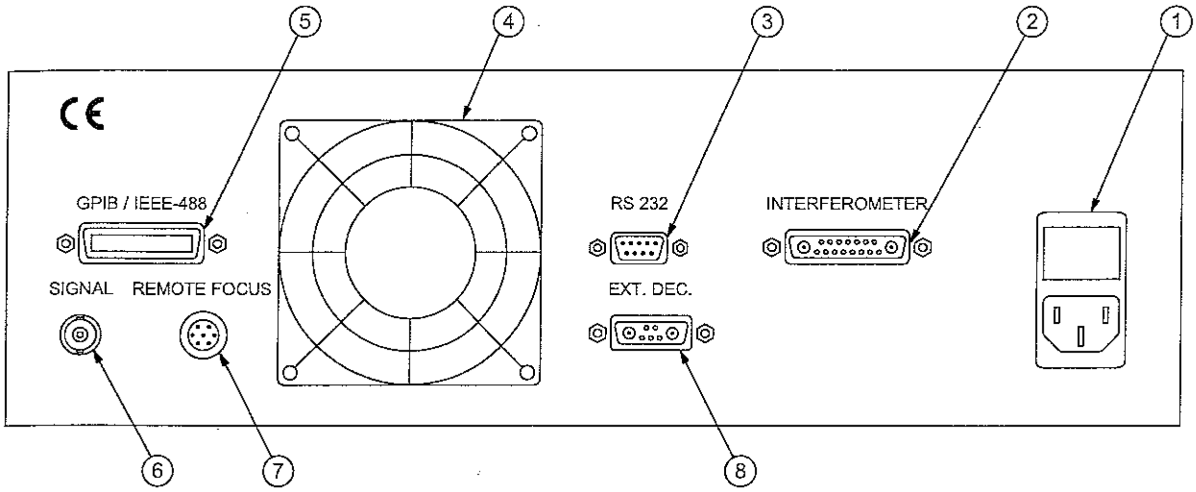


Figure 3.2: Rear view of the controller

1 **Mains connection** combination

Socket for standard power cord with built-in fuses and mains voltage selector

> **Warning!**
>
> **Always** disconnect from the mains **before** checking the fuses!

> **Caution!**
>
> **Always** check the settings of the voltage selector and the rating of the fuses **before** connecting to the mains!

2 **INTERFEROMETER** connector (Sub-D jack)

Jack for the interferometer cable to the junction box

3 **RS 232** interface (9-pin Sub-D jack)

Jack for the RS-232 cable to the workstation to control the PSV with the software

> **Note!**
>
> To control the PSV using the software, in the controller the transfer rate must be set to **9600 Baud** (refer to section 5.12.3)!

4 **Cooling fan**

> **Caution!**
>
> This opening must **always** be kept free to ensure sufficient cooling! The distance from the wall should be at least 50mm!

5 **IEEE-488/GPIB** interface

6 **SIGNAL** output (BNC jack)

The DC voltage at this output is proportional to the logarithm of the optical signal level.

7 **REMOTE FOCUS** interface (7-pin circular jack)

Interface for the optional hand set OFV-310 to focus the laser beam (refer to section A.3)

8 External decoder interface **EXT. DEC.** (optional)

Interface for an external digital displacement decoder

3.3.2 Scanning Head

On the underside of the scanning head, there is a 4-pin circular jack for the cable to the optional pan-tilt stage PSV-Z-017.

Front panel The front panel of the scanning head is shown in figure 3.3.

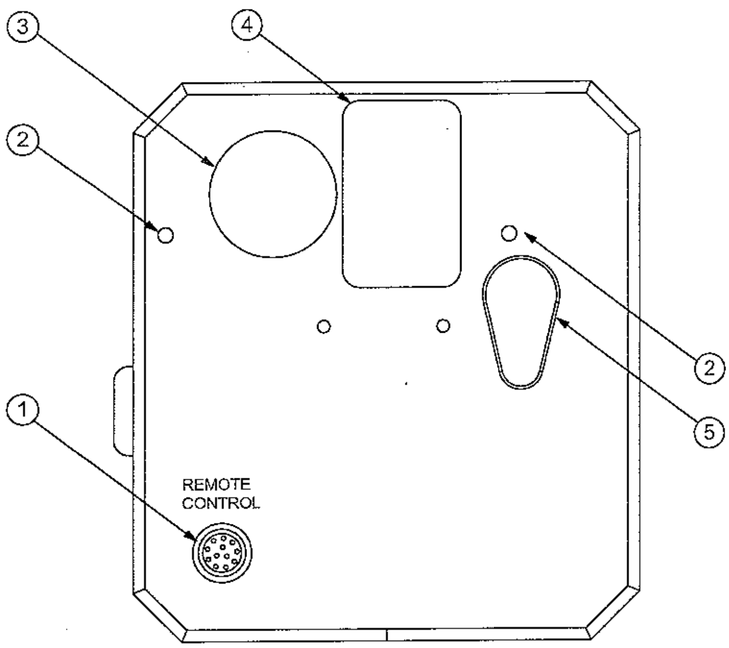


Figure 3.3: Front view of the scanning head

1 Connector **REMOTE CONTROL** for the hand set PSV-Z-051 (12-pin circular connector)

The hand set is used for focusing and positioning the laser beam (refer to section 5.6 and section 5.8).

2 Mounting holes for the optional **coaxial unit** OFV-056-C

The optional coaxial unit is used for scanning small parts at short distance (refer to section A.1).

3 **Video camera** front lens

The video camera is controlled via the software as described in your software manual.

4 Laser beam aperture

Focusing and positioning the laser beam is controlled via the software as described in your software manual. The laser beam can also be focused and positioned using the hand set as described in section 5.6 and section 5.8.

> **Warning!**
>
> **Never** look directly into the laser beam with the naked eye or with the aid of mirrors or optical instruments!

5 Dust cover switch bar

Rotating the switch bar to a vertical position closes the apertures for the laser beam and the video camera.

> **Caution!**
>
> To protect the lenses and scanner mirrors, **only** open the dust cover when your are making measurements!

Back panel

The back panel of the scanning head is shown in figure 3.4.

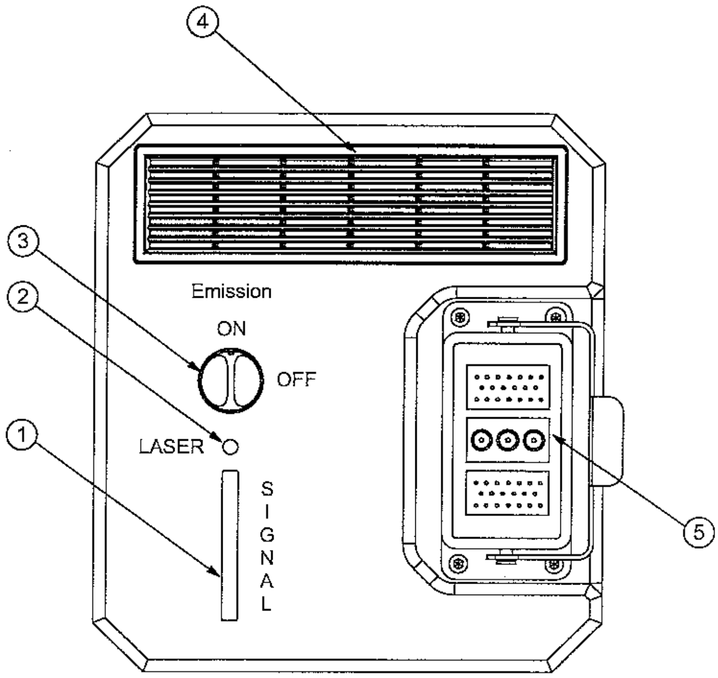


Figure 3.4: Rear view of the scanning head

1 Signal level display **SIGNAL**

The length of the bar is a measure of the amount of light scattered back from the measurement surface.

2 LASER LED

The LED lights up when the scanning head is correctly cabled to the junction box and the laser is turned on (key switch on the controller in position I). The LED indicates that the laser is active, even if the beam shutter is closed (refer to section 5.2).

3 Beam shutter **EMISSION ON/OFF**

In position OFF the laser beam is blocked.

Warning!
Only switch the beam shutter to the ON position when you are making measurements!

4 **Air vents**

Caution!
This opening must **always** be kept free to ensure sufficient cooling!

5 **Main connector** (industrial-style)

Jack for the umbilical cable to the junction box

3.3.3 Junction Box

Front panel for model -H The front panel of the junction box for the PSV model -H is shown in figure 3.5.

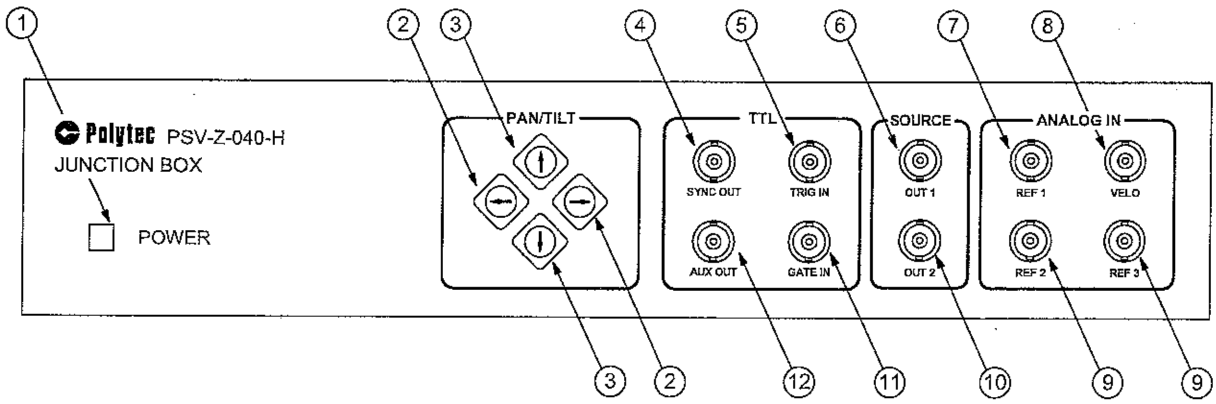


Figure 3.5: Front view of the junction box for the PSV model -H

1 **POWER** LED

The LED lights up when the junction box is correctly cabled to the controller and the key switch on the controller is turned to position I. The LED indicates that the junction box is ready to operate.

2 Control keys for the **pan-tilt head**, pan

Using these keys the optional pan-tilt stage is panned clockwise (→) or anti-clockwise (←) (refer to section 5.4). Alternatively it can be controlled via the software as described in the software manual.

3 Control keys for the **pan-tilt head**, tilt

Using these keys the optional pan-tilt stage is tilted upward (↑) or downward (↓) (refer to section 5.4). Alternatively it can be controlled via the software as described in the software manual.

4 TTL output **SYNC OUT** (BNC jack)

Synchronization pulse for the generator signal.

5 TTL input **TRIG IN** (BNC jack)
TTL input for an external trigger signal

6 Generator output **OUT 1** (BNC jack)
Output signal of the internal function generator.

7 Analog input **REF 1** (BNC jack)
Analog input for the reference signal

8 Analog input **VELO** for the velocity signal (BNC jack)
Analog input for the velocity signal from the controller

9 Analog inputs **REF 2** and **REF 3** (BNC jack)
Analog inputs for 2 additional reference signals

10 Generator output **OUT 2** (BNC jack)
Additional output signal of the internal function generator

11 TTL input **GATE IN** (BNC jack)
TTL input for an external gating signal.

12 TTL output **AUX OUT** (BNC jack)
TTL output for special applications, programmable via the optional Visual® Basic Engine PSV-Z-082

Front panel for models -F, -U The front panel of the junction box for the PSV models -F and -U is shown in figure 3.6.

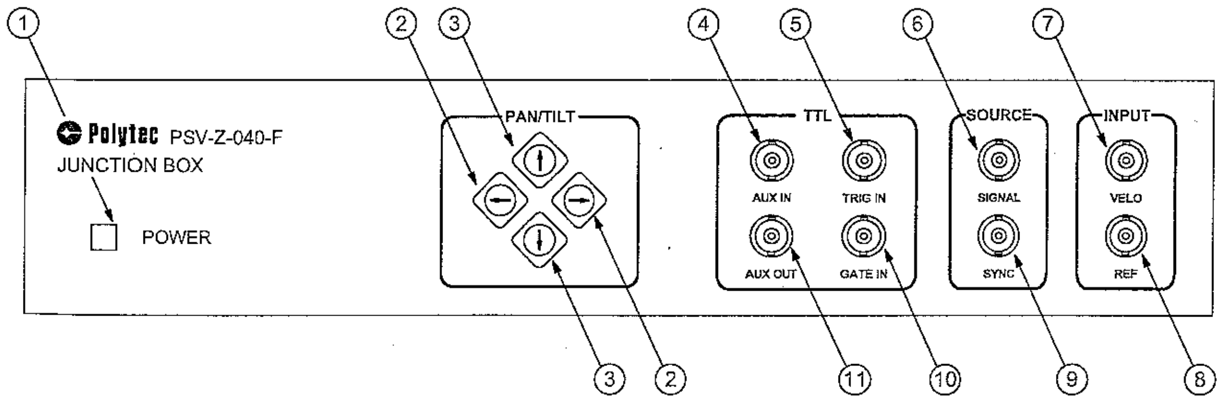


Figure 3.6: Front view of the junction box for the PSV models -F and -U

1 **POWER** LED
The LED lights up when the junction box is correctly cabled to the controller and the key switch on the controller is turned to position I. The LED indicates that the junction box is ready to operate.

2 Control keys for the **pan-tilt head**, pan
Using these keys the optional pan-tilt stage is panned clockwise (→) or anti-clockwise (←) (refer to section 5.4). Alternatively it can be controlled via the software as described in the software manual.

3 Control keys for the **pan-tilt head**, tilt

Using these keys the optional pan-tilt stage is tilted upward (↑) or downward (↓) (refer to section 5.4). Alternatively it can be controlled via the software as described in the software manual.

4 TTL input **AUX IN** (BNC jack)

TTL input for special applications

5 TTL input **TRIG IN** (BNC jack)

TTL input for an external trigger signal

6 Generator output **SIGNAL** (BNC jack)

Output signal of the internal function generator.

PSV 300-U: The output is only active if the corresponding option is installed.

7 Analog input **VELO** for the velocity signal (BNC jack)

Analog input for the velocity signal from the controller

8 Analog input **REF** (BNC jack)

Analog input for the reference signal

9 TTL output **SYNC** (BNC jack)

Synchronization pulse for the generator signal.

PSV 300-U: The output is only active if the corresponding option is installed.

10 TTL input **GATE IN** (BNC jack)

TTL input for an external gating signal.

PSV 300-U: The input is only active if the corresponding option is installed.

11 TTL output **AUX OUT** (BNC jack)

TTL output for special applications, programmable via the optional Visual® Basic Engine PSV-Z-082

Back panel for all models The back panel of the junction box for the PSV models -H, -F and -U is shown in figure 3.7.

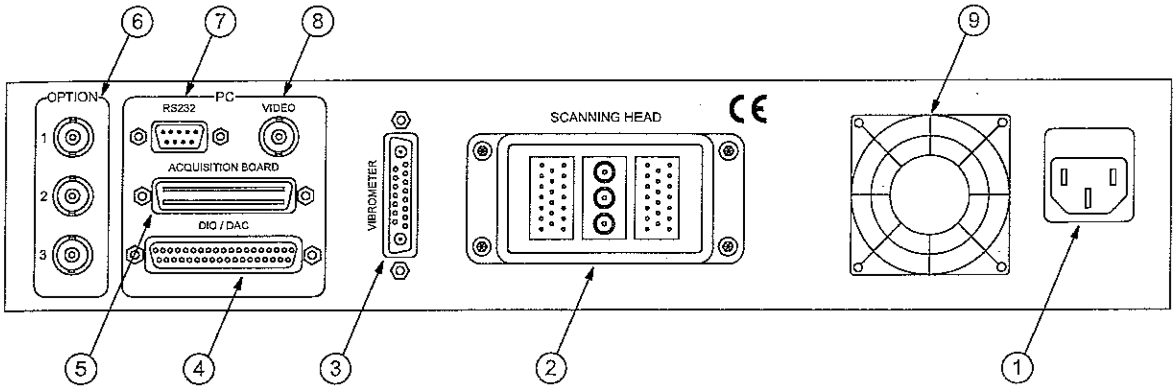


Figure 3.7: Rear view of the junction box

1 **Mains connection combination**

Mains socket with built-in fuses. The mains voltage input is designed as a wide range input.

Warning!
Always disconnect from the mains **before** checking the fuses!

Caution!
Always check the fuses **before** installing the PSV!

2 **SCANNING HEAD** connector (industrial-style)

Jack for the umbilical cable to the scanning head

3 **VIBROMETER** connector (Sub-D jack)

Jack for the interferometer cable to the controller

4 **DIO/DAC** connector (37-pin Sub-D jack)

Jack for the DIO/DAC cable to the workstation to control the scanner mirrors and the pan-tilt stage

5 **ACQUISITION BOARD** connector (SCSI-II type)

Jack for the acquisition cable to the workstation to transmit both measurement and control signals

6 Optional connectors **OPTION 1, 2, 3** (BNC jacks)

PSV 300-H: Connectors for the generator cable to the workstation for the internal function generator (optional)

PSV 300-F, -U: Up to three BNC jacks can be made available for special applications.

7 **RS 232** interface (9-pin Sub-D connector)

Jack for the RS-232 cable to the workstation to control the video camera

8 **VIDEO** output (BNC jack)

Jack for the video cable to transmit the video signal to the workstation

9 Cooling fan

Caution!
This opening must **always** be kept free to ensure sufficient cooling! The distance from the wall should be at least 50 mm!

3.3.4 Workstation

Front panel for all models The front panel of the workstation for the PSV models -H, -F and -U is shown in figure 3.8. The lockable front flap is shown as transparent.

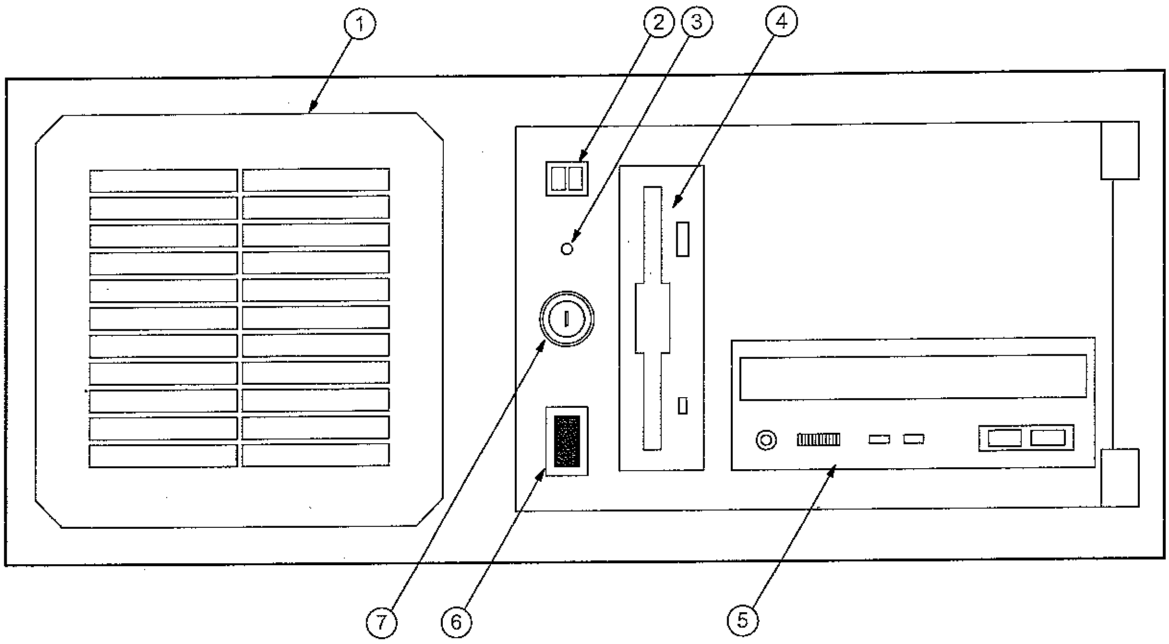


Figure 3.8: Front view of the workstation

1 Cooling fan

Caution!
This opening must **always** be kept free to ensure sufficient cooling!

2 POWER and HDD LED

The green LED (POWER) lights up when the workstation is switched on using the mains switch on the back and when the black key on the front is pressed. The red LED being lit indicates the activity of the hard disk drive (HDD) in the workstation.

3 RESET key

Using this key the control processor of the workstation can be reset and the workstation can be restarted. The setting of the workstation is subsequently the same as it was straight after switching on. You can press this key through the opening using a thin object.

4 3.5" disk drive

5 CD-ROM drive or rewriter

You will find an exact description of the drive in the user manual of the manufacturer.

6 On/Off key

Pressing the black key, the workstation will be switched on or off.

7 Lock with key in the front flap

To secure the workstation for unauthorized using, the front flap can be locked using the key.

Back panel for model -H The back panel of the workstation for the PSV model -H is shown in figure 3.9. The order of the boards can be different from the picture.

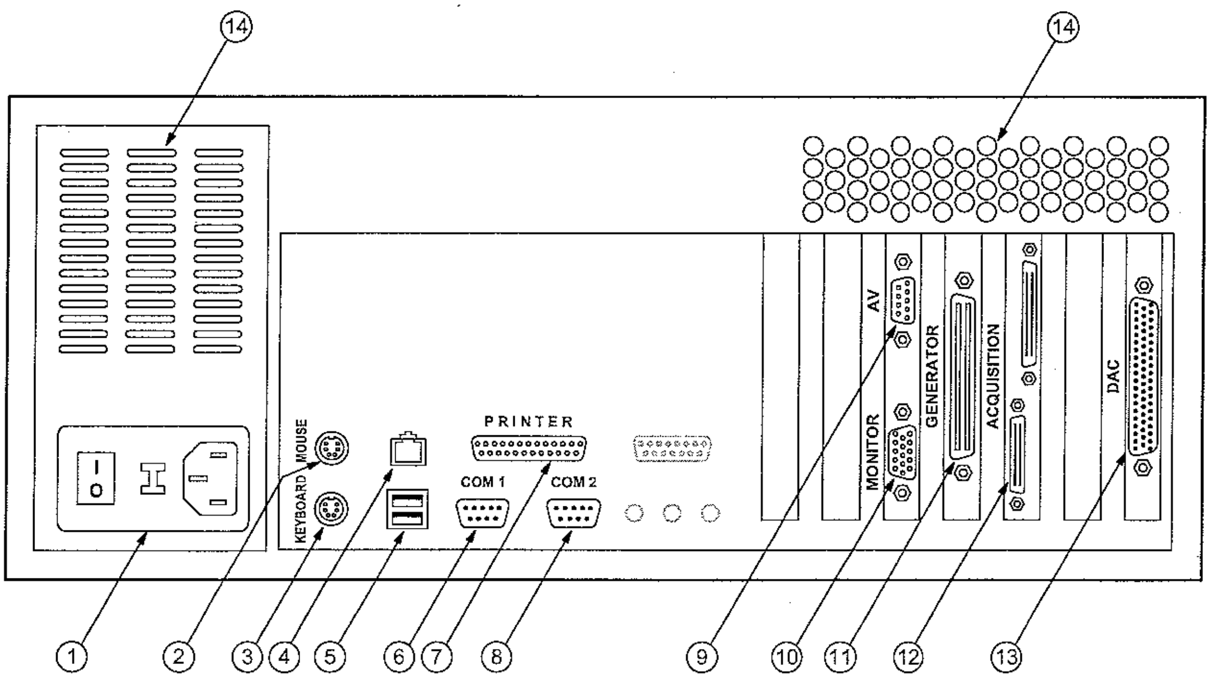


Figure 3.9: Rear view of the workstation for the PSV model -H

1 Mains connection combination

Mains socket with a mains switch and mains voltage selector. Instead of using the voltage selector, the mains voltage input can also be designed as a wide range input (refer to section 3.1). The mains switch disconnects the workstation from the mains (position O) and is used to turn it off in case of danger.

Caution!
If applicable, **always** check the setting of the mains voltage selector **before** connecting the workstation to the mains!

2 **MOUSE** connector (6-pin circular jack)

3 **KEYBOARD** connector (6-pin circular jack)

4 **Network** connector
Jack of the Ethernet network board

5 **USB** port (Universal Serial Bus)
Alternative jack for peripheral devices like mouse, keyboard, etc.

6 Serial interface **COM 1** (9-pin Sub-D connector)
Jack for the RS-232 cable to the junction box to control the video camera

7 Parallel **PRINTER** connector (25-pin Sub-D jack)

8 Serial interface **COM 2** (9-pin Sub-D connector)
Jack for the RS-232 cable to the controller to control the PSV via the software

9 **AV** connector (9-pin Sub-D jack)
Jack for the video cable to the junction box to transmit the video signal

10 **MONITOR** connector (15-pin Sub-D jack)

11 **GENERATOR** connector for the internal function generator (SCSI-II type)
Jack for the generator cable of the internal function generator to the junction box

12 **ACQUISITION** connector for the data acquisition (VHDIC type)
Jack for the Y-shaped acquisition cable to the junction box to transmit both measurement and control signals

13 **DAC** connector (62-pin Sub-D jack)
Jack for the DIO/DAC cable to the junction box to control the scanner mirrors and the pan-tilt stage

14 **Air vents**

Caution!

These openings must **always** be kept free to ensure sufficient cooling! The distance from the wall should be at least 50 mm!

Back panel for models -F, -U The back panel of the workstation for the PSV models -F and -U is shown in figure 3.10. The order of the boards can be different from the picture.

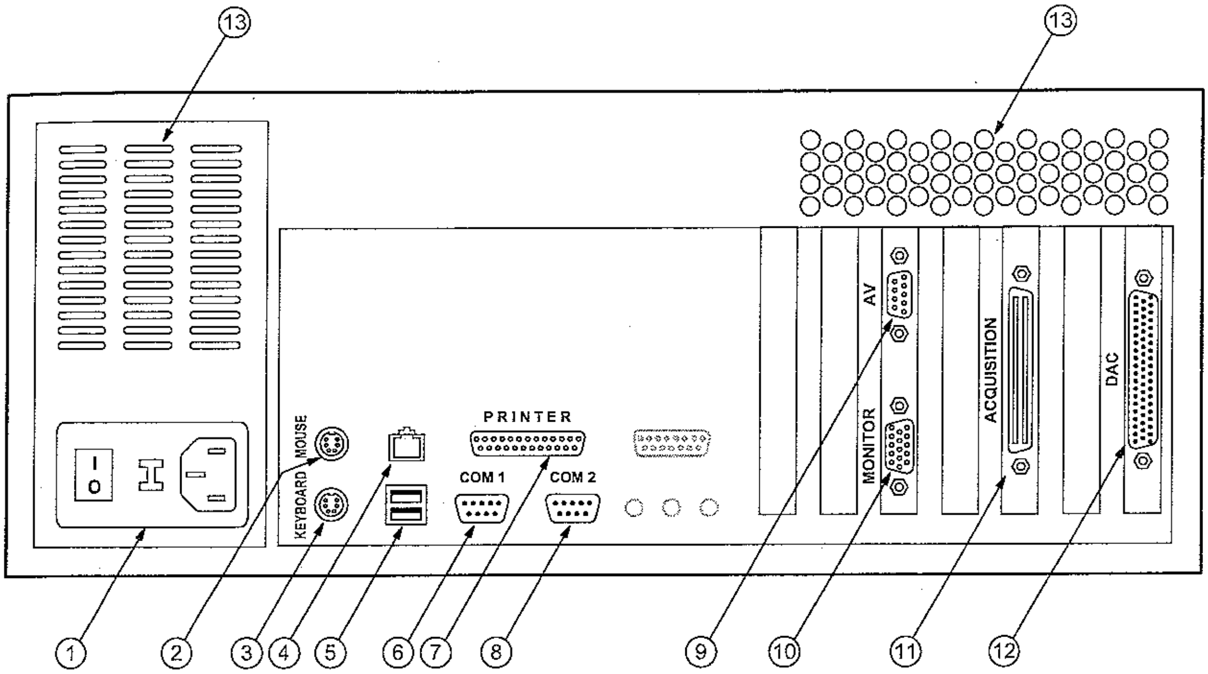


Figure 3.10: Rear view of the workstation for the PSV models -F and -U

1 Mains connection combination

Mains socket with a mains switch and mains voltage selector. Instead of using the voltage selector, the mains voltage input can also be designed as a wide range input (refer to section 3.1). The mains switch disconnects the workstation from the mains (position O) and is used to turn it off in case of danger.

Caution!
If applicable, **always** check the setting of the mains voltage selector **before** connecting the workstation to the mains!

2 **MOUSE** connector (6-pin circular jack)

3 **KEYBOARD** connector (6-pin circular jack)

4 **Network** connector
Jack of the Ethernet network board

5 **USB** port (Universal Serial Bus)
Alternative jack for peripheral devices like mouse, keyboard, etc.

6 Serial interface **COM 1** (9-pin Sub-D connector)
Jack for the RS-232 cable to the junction box to control the video camera

7 Parallel **PRINTER** connector (25-pin Sub-D jack)

8 Serial interface **COM 2** (9-pin Sub-D connector)

Jack for the RS-232 cable to the controller to control the PSV via the software

9 **AV** connector (9-pin Sub-D jack)

Jack for the video cable to the junction box to transmit the video signal

10 **MONITOR** connector (15-pin Sub-D jack)

11 **ACQUISITION** connector for the data acquisition (SCSI-II type)

Jack for the acquisition cable to the junction box to transmit both measurement and control signals

PSV 300-U: The PSV model -U has two VHDIC connectors instead of the SCSI-II type connector (refer to PSV model -H).

12 **DAC** connector (62-pin Sub-D jack)

Jack for the DIO/DAC cable to the junction box to control the scanner mirrors and the pan-tilt stage

13 **Air vents**

Caution!

These openings must **always** be kept free to ensure sufficient cooling! The distance from the wall should be at least 50 mm!

3.4 Installation

3.4.1 Mechanical Assembly

Scanning head

The scanning head is mounted on either a tripod with fluid stage (OFV-S2) or a heavy duty tripod with motorized pan-tilt stage (optional PSV-Z-017). The heavy-duty tripod can also be mounted on a trolley (optional). The scanning head mounted on the fluid stage and on the tripod is shown in figure 3.11.

Figure 3.11: Scanning head mounted on the fluid stage and on the tripod

Before attempting to mount the scanning head, all locking mechanisms of the trolley and the tripod, particularly screws, should be checked to make sure they are tight. A loose screw may cause the stand to be unstable and possibly collapse.

Note!

It is best to carry out the following assembly when someone is there to help you!

Tripod with fluid stage OFV-S2

If your PSV is equipped with a fluid stage, you must proceed with the assembly as follows:

1. Assemble the tripod as described in the assembly instructions provided by the manufacturer MANFROTTO.
2. Then mount the fluid stage as described in the assembly instructions provided by the manufacturer MANFROTTO.
3. Open the locking mechanism on the fluid stage by simultaneously pressing the safety latch and opening the safety lever.
4. A suitable quick release hexagonal plate has been pre-mounted on the scanning head. Use this plate to position the scanning head on the fluid stage.

   The safety lever clicks into place automatically.
5. Ensure that the quick release plate is attached all the way around. This needs to be done before the scanning head is ready to use.
6. Whenever you want to remove the scanning head from the fluid stage, one person should hold the scanning head while the second person opens the safety lever.
7. Keep the assembly instructions for the tripod and the fluid stage in a safe place.

Tripod with pan-tilt stage PSV-Z-017 (optional)

If your PSV is equipped with a pan-tilt stage you must proceed with the assembly as follows:

1. Unpack the pan-tilt stage and check it for external damage (scratches, loose screws, etc.).
2. Check the contents of the assembly kit:

   1 Adapter plate with 3 Allen screws M6x16
   1 Connector box with 4 Allen screws M8x40
   3 Allen screws M8x16 with washers
   1 Mounting plate with 2 Allen screws M6x20
   2 Allen screws M6x16 with washers
   1 Allen key size 5
   1 Allen key size 6

Caution!

Make sure that the screws are always tightened, to ensure that the system is both stable and functions accurately!

3. Attach the mounting plate on the underside of the scanning head with 2 Allen screws M6x20. To do this use the Allen key size 5.

Caution!

Make sure that the mounting plate is correctly aligned! The FRONT labeled side of the plate has to be mounted in the direction of the front panel of the scanning head as shown in figure 3.12.

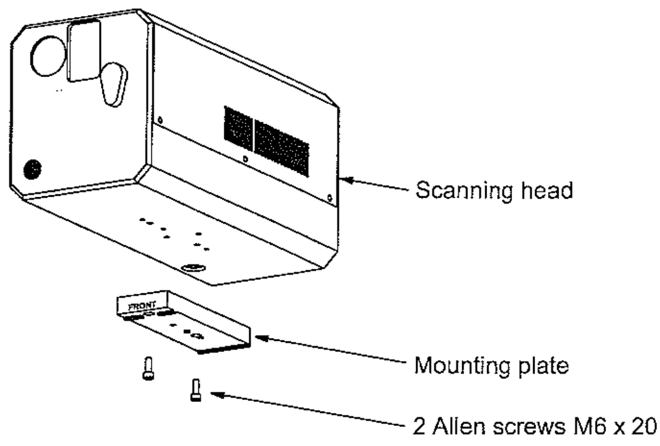


Figure 3.12: Fixing the mounting plate on the scanning head

4. Unpack the tripod and check it for external damage (scratches, loose screws, etc.).

5. Assemble the tripod as described in the assembly instructions from the manufacturer MANFROTTO.

6. Unscrew the plate on the top of the tripod and keep the plate and the screws in case you may need them at a later date.

7. Now mount the adapter plate on the top of the tripod using the 3 Allen screws M6x16 as also shown in figure 3.13. Ensure that the knob on the underside of the tripod is always tightened securely.

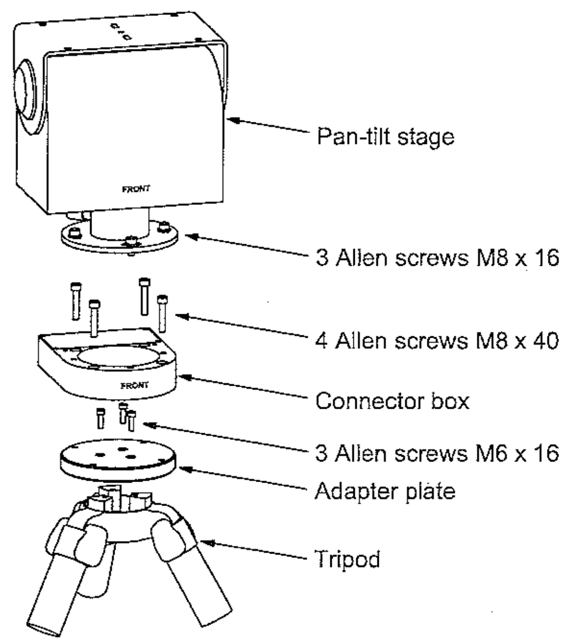


Figure 3.13: Mounting the pan-tilt stage on the tripod

8. Screw the connector box on the adapter plate using the 4 Allen screws M8x40. To do this, use the Allen key size 6.

9. Fix the pan-tilt stage on the connector box using the 3 Allen screws M8x16 and the washers.

Caution!
Make sure that the pan-tilt stage is correctly aligned to the connector box! The FRONT labeled sides have to be mounted in the same direction.

10. Then mount the scanning head with its mounting plate on the pan-tilt stage using the 2 Allen screws M6x16 and the washers as shown in figure 3.14.

Caution!
Make sure that the FRONT labeled sides of the components are mounted in the direction of the front panel of the scanning head!

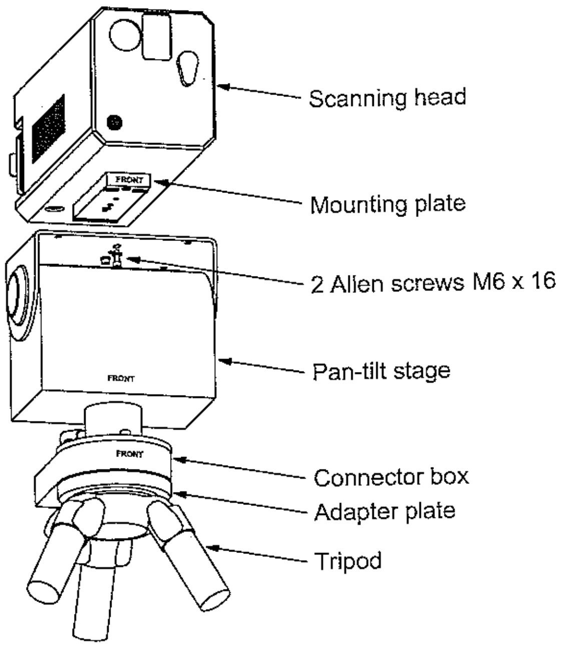


Figure 3.14: Mounting the scanning head on the pan-tilt stage

11. Keep the assembly instructions for the tripod and pan-tilt stage in a safe place.

For cabling the pan-tilt stage, refer to section 3.4.2.

System cabinet PSV-Z-035 (optional)

You receive the system cabinet PSV-Z-035 ready assembled. The positions of the individual system components in the cabinet is shown in figure 3.15.

1. Undo the housing feet of the system components and keep the housing feet and the screws in a safe place.

2. Place the controller at the bottom as the air vents are situated in the bottom plate.

Caution!
To ensure sufficient cooling, the controller must be situated at the bottom and the junction box at the top of the system cabinet!

3. Insert the workstation above the controller.

4. Are the air vents of your junction box in the top plate? If not, please exchange the top and bottom plate.

5. Insert the junction box above the workstation.

6. Fix all front panels with the screws provided.

7. Place the other system components as shown in figure 3.15.

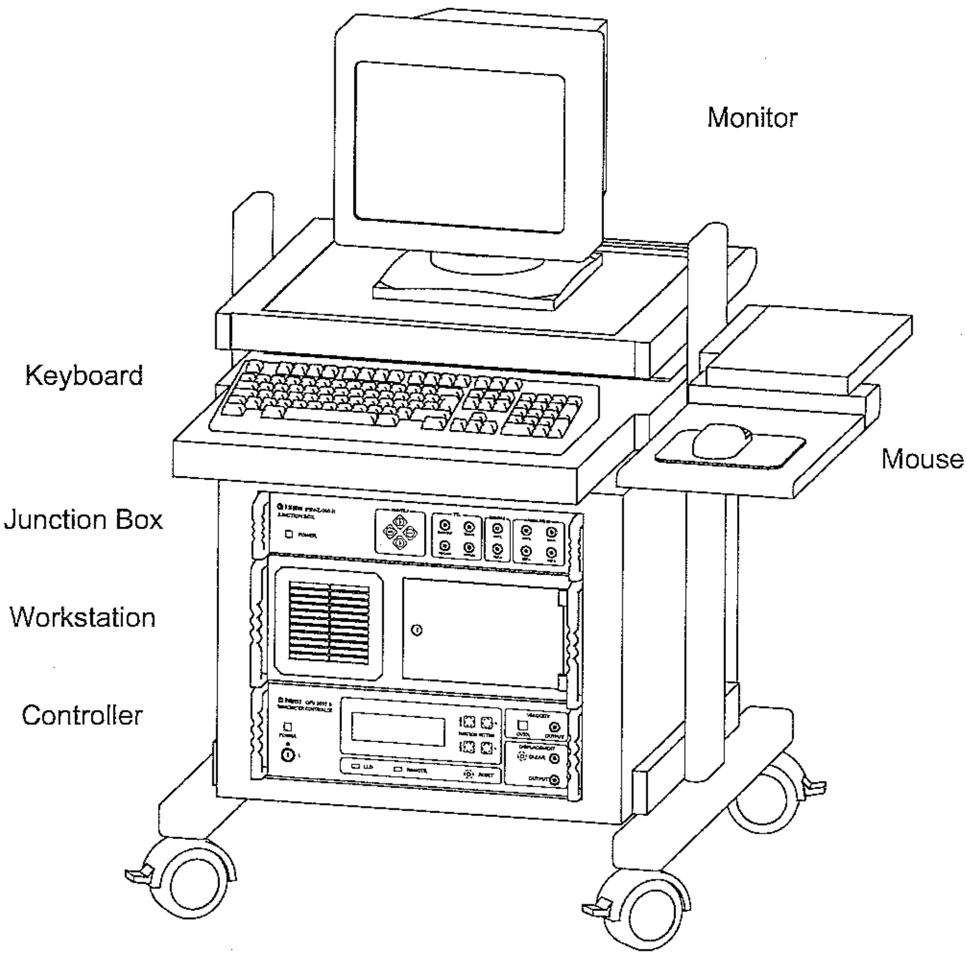


Figure 3.15: Position of the PSV components on the system cabinet

All system components should now be correctly mounted.

3.4.2 Cabling

The individual steps on cabling the PSV are described in the following. The complete cabling is shown in figure 3.16 to figure 3.18. All connections must be made easily. If not, check the plugs for bent contact pins to avoid serious damage being incurred. Secure the connections correspondingly. Should any problems occur in cabling, please contact your local Polytec representative.

Caution!
Always connect all components to each other **before** plugging in the mains cables!

Workstation

1. Connect the keyboard to the socket KEYBOARD on the back of the workstation.
2. Connect the mouse to the socket MOUSE on the back of the workstation.
3. Plug the monitor cable into the back of the monitor and into the socket MONITOR on the back of the workstation.

Controller ⇔ workstation

4. To operate the controller via the software, plug an **RS-232** cable into the jack RS 232 on the back of the controller and into either of the jacks COM1 or COM2 on the back of the workstation.

Controller ⇔ hand set OFV-310

5. If applicable, connect the optional hand set OFV-310 to the circular jack REMOTE FOCUS on the back of the controller.

Controller ⇔ junction box

6. Plug the **Interferometer** cable into the Sub-D jack INTERFEROMETER on the back of the controller and into the Sub-D jack VIBROMETER on the back of the junction box.
7. For transmission of the velocity signal, plug the **BNC** cable into the BNC jack VELOCITY OUTPUT on the front of the controller and into the BNC jack VELO on the front of the junction box.

Reference signal

8. **PSV 300-H:** If required, connect the reference signal to the BNC jack REF1 on the front of the junction box for the model -H.

   PSV 300-F, -U: If required, connect the reference signal to the BNC jack REF on the front of the junction box for the models -F and -U.
9. **Only PSV 300-H:** You can connect two additional reference signals to the BNC jacks REF2 and REF3 on the front of the junction box for the model -H.

External trigger

10. If required, connect the external trigger signal to the BNC jack TRIG IN on the front of the junction box.

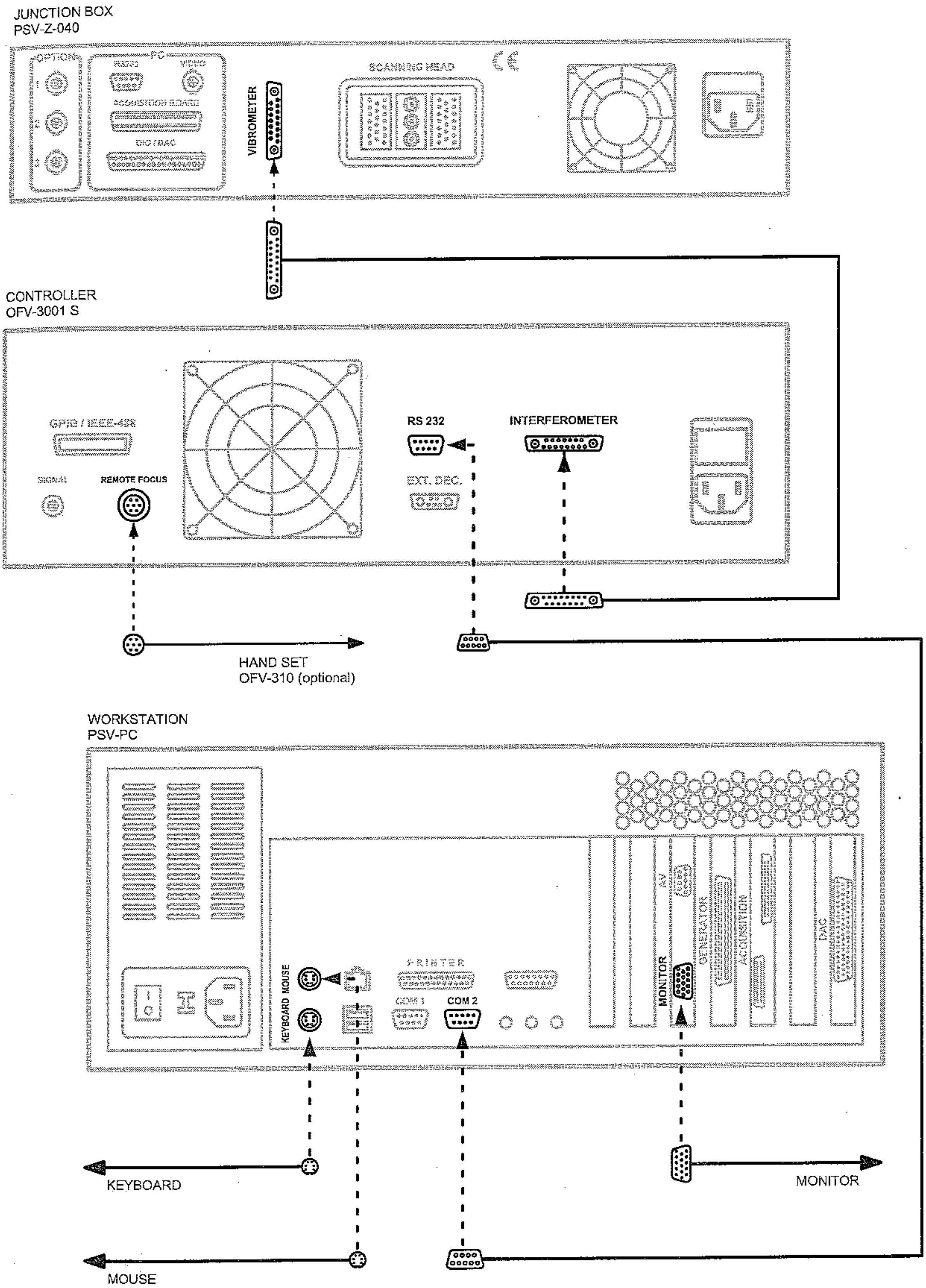


Figure 3.16: Cabling of the controller's back panel

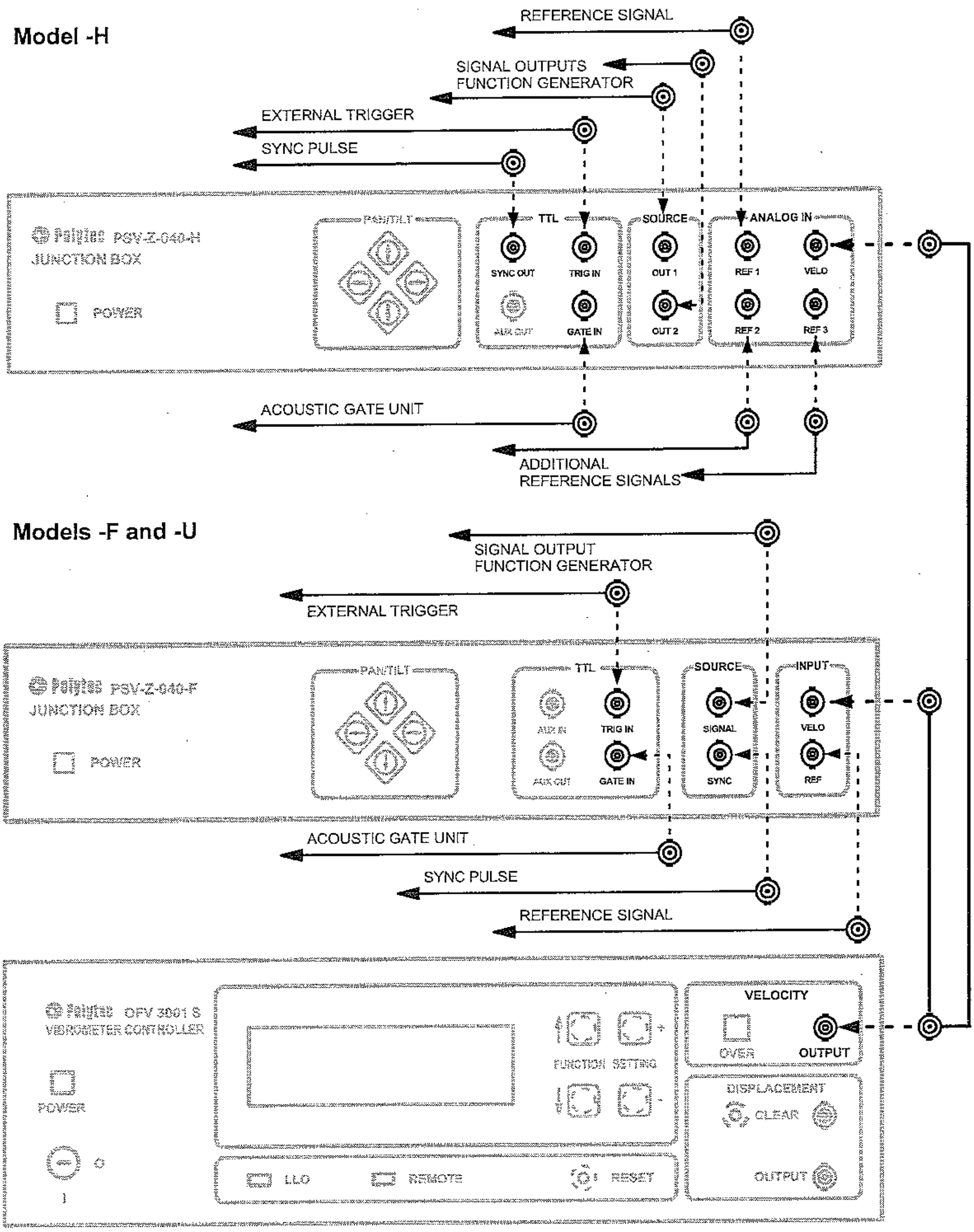


Figure 3.17: Cabling of the front panels of the controller and the junction box

Internal function generator

11. **PSV 300-H:** If required, the signal of the internal function generator is available at the BNC jacks OUT 1 and OUT 2 on the front of the junction box for the model -H and at the BNC jack OUT 3 of the generator cable.

    PSV 300-F, -U: If required, the signal of the internal function generator is available at the BNC jack SIGNAL on the front of the junction box for the models -F and -U.

12. **PSV 300-H:** If required, the synchronized pulse of the generator signal is available at the BNC jack SYNC OUT on the front of the junction box.

    PSV 300-F, -U: If required, the synchronized pulse of the generator signal is available at the BNC jack SYNC on the front of the junction box.

Acoustic gate unit

13. If applicable, connect the optional acoustic gate unit PSV-Z-EQ to the BNC jack GATE IN on the front of the junction box.

Junction box ⇔ workstation

14. To control the video camera, plug an **RS-232** cable into the jack RS 232 on the back of the junction box and into either of the jacks COM1 or COM2 on the back of the workstation.

15. Plug the **Video** cable into the BNC jack VIDEO on the back of the junction box and into the 9-pin Sub-D jack AV on the back of the workstation.

Caution!
Plug in the SCSI-type connectors with great care at the right angles so as not to damage them!

16. **PSV 300-H, -U:** Plug the Y-shaped **Acquisition** cable into the SCSI-type connector ACQUISITION BOARD on the back of the junction box and into the two VHDIC-type connectors ACQUISITION on the back of the workstation.

    PSV 300-F: Plug the **Acquisition** cable into the SCSI-type connector ACQUISITION BOARD on the back of the junction box and into the SCSI-type connector ACQUISITION on the back of the workstation.

17. Plug the **DIO/DAC** cable into the 37-pin Sub-D jack DIO/DAC on the back of the junction box and into the 62-pin Sub-D jack DAC on the back of the workstation.

18. **Only PSV 300-H:** If required, plug the **Generator** cable into the three BNC jacks OPTION 1, 2 and 3 on the back of the junction box and into the SCSI-type connector GENERATOR on the back of the workstation.

Caution!
The cable numbers of the generator cable have to be in accordance with the corresponding number of the jack (OPTION 1, 2 or 3) on the junction box!

Junction box ⇔ scanning head

19. The umbilical cable has both a jack with a straight cable exit and a jack with a cable exit on the side. The cabling can be freely selected depending on the way the scanning head has been mounted. Plug the **Umbilical** cable into the industrial-style connector on the back of the scanning head and into the industrial-style connector SCANNING HEAD on the back of the junction box.

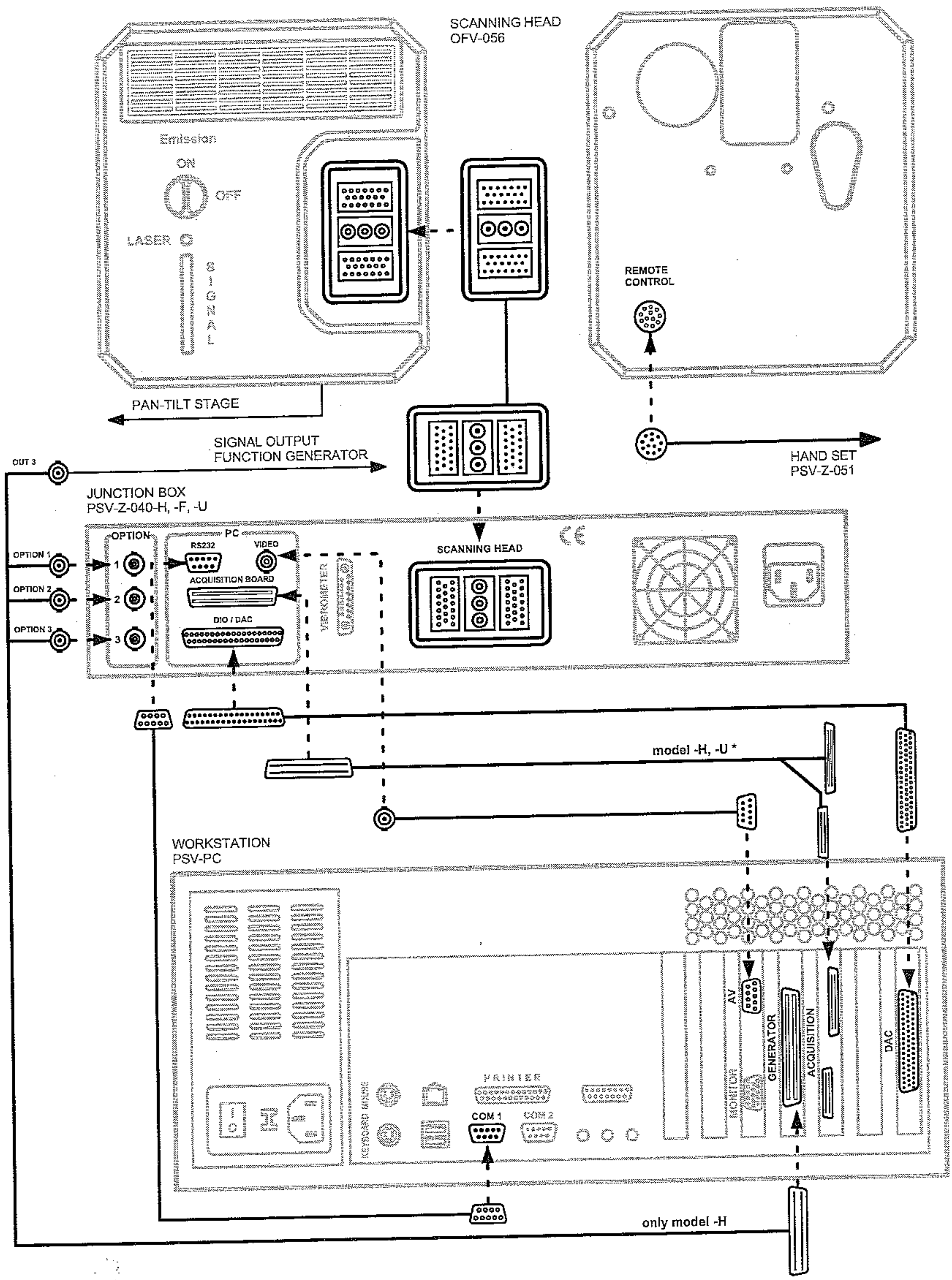


Figure 3.18: Cabling of the back panel of the junction box (* Model -F has one 68-pin SCSI-type connector instead of the two VHDIC-type connectors.)

Scanning head ⇔ hand set PSV-Z-051

20. If required, connect the hand set PSV-Z-051 to the 12-pin circular jack REMOTE CONTROL on the front of the scanning head.

Pan-tilt stage PSV-Z-017

21. If applicable, plug the **Scanning Head** cable from the connector box of the optional pan-tilt stage into the 4-pin circular jack on the underside of the scanning head.

22. Plug the **Pan-Tilt** cable from the connector box of the pan-tilt stage into the circular jack on the pan-tilt stage.

Mains connection

23. Plug a mains cable into the back of the workstation and into a wall socket providing protective grounding.

Caution!

Always check the setting of the voltage selectors on the back of the workstation and the controller as well as the rating of the fuses on the back of the controller and the junction box **before** connecting to the mains!

24. Plug a mains cable into the back of the junction box and into a wall socket providing protective grounding.

25. Plug a mains cable into the back of the controller and into a wall socket providing protective grounding.

26. If applicable, plug a mains cable into the connector box of the pan-tilt stage and into a wall socket providing protective grounding.

Caution!

Always check the setting of the voltage selector on the connector box of the pan-tilt stage **before** connecting to the mains!

The PSV is now completely installed. Carry out a functional test as described in section 3.5.

3.5 Functional Test

For an initial functional test of the PSV you proceed as follows:

Preparing

1. Install the PSV as described in section 3.4.
2. Make sure that the key switch on the controller is in position O and the beam shutter on the scanning head is in position OFF.
3. Position the scanning head roughly such that its laser beam aperture points to a test surface.

Switching on

4. Switch the controller on by turning the key switch to position I.

   On the front of the controller the LED POWER lights up. Providing all connecting cables have been installed correctly, the LED POWER on the front of the junction box and the emission LED LASER on the scanning head also light up. Laser light is not yet emitted as the beam shutter is still closed.

5. Switch on the workstation, start the PSV software and change to the Acquisition Mode as described in your software manual.

   On changing to the Acquisition Mode, control of the system by the software is activated. On the front of the controller both LEDs LLO and REMOTE light up.

6. Before now opening the beam shutter, remember the information on laser safety provided in section 1.1!
7. Open the dust cover and the beam shutter of the scanning head.

   The laser beam is now emitted from the scanning head.

Test

8. Test the function of the scanning head controls (focus and position of the laser beam, zoom and focus of the video camera, movement of the pan-tilt stage) as described in your software manual.
9. Put a matt white test surface, e.g. a piece of paper, at approximately 20cm from the front panel of the scanning head in the beam path.
10. Focus the laser beam on the test surface.

    The signal level display will light up to show that the scanning head and the input section of the controller are working correctly.

If the functional test has been successful you can now make measurements as described in chapter 4.

If your PSV does not perform as described above, read through the information on fault diagnosis provided in chapter 6 and, if necessary, contact your local Polytec representatives.

4 Making Measurements

Data acquisition and storage for the PSV is fully controlled via the software. A live video image of the object is displayed on the monitor and automatic scan sequences are defined directly on the live video image of the object. All acquisition properties are set in the software. For evaluation, the acquired data is directly overlaid onto the recorded video image. Data can also be exported to various software packages e.g. for modal analysis.

> **Note!**
>
> If you control the PSV using the software via the IEEE-488/GPIB interface, the IEEE-488/GPIB address of the controller must be set to 5!

4.1 Start-up

To make a measurement with the PSV you proceed as follows:

Setup

1. Make sure that the key switch on the controller is in position O and the beam shutter on the scanning head is in position OFF.
2. Position the scanning head roughly so that its laser beam aperture points in the direction of the object to be measured. If possible set the scanning head up at an optimal stand-off distance to the object to be measured. You will find information about optimal stand-off distances in section 4.3.

Switching on

3. Turn the controller on by setting the key switch to position I. Please allow 30 minutes for the laser to warm up before making measurements.

   On the front of the controller the LED POWER lights up. Providing all connecting cables have been installed correctly, the LED POWER on the front of the junction box and the emission LED LASER on the scanning head also light up. Laser light is not yet emitted as the beam shutter is still closed.
4. Switch on all optional devices.
5. Switch on the workstation, start the software and change to the Acquisition Mode as described in your software manual.

   On changing to the Acquisition Mode, control of the system by the software is activated. On the front of the controller both LEDs LLO and REMOTE light up.
6. Before now opening the beam shutter, remember the information on laser safety provided in section 1.1!
7. Open the dust cover on the front of the scanning head and the beam shutter on the back.

   The laser beam is now emitted from the scanning head.

Measuring

8. Data acquisition is now fully controlled by the software. Once the laser has warmed up you can make measurements as described in your software manual.

4.2 Selecting Suitable Settings

4.2.1 Measurement Range

When selecting a suitable measurement range, the maximum expected values for velocity, acceleration and frequency have to be taken into consideration. Orientation purely on the velocity is often not enough, as the various measurement ranges have different bandwidths and maximum accelerations. The respective values are given in the specifications (refer to section 7.1.3).

Most of the applications are covered by the 10 $\frac{mm}{s}$/V range. It should therefore be selected for initial measurements with the PSV. A higher range only has to be selected if the overrange indicator OVER on the front of the controller lights up permanently at scan points with high amplitude.

For low-frequency applications the ranges 1 $\frac{mm}{s}$/V, 5 $\frac{mm}{s}$/V and 25 $\frac{mm}{s}$/V are available. These measurement ranges can be used from the frequency 0 Hz (full DC capability). For both measurement ranges 1 $\frac{mm}{s}$/V and 5 $\frac{mm}{s}$/V please pay attention to the information on setting the tracking filter provided in section 4.2.3.

For high-frequency applications the top three ranges of model PSV 300-F (25 $\frac{mm}{s}$/V; 125 $\frac{mm}{s}$/V; 1 000 $\frac{mm}{s}$/V) provide an extended frequency range of up to 1.5 MHz which can be digitally processed up to 1 MHz by the software.

If either the positive or negative end of the measurement range is reached the overrange is indicated in the software and the indicator OVER on the front of the controller lights up. As a general rule, the next highest measurement range should then be selected. Please note however, that the indicator is activated by very short overrange already which could be caused by noise spikes. In such cases the measurement range can be retained as long as it is suitable for the amplitude of the required signal. Observing the signal in the time domain will provide clarification on this.

4.2.2 Low Pass Filter

The controller is equipped with an adjustable analog low pass filter which adapts the bandwidth of the measurement signal to the application. When displaying a signal in the time domain, the signal-to-noise ratio can be improved by limiting the bandwidth to the necessary extent. When analyzing in the frequency domain, this filter has no additional benefit. With the filter switched on, its influence on both amplitude and phase of the velocity signal has to be taken into consideration.

Note that the software uses appropriate antialias filters which are automatically adapted to the bandwidth set.

PSV 300-H

In the PSV 300-H, low pass filters with 8th order Butterworth characteristics are used. Multiples of 0.4 kHz up to a maximum of 102.4 kHz can be selected for the cutoff frequency. The amplitude error in the pass band can be roughly estimated as follows:

- Up to 75% of the cutoff frequency, the maximum amplitude error is ±1%.
- At the cutoff frequency, the amplitude error is −3 dB (approx. −30%).

The phase shift increases with the frequency as shown in figure 4.3. Up to approximately 50% of the cutoff frequency the phase shift increases proportionally to the frequency.

The complete amplitude frequency response of an 8th order Butterworth low pass filter is shown in figure 4.1. The frequency is normalized to the cutoff frequency f_c.

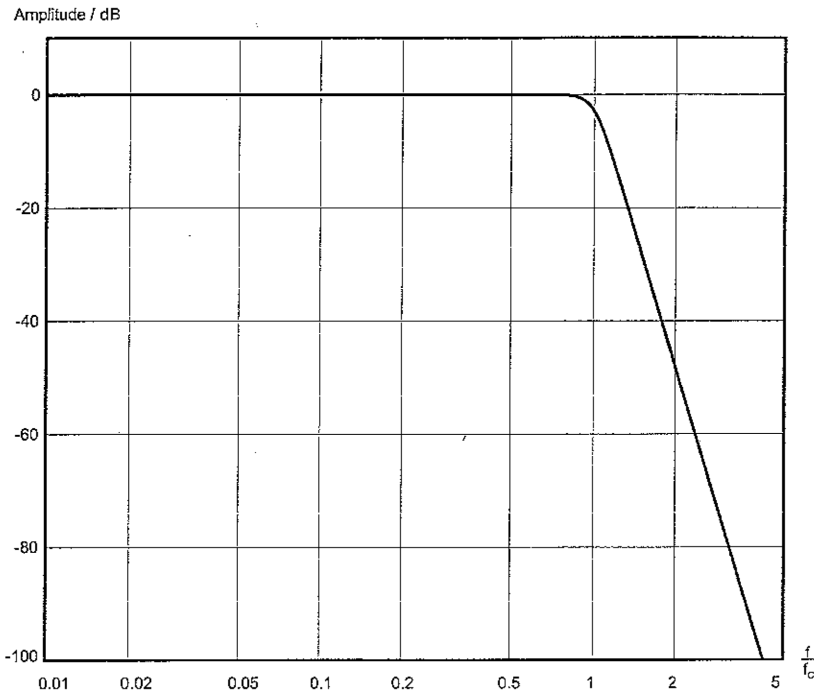


Figure 4.1: Amplitude frequency response of an 8th order Butterworth low pass filter

The amplitude error in the pass band caused by the filter can be determined from figure 4.2.

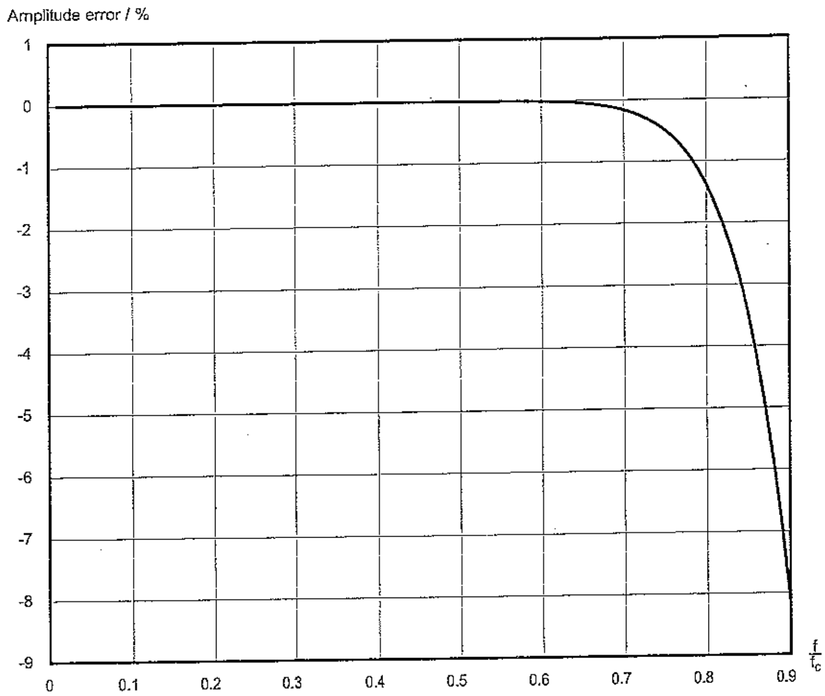


Figure 4.2: Amplitude error of an 8th order Butterworth low pass filter

The phase frequency response of the filter is shown in figure 4.3.

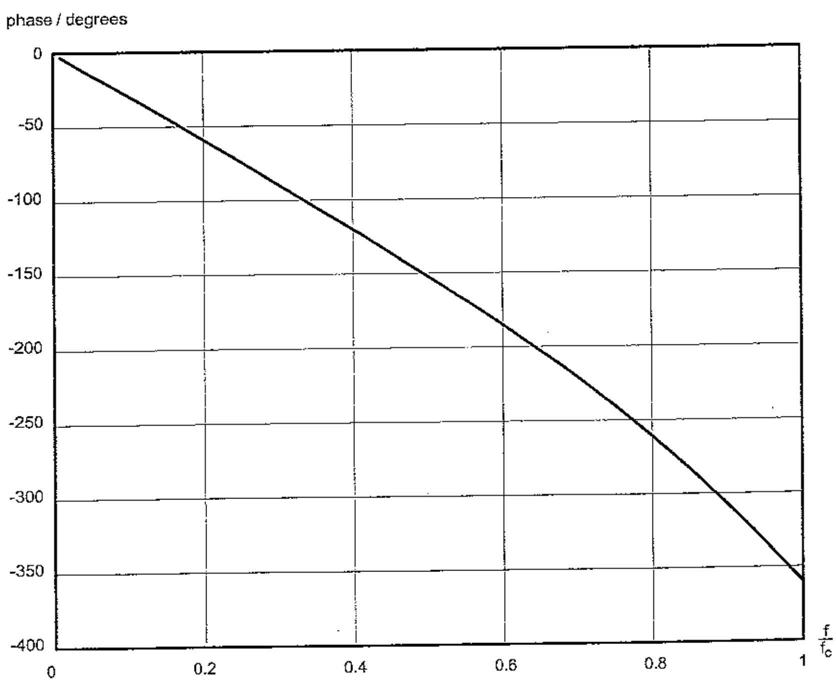


Figure 4.3: Phase frequency response of an 8th order Butterworth low pass filter in the pass band

PSV 300-F, -U

In the PSV 300-F and -U low pass filters with 3rd order Bessel characteristics and cutoff frequencies of 5 kHz, 20 kHz or 100 kHz are used. Characteristic for Bessel filters is the phase linearity from the frequency zero up to the cutoff frequency, i.e. the phase shift increases in proportion to the frequency. The filter however, causes amplitude errors in the pass band which can be roughly estimated:

- Up to 20% of the cutoff frequency, the maximum amplitude error is ±1%.
- At the cutoff frequency, the amplitude error is −3 dB (approx. −30%).

The phase shift increases in proportion to the frequency from Zero degree at the frequency Zero to approximately −100 degrees at the cutoff frequency (refer to figure 4.6). Due to this linear phase frequency response, the filter shows optimal transmission behavior for pulses, as all frequencies of a complex wave are subjected to the same time delay. Thus the shape of the pulse is not falsified but it is merely delayed.

The complete amplitude frequency response of a 3rd order Bessel low pass filter is shown in figure 4.4. The frequency is normalized to the cutoff frequency f_c.

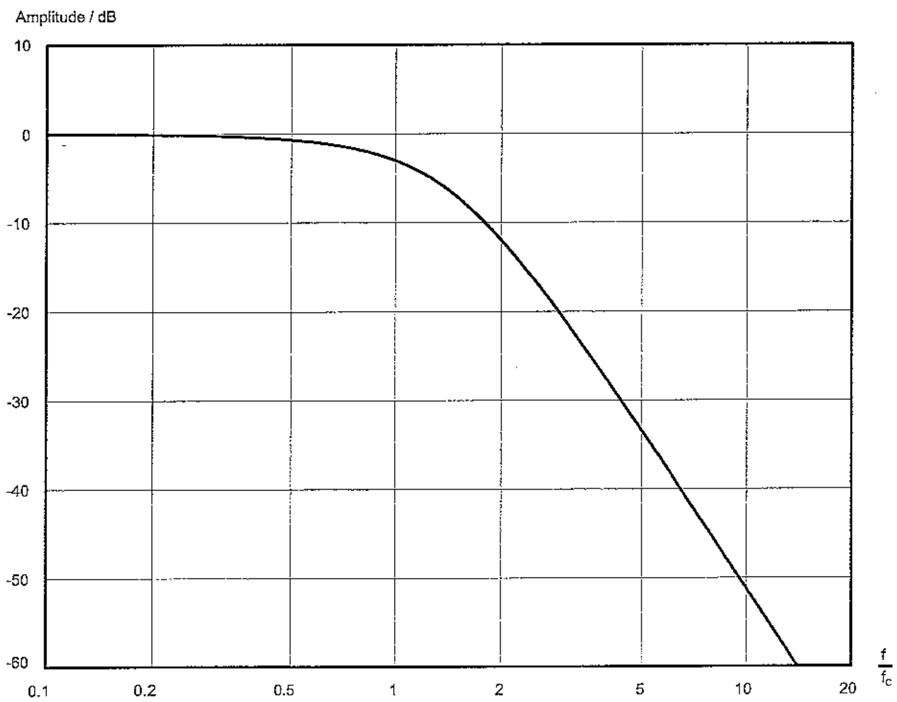


Figure 4.4: Amplitude frequency response of a 3rd order Bessel low pass filter

The amplitude error caused by the filter can be determined from figure 4.5.

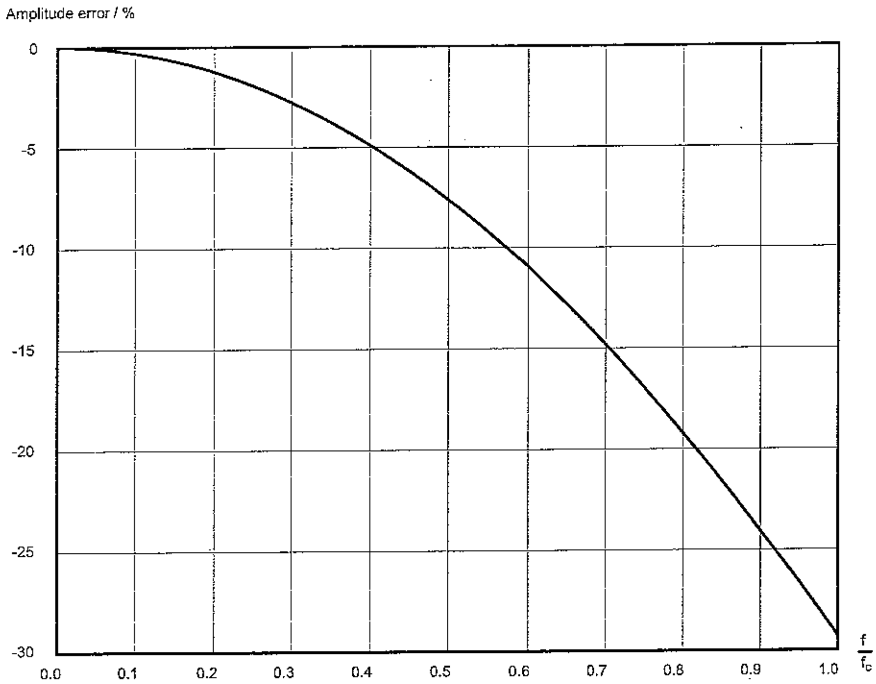


Figure 4.5: Amplitude error of a 3rd order Bessel low pass filter in the pass band

The phase frequency response of the filter is shown in figure 4.6.

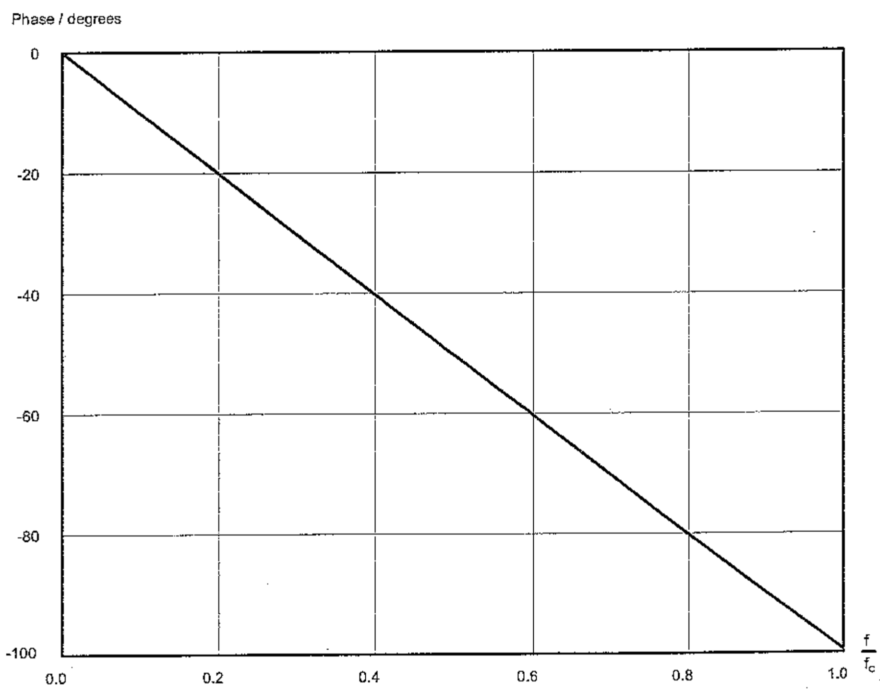


Figure 4.6: Phase frequency response of a 3rd order Bessel low pass filter in the pass band

Phase shift caused by the velocity decoder

An additional time delay is caused by the velocity decoder. It depends on the measurement range and is approximately a few microseconds. The resulting overall phase shift $\Delta\Phi$ can be estimated using the following simple equation:

$$\Delta\Phi = \Phi_{LP} + p_s \cdot f \qquad \text{Equation 4.1}$$

Φ_{LP} ... phase shift of the low pass filter, refer to figure 4.3 and figure 4.6

p_s ... specific phase roll-off, refer to specifications in section 7.1.3

f ... frequency in kHz

4.2.3 Tracking Filter

The tracking filter is used to improve the signal-to-noise ratio of the interferometer signal. This is particularly good for bridging short dropouts which occur due to the speckled natured of the light scattered back. The bridging capability is generally better with a high time constant SLOW, however, it may not be possible to follow highly dynamic signals any more. In this case, FAST or OFF have to be selected. The best setting therefore has to be determined from case to case or be estimated based on the range diagram in figure 4.7. The range diagram shows the dynamic limits for both settings of the tracking filter, plotted versus the frequency.

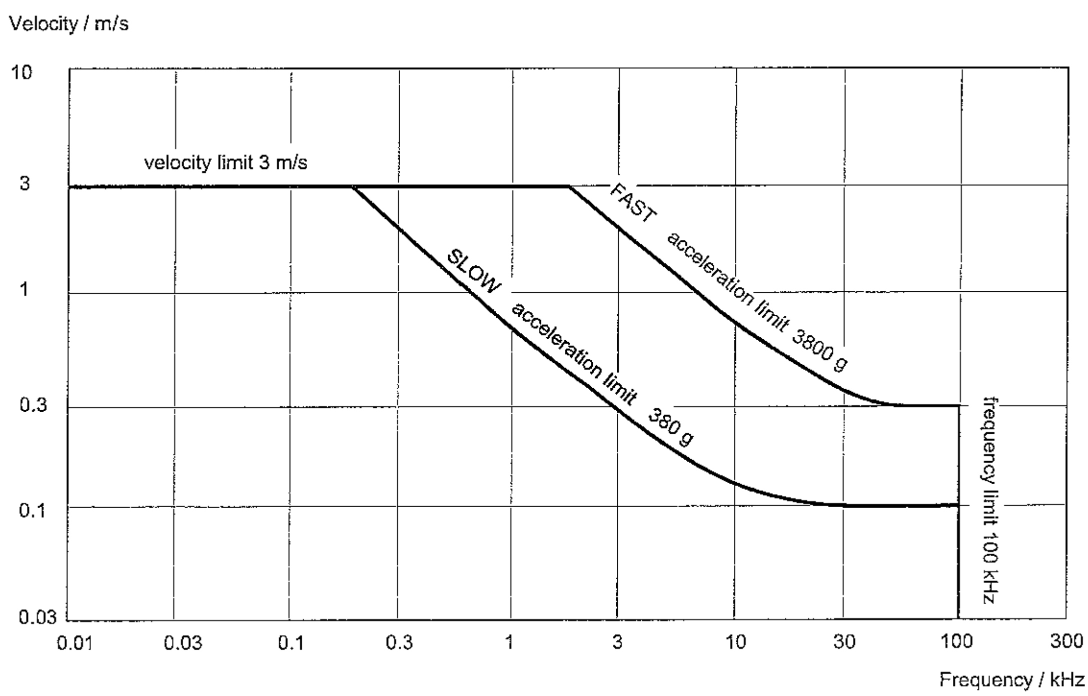


Figure 4.7: Operating ranges of the tracking filter

A constant velocity limit of approximately 3 m/s is characteristic for the lower frequency range. If the velocity exceeds this value, it means that the tracking filter generally has to be switched OFF. In the medium frequency range, the velocity limit changes over to become an acceleration limit, i.e. the velocity limit decreases in inverse proportion to the frequency. In the upper frequency range a constant velocity limit becomes effective again.

To set the tracking filter, the diagram in figure 4.7 can be summarized in the following general rules:

- For frequencies above 100 kHz as a general rule the tracking filter should be switched off. In principle it can follow higher frequencies but in this range amplitude errors of up to approximately 10% can occur due to dynamic errors.
- For medium velocities and frequencies, the acceleration limits of the tracking filter have to be taken into consideration. The optimal setting must be found with the diagram. If the velocity or acceleration limits are exceeded, the tracking filter loses lock (refer to section C.2). This will cause serious signal distortions, an example of which can be seen in figure 4.8.

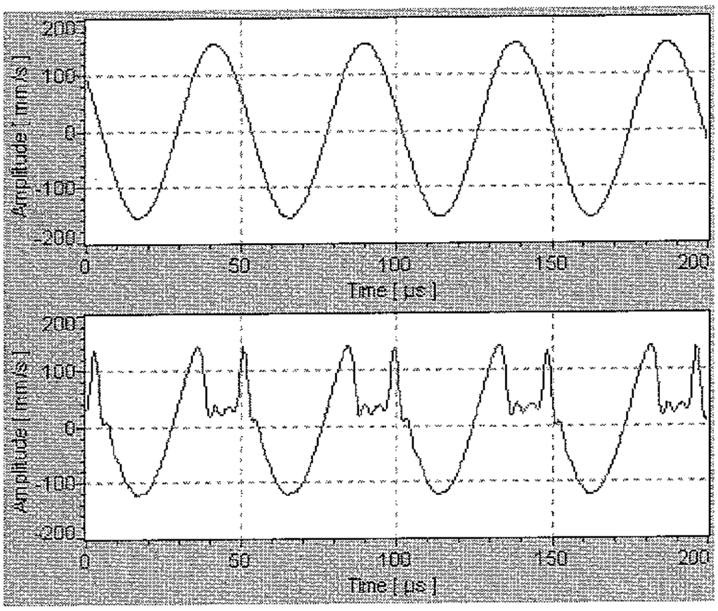


Figure 4.8: True velocity signal (top) and signal when the tracking filter loses lock (bottom)

The upper trace in figure 4.8 shows the sinusoidal velocity signal with the tracking filter in position OFF. The lower trace shows the velocity signal with the tracking filter in position SLOW. The tracking filter is on the limit of the range where it loses lock, the signal is partly distorted.

- In the measurement ranges 1 $\frac{mm}{s}$/V, 5 $\frac{mm}{s}$/V and 10 $\frac{mm}{s}$/V, the tracking filter should be set to SLOW as a general rule.
- Using the velocity decoder PLL-DC the tracking filter is particularly important. For technical reasons the PLL-DC is more sensitive to dropouts than the decoder OVD-04. Thus the tracking filter should be set to SLOW as long as the acceleration limit is not exceeded (refer to figure 4.7).

4.3 Optimal Stand-off Distances for the Scanning Head

The stand-off distance is measured from the front panel of the scanning head. The optimal stand-off distances are:

$14\,\text{mm} + n \cdot 203\,\text{mm}, \qquad n = 0; 1; 2; \ldots$

i.e. at 14 mm; 217 mm; 420 mm; 623 mm; etc.

Maxima of visibility

The light source of the PSV is a helium neon laser. This is a multimode laser in which a maximum of two modes can exist. The interference of the two modes leads to the intensity of the resulting optical signal varying periodically with the stand-off distance. The intensity increases to a maximum, i.e. a maximum of visibility is present if the optical path difference is an even-numbered multiple of the length of the laser cavity (203 mm). As the optical path difference is equal to twice the stand-off distance (the beam goes there and back), a maximum of visibility is present once per laser cavity length.

In practice, it is not usually necessary to search for the maximum of visibility as the PSV is sensitive enough to make a measurement even close to the minimum. A minimum is indicated during the warm-up phase by periodic fluctuation on the signal level display.

5 Operating the PSV

5.1 Switching On and Off

Controller

The controller is switched on by turning the key switch on the front panel to position I. The LED POWER above the key switch lights up and shows that the controller is ready to operate.

Is the PSV correctly cabled as described in section 3.4.2, the LED POWER on the front of the junction box also lights up and shows that the junction box is ready to operate. Also the LED LASER on the scanning head lights up and shows that the scanning head is ready to operate and that the laser is active, even if the beam shutter is closed (refer to section 5.2 and section 5.3).

Workstation

To switch on the workstation, set the main switch on the back to position I. Then open the front flap using the key and push the black button.

5.2 Blocking the Laser Beam

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

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

Warning!
Only switch the beam shutter to the ON position when you are making measurements!

Warning!
To position the scanning head, switch the beam shutter to the OFF position. Only when the head is roughly in place and has been fixed in a stable position, switch the beam shutter to ON for precise adjustment.

5.3 Indicating Laser Activity

On the back of the scanning head the LED LASER below the rotary knob of the beam shutter indicates the laser activity. The LED is lit when the laser is active (key switch on the front of the controller in position I). The LED is lit regardless of whether the beam shutter is open or closed.

5.4 Setting up the Scanning Head

Fluid stage

If your PSV is equipped with a tripod and a fluid stage, you can manually setup the scanning head using the three hand-grips as described in the assembly instruction provided by the manufacturer MANFROTTO.

Pan-tilt stage (optional)

If your PSV is equipped with a heavy-duty tripod and a motorized pan-tilt stage, it is easier to setup the scanning head. You control the pan-tilt stage either with the software (refer to your software manual) or using the four control keys on the front of the junction box.

The scanning head can be panned to the left and right by ±90 degrees using the control keys ← and →. It can be tilted upward and downward by ±84° using the control keys ↑ and ↓.

> **Caution!**
>
> Avoid any additional weighting on the pan-tilt stage by placing objects on top of the scanning head or attaching things to it! This may put strain on the pan-tilt stage.

Stand-off distance

Please pay also attention to the information on optimal stand-off distances for the scanning head provided in section 4.3.

5.5 Dust Cover on the Scanning Head

The scanning head is equipped with a dust cover to protect the scanner mirrors and the front lens of the video camera when you are not making measurements.

The dust cover is closed by rotating the switch bar on the front of the scanning head into vertical position.

> **Caution!**
>
> To protect the lenses and scanner mirrors, **only** open the dust cover when your are making measurements!

5.6 Focusing the Laser Beam

Hand set PSV-Z-051

The hand set PSV-Z-051 is connected to the circular jack REMOTE CONTROL on the front of the scanning head. You can focus the laser beam using the emphasized part of the hand set shown in figure 5.1.

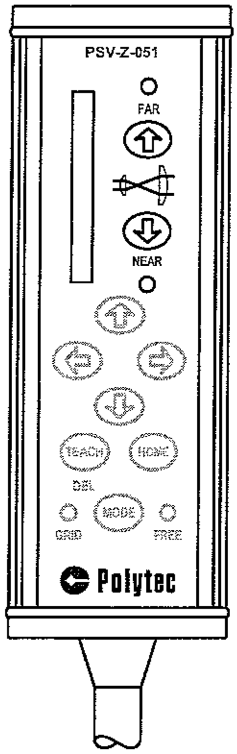


Figure 5.1: Focusing the laser beam using the hand set PSV-Z-051

> **Note!**
>
> **Never** use the hand set PSV-Z-051 together with the optional hand set OFV-310 (refer to section A.3)!

Using the two arrow keys FAR and NEAR, the laser beam is focused as follows:

- Focusing on infinity: key ↑ FAR
- Focusing close-up: key ↓ NEAR

If you press the keys for more than approximately one second, the motor switches over to fast mode. For fine positioning, the keys can be repeatedly pressed briefly. At the end of the adjustment range, the motor stops automatically and the respective LED FAR or NEAR lights up.

Beside the keys for focusing, there is a signal level display which helps you to optimize the focus. The signal shown is identical to that on the scanning head and on the display of the controller.

Software

When the PSV is controlled via the software (LEDs REMOTE and LLO are lit up), you can use the software to focus the laser beam, please refer to your software manual.

Controller

When the controller is operated without the software, you can focus the laser beam via the menu FOCUS (refer to section 5.12.3).

Hand set OFV-310 (optional)

To focus the laser beam, you can also use the optional hand set OFV-310 instead of the hand set PSV-Z-051 (refer to section A.3).

5.7 Optimizing the Focus of the Laser Beam

The signal level display helps you to optimize the focus of the laser beam. The signal level is shown as a bar display:

- on the back of the scanning head
- on the display of the controller
- in the software (refer to your software manual)
- on the hand set PSV-Z-051 (refer to section 5.6)
- on the optional hand set OFV-310 (refer to section A.3).

5.8 Positioning the Laser Beam

Hand set PSV-Z-051

The hand set PSV-Z-051 is connected to the circular jack REMOTE CONTROL on the front of the scanning head. You can position the laser beam using the clearly visible part of the hand set shown in figure 5.2. To do so, proceed as follows:

1. Switch on the workstation and start the PSV software.
2. Change to the Acquisition Mode as described in your software manual.

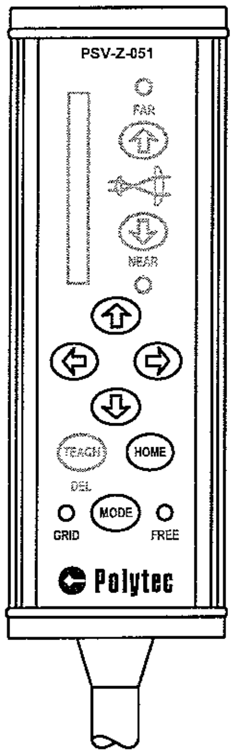


Figure 5.2: Positioning the laser beam using the hand set PSV-Z-051

3. Press the MODE key on the hand set to select the kind of movement.

   The laser beam can be positioned in the GRID mode or in the FREE mode.

GRID mode (LED GRID is lit up)

You move the laser beam on already defined scan points using the arrow keys. The order in which the software approaches the scan points is determined by an internal algorithm. Using the keys → or ↑, you move the laser beam forwards along the scan points and backwards using the keys ← or ↓. If you press the HOME key, the laser beam is positioned on the first scan point.

Note!
The longer you hold the arrow key pressed, the faster the laser beam moves!

FREE mode (LED FREE is lit up)

You move the laser beam freely using the arrow keys. To do so, press the arrow key for the direction you require. If you press the HOME key, then the laser beam is positioned so that it is emitted from the scanning head perpendicular to the front panel (position (0;0), is indicated in the software).

Software

When the PSV is controlled via the software (LEDs REMOTE and LLO are lit up), you can use the software to position the laser beam, please refer to your software manual.

5.9 Defining and Deleting Scan Points (APS)

Note!
Defining and deleting individual scan points is only available if you have the software option APS Professional (PSV-Z-062)!

Hand set PSV-Z-051

The hand set PSV-Z-051 is connected to the circular jack REMOTE CONTROL on the front of the scanning head. You can define and delete individual scan points using the clearly visible part of the hand set shown in figure 5.3. To do so, proceed as follows:

1. Switch on the workstation and start the PSV software.
2. Change to the Acquisition Mode then to Define Scan Points and select the Point Mode as described in your software manual.

To define scan points, select the FREE mode using the MODE key on the hand set (LED FREE is lit up).

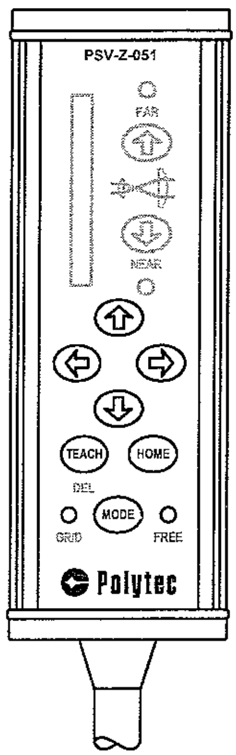


Figure 5.3: Defining and deleting scan points using the hand set PSV-Z-051

3. Using the four arrow keys, move the laser beam to the desired position.
4. Press the TEACH button and the scan point is defined.
   The newly defined scan point is shown in the software.

5. Repeat steps 3 and 4 until all desired scan points are defined.

Note!
To get a 3D view style of the data, you have to define connections in the software. Please refer to your software manual.

To delete defined scan points, select the GRID mode using the MODE key on the hand set (LED GRID is lit up). The TEACH key now functions as DEL key (for deleting).

6. Using the arrow keys, move the laser beam forwards or backwards to the scan point you want to delete.
7. Press the DEL key and the selected scan point is deleted.
8. Repeat steps 6 and 7 until all desired scan points are deleted.

Note!
If you press the DEL key for more than approximately one second, the scan points will be deleted one after the other!

Software When the PSV is controlled via the software (LEDs REMOTE and LLO are lit up), you can use the software to define and delete scan points, please refer to your software manual.

5.10 Settings

Software When the PSV is controlled via the software (LEDs REMOTE and LLO are lit up), all settings are adjusted via the software, refer to your software manual. In this case the keys FUNCTION and SETTING on the front of the controller do not have a function.

You will find information on setting the measurement range and the filters in section 4.2.

Controller When the controller is operated without the software, you can set the measurement range and the filters via a menu on its display using the keys FUNCTION and SETTING (refer to section 5.12).

5.11 Overrange Indicator

Software Overranging is indicated in the software. Please refer to your software manual.

Controller If the LED OVER on the front of the controller is lit up continuously, it means that the measurement range set is being exceeded. In this case the next highest measurement range must be selected. You will find further information on setting the measurement range in section 4.2.1.

5.12 Operating the Controller without the Software

5.12.1 Operating Philosophy

In normal operation the keys FUNCTION and SETTING on the controller are deactivated and all settings are adjusted via the software. It is also possible to make measurements without using the workstation. In this case you can only make single-point measurements and you can not make use of the digital data processing of the PSV. The velocity signal is then available at the BNC jack VELOCITY OUTPUT on the front of the controller.

The controller is operated via a menu on its display using the keys FUNCTION and SETTING. The operating structure is mainly self-explanatory. The individual menus are described in section 5.12.3.

FUNCTION: Using the keys ↑ and ↓ a menu is selected and within the menu a parameter is selected.

SETTING: Settings are changed using the keys + and –.

The menu SETTINGS is shown in figure 5.4 as an example of the display.

			Focus ↑
⇒	Tracking Filter	Fast	
	Velocity Decoder	HF	
	Velocity Range	125 mm/s/V	
	Velocity Filter	off (1.5 MHz)	
	Signal		
			Config ↓

Figure 5.4: Example of the controller's display

The parameters are run through vertically on the display using the keys ↑ and ↓. Once the end of the display page is reached, it changes to the next menu. The possibility of branching off to other menus is shown at the top and the bottom on the right.

The cursor ⇒ on the left marks a selected parameter. The setting of the parameter is changed to higher and lower values with the keys + and –. Adjusted settings are activated straight away.

As the control processor has a battery supported memory, the settings are stored when the instrument is switched off and reloaded when it is switched on again or after RESET. This saves time making adjustments for repeated measurements.

5.12.2 Organization of the Menus

The organization of the menus is shown in figure 5.5.

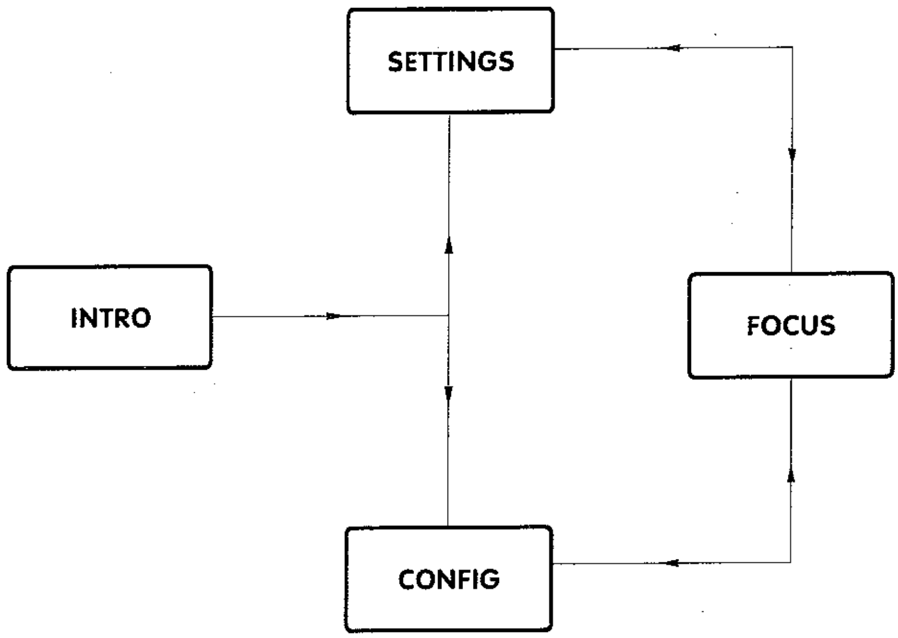


Figure 5.5: Organization of the controller's menus. Menu FOCUS is optional.

The menus are organized as follows:

INTRO: The start menu appears after switching on the controller or after RESET.

SETTINGS: This is the most important menu in which all settings for a measurement in stand-alone operation are made i.e. the measurement ranges and the filters are selected. It also displays the signal level.

CONFIG: This menu provides information on the configuration of the controller i.e. the decoders and interfaces installed. The interfaces can be configured in this menu.

FOCUS: The laser beam can be focused in this menu. It also displays the signal level.

5.12.3 The Individual Menus

Menu INTRO After being switched on or RESET, the controller shows that it is ready to operate with the menu INTRO. It is not possible to change back to this menu as it does not have a control function.

Menu CONFIG This menu provides information on the decoders and interfaces installed. The individual configurations are described in the following.

Velocity Decoder

This line shows the velocity decoders installed and the number of available velocity measurement ranges. The following abbreviations are used for the individual decoders:

Table 5.1: Abbreviations of the individual velocity decoders

Abbreviation	Decoder
DC	PLL-DC
HF	OVD-04

Example:
3DC + 4HF means that the velocity decoder PLL-DC with 3 measurement ranges and the velocity decoder OVD-04 with 4 measurement ranges are installed.

IEEE Bus Interface

When operating the controller via the IEEE-488/GPIB interface on the back in this line the instrument address can be set in the range **1...30**.

Note!

If you control the PSV using the software via the IEEE-488/GPIB interface, the IEEE-488/GPIB address of the controller must be set to **5**!

Serial Interface

When operating the controller via the RS-232 interface on the back in this line it is possible to switch between the transfer rates **4800 Baud** and **9600 Baud**.

Note!

For all PSV models, here the transfer rate must be set to **9600 Baud**!

Menu SETTINGS

In the menu SETTINGS the measurement ranges and filters are set. The contents of the menu depends on the decoders installed. The individual settings have the following meaning.

Tracking Filter

In this line you can set the tracking filter. The input signal is pre-processed with the tracking filter. You will find information on the settings **OFF/SLOW/FAST** of the tracking filter in section 4.2.3.

Velocity Decoder

In this line you can set the active velocity decoder. This line is only present if both decoders OVD-04 and PLL-DC are installed. The velocity decoders are abbreviated as described above in table 5.1.

> **Note!**
>
> If the DC decoder is selected and the velocity measurement range 1 $\frac{mm}{s}$/V is set, it is not possible to change to the HF decoder because the HF decoder does not have this velocity measurement range available.

Velocity Range

In this line you can set the velocity measurement range. The possible settings depend on the velocity decoder selected. You will find information on setting the velocity measurement range in section 4.2.1.

Velocity Filter

In this line you can set the cutoff frequency of the low pass filter. The possible settings depend on the PSV model. In position OFF, the upper frequency limit of the active velocity decoder is shown. You will find information on setting the low pass filter in section 4.2.2.

Signal

This line shows the optical signal level as a bar display.

Menu FOCUS

In this menu, the laser beam is focused using the – and + keys. The movement of the motor to position the front lens is shown on the display of the controller with following symbols:

< and >	Motor is running slowly
<< and >>	Motor is running quickly
I<< and >>I	Motor has stopped at the end of the adjustment range

The bar in the lower line of the display shows the optical signal level.

6 Fault Diagnosis

Simple tests are described in the following which you can carry out yourself in the case of malfunction. In the case of more difficult faults in 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.

Testing the PSV 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 PSV has to be sent back for repair, please use the original packaging and enclose an exact description of the fault.

6.1 General Tests

If any system component of the PSV does not function properly, please first check the following:

1. Is the PSV correctly cabled as described in section 3.4.2?

2. Are there only original RS-232 cables from Polytec used (1:1 wired)?

3. Is the transfer rate set to 9600 Baud (refer to section 5.12.3)?

4. If you control the PSV using the software via the IEEE-488/GPIB interface: Is the IEEE-488/GPIB address of the controller set to 5 (refer to section 5.12.3)?

Check whether the data acquisition board is correctly installed. To do so, proceed as follows:

5. Double-click the icon Measurement&Automation on the desktop.

6. Change into the folder Devices and Interfaces.

   The data acquisition board is correctly installed, if in the folder PCI-4451 or PCI-4452 or PCI-6111 is listed. If not, please check whether the data acquisition board is properly inserted into its slot in the workstation.

6.2 No Laser Beam

If no laser beam is emitted, check the following:

1. Is the PSV correctly cabled as described in section 3.4.2?
2. Is the key switch on the front of the controller in position I?
3. Is the dust cover on the front of the scanning head open (switch bar in horizontal position)?
4. Is the beam shutter on the back of scanning head in position ON?
5. Is the LED LASER on the back of the scanning head lit up?

Warning!
Always disconnect from the mains **before** checking the fuses!

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

6. Is the LED POWER on the front of the junction box lit up?

Warning!
Always disconnect from the mains **before** checking the fuses!

If the LED is not lit up, it can be assumed that there is a fault with the power supply of the junction box. In this case disconnect the mains plug and check the fuses on the back panel. Please note that there are two active fuses which can both lead to failure.

6.3 No Velocity Signal

If the laser beam is emitted but there is no velocity signal, check the following:

1. Is the PSV correctly cabled as described in section 3.4.2?
2. Put a matt white test surface such as a piece of paper at approximately 20 cm from the front panel of the scanning head in the beam path. Does the signal level display react?

   If the signal level display does not react, the input section of the controller is faulty.

Data acquisition

Check the correct function of the data acquisition board and the software as follows:

3. Disconnect the BNC cable for the velocity signal from the BNC jack VELO on the front of the junction box.
4. Feed the signal of a function generator to this BNC jack.
5. Display the time signal in an analyzer as described in your software manual.

   The data acquisition board and the software work properly, if the signal of the function generator is displayed correctly. In this case there is a problem in the controller.

Output signal

Now check the output signal of the controller as follows:

6. Re-connect the velocity signal to the BNC jack VELO on the front of the junction box.
7. Display the time signal in an analyzer as described in your software manual.
8. Set the measurement range to $10\frac{mm}{s}/V$. Does the output signal react to the test surface moving?
9. If the output signal does not react, check whether a significant DC offset is present.

   Normally a DC voltage of less than ±50 mV is measured.
10. Block the laser beam. Is the output signal noisy or is a straight line shown?

    Noise must occur when the laser beam is blocked.

7 Technical Specifications

7.1 Controller OFV-3001 S

7.1.1 General Data

Mains voltage:	100/115/230 VAC ±10%, 50/60 Hz, adjustable on the back panel
Power consumption:	max. 150 VA
Fuses:	1.0 A/slow-blow for 230 V 2.0 A/slow-blow for 100/115 V
Protection class:	I (protective grounding)
Operating temperature:	+5°C...+40°C (41°F...104°F)
Storage temperature:	−10°C...+65°C (14°F...149°F)
Relative humidity:	max. 80%, non-condensing
Dimensions:	450 mm × 355 mm × 135 mm
Weight:	10.8 kg
Calibration recommended:	every 2 years

7.1.2 Low Pass Filter

PSV 300-H

(for typ. amplitude and phase frequency response refer to section 4.2.2)

Filter type:	Butterworth 8th order
Cutoff frequencies:	400 Hz ... 102.4 kHz, adjustable in steps of 400 Hz
Frequency roll-off:	−160 dB/dec = −48 dB/oct
Stop band rejection:	> 80 dB

PSV 300-F, -U

(for typ. amplitude and phase frequency response refer to section 4.2.2)

Filter type:	Bessel 3rd order
Cutoff frequencies:	5 kHz, 20 kHz, 100 kHz, adjustable
Frequency roll-off:	−60 dB/dec = −18 dB/oct
Stop band rejection:	> 70 dB

7.1.3 Signal Voltage Output VELOCITY OUTPUT

General Data

Output swing: ±10 V
Output impedance: 50 Ω
Minimum load resistance: 10 kΩ (–0.5% additional error)
Overrange indicator threshold: typ. 95% of full scale
Maximum DC-offset: Velocity decoder PLL-DC: ±50 mV
Velocity decoder OVD-04: ±20 mV

Measurement Ranges

Velocity decoder	Measurement range (scaling factor)	Full scale output (peak-peak)	Resolution[1]	Maximum frequency[2]		Maximum acceleration	
				-H, -U	-F	-H, -U	-F
	$\frac{mm}{s}$/V	$\frac{mm}{s}$	$\frac{\mu m}{s}$	kHz	kHz	g	g
PLL-DC	1	20	0.3	20	20	150	150
	5	100	0.3	50	50	1600	1600
	25	500	0.8	50	50	8000	8000
OVD-04	10	200	0.5	200	200	12000	12000
	25	500	2	250	1000	40000	160000
	125	2,500	5	250	1500	200000	1200000
	1000	20000	10	250	1500	1600000	9600000

[1] Resolution is defined as the signal amplitude (rms) at which the signal-to-noise ratio is 0 dB in a 10 Hz spectral bandwidth (RBW), measured at 3M Scotchlite Tape®.

[2] –1 dB maximum error

Calibration Accuracy

Velocity decoder	Measurement range	Amplitude error	
		@ T = (25±5) °C (T = (77±9) °F)	full operating temperature range
	$\frac{mm}{s}$/V	% of rms reading	% of rms reading
PLL-DC	1		
	5	±1.0	±1.2
	25		
OVD-04	10	±1.0	±1.5
	25	±1.0	±2.0
	125	±1.5	±2.5
	1000	±1.5	±2.5

Conditions: sinusoidal vibration, f = 1 kHz, amplitude 70% of full scale range, load resistance ≥ 1 MΩ

Amplitude Linearity

Maximum linearity error: ±1% of rms. reading (one particular range)
±2.5% of rms. reading (overall)

Linearity error is defined as the amplitude-dependent, relative deviation of the scaling factor referred to the nominal scaling factor under calibration conditions.

Amplitude Frequency Response (Flatness)

Velocity decoder	Measurement range mm/s/V	Max. additional error referred to f = 1 kHz
PLL-DC[1]	1	0 Hz - 15 kHz : ±0.1 dB 15 kHz - 20 kHz : +0.1 dB/−0.25 dB
	5 and 25	0 Hz - 20 kHz : ±0.1 dB 20 kHz - 50 kHz : ±0.2 dB
OVD-04	10	0.5 Hz - 10 Hz : ±0.5 dB 10 Hz - 20 kHz : ±0.05 dB 20 kHz - 100 kHz : +0.05 dB/−0.2 dB 100 kHz - 200 kHz : +0.05 dB/−1 dB
	25, 125 and 1 000	0.5 Hz - 10 Hz : ±0.5 dB 10 Hz - 20 kHz : ±0.05 dB 20 kHz - 100 kHz : ±0.15 dB 100 kHz - 200 kHz : ±0.3 dB 200 kHz - 1 MHz : ±0.8 dB[2]

[1] The measurement ranges of this decoder can be used from the frequency 0 Hz (full DC capability).

[2] PSV 300-F only

Phase Frequency Response

With the low pass filter switched off, the velocity decoder behaves as a system of constant time delay up to approximately 60% of the maximum frequency of the measurement range set, i.e. the phase shift is proportional to the frequency. The phase shift depends, however, on the range settings.

Velocity decoder	Measurement range	Time delay (typ.)		Specific phase roll-off p_s (typ.)	
		-H, -U	-F	-H, -U	-F
	mm/s/V	µs	µs	°/kHz	°/kHz
PLL-DC	1	24	24	−8.6	−8.6
	5	7.1	7.1	−2.6	−2.6
	25	6.0	6.0	−2.2	−2.2
OVD-04	10	6.1	6.1	−2.2	−2.2
	25	5.5	1.9	−2.0	−0.7
	125	5.5	1.9	−1.9	−0.7
	1 000	3.5	0.9	−1.3	−0.33

Harmonic Distortions

Measurement range	THD @ f = 1 kHz	
$\frac{mm}{s}$/V	up to 70% of full scale range	up to full scale
1, 5, 10 and 25	< 0.2% (< −54 dB)	< 0.3% (< −50 dB)
125 and 1 000	< 0.3% (< −50 dB)	< 0.5% (< −46 dB)

7.1.4 Interfaces

RS-232:	8 data bits, no parity, baud rate 4800 or 9600 9-pin female Sub-D cable to the workstation, 1:1 wired
IEEE-488/GPIB:	according to IEEE-488.1
REMOTE FOCUS:	special interface for the optional hand set OFV-310
EXT.DEC.:	special interface for an external digital displacement decoder
SIGNAL:	0V...3V DC, proportional to the logarithm of the optical signal level, load resistance ≥ 10 kΩ

7.2 Junction Box PSV-Z-040

7.2.1 General Data

Mains voltage:	100...240 VAC ±10%, 50/60 Hz
Power consumption:	max. 75 VA
Fuses:	2.0 A/slow-blow
Protection class:	I (protective grounding)
Operating temperature:	+5°C...+40°C (41°F...104°F)
Storage temperature:	−10°C...+60°C (49°F...149°F)
Relative humidity:	max. 80%, non-condensing
Dimensions:	450 mm × 355 mm × 90 mm
Weight:	5.8 kg

7.2.2 Interfaces

RS-232

Baud rate:	9600 Baud
Data format:	8 data bits, 1 stop bit, no parity bit
Cable:	9-pin female Sub-D cable, 1:1 wired
Pins:	pin 2: received data Red (←)
	pin 3: transmitted data Axed (→)
	pin 5: reference potential GND
	pin 1; 4; 6; 7; 8; 9: N/A

VELO, REF (REF1...REF3 at Model -H)

Input impedance:	1 MΩ in parallel with 100 pF
Input coupling:	AC/DC, adjustable in the software
	AC −3 dB cutoff frequency: 3.4 Hz
Over voltage protection:	±42 V

TRIG IN

Compatibility:	TTL
Input voltage:	max. +5.5 V
Input current:	max. 1 mA

GATE IN

Compatibility:	TTL
Input voltage:	max. +7.0 V

OUT1, OUT2, OUT3 (Only Model -H)

Output voltage swing:	max. ±10V referred to GND
Output current:	max. ±5mA
Output impedance:	< 0.1Ω
Short circuit protection:	permanently short circuit proof
Load resistance:	min. 2kΩ
Load capacity:	unlimited

SIGNAL (Only Model -F, -U)

Output voltage swing:	max. ±10V referred to GND
Output current:	max. ±5mA
Output impedance:	50Ω
Short circuit protection:	permanently short circuit proof
Load resistance:	min. 2kΩ
Load capacity:	unlimited

SYNC (SYNC OUT at Model -H)

Compatibility:	TTL
Output HIGH voltage:	min. 4.35V (I_{out} = 3.5mA)
Output LOW voltage:	max. 0.4V (I_{out} = 5mA)

AUX OUT

Compatibility:	TTL
Output HIGH voltage:	min. 2.4V (I_{out} = 15mA)
Output LOW voltage:	max. 0.5V (I_{out} = 64mA)

AUX IN (Only Model -F, -U)

Compatibility:	TTL
Input voltage:	max. +7.0V

7.3 Scanning Head OFV-056

7.3.1 General Data

Laser type:	helium neon
Wavelength:	633 nm
Cavity length:	203 mm
Laser class:	II
Laser output power:	<1 mW
Power consumption:	ca. 15 W
Operating temperature:	+5°C...+40°C (41°F...104°F)
Storage temperature:	−10°C...+65°C (14°F...149°F)
Relative humidity:	max. 80 %, non-condensing
Dimensions:	refer to section 7.3.5
Weight:	11 kg

7.3.2 Optics

Front lens[1]		Long range (QR)	Mid range (MR)
Focal length	mm	100	60
Minimum stand-off distance	mm	450	175
Aperture diameter ($1/e^2$)	mm	12	7
Spot size (typ.)	µm		
@ 175 mm		-	10
@ 450 mm		15	33
@ 1 000 mm		42	79
@ each additional meter plus		50	84
Maxima of visibility[2]	mm	$14 + n \cdot 203$, n = 0; 1; 2;...	

[1] A label shows the front lens model which is fitted. The label can be seen through the top left air vents of the scanning head (refer to figure 7.1).

[2] Measured from the front panel of the scanning head

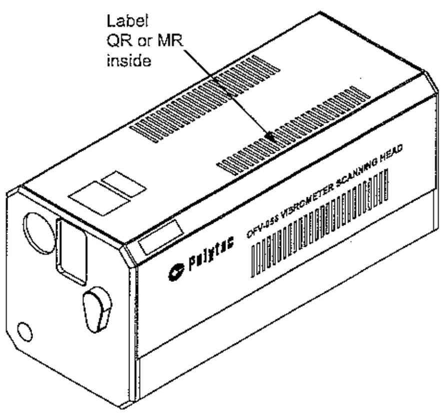


Figure 7.1: Position of the label for the front lens model

7.3.3 Scanner

Type:	servo-controlled galvo motor
Maximum deflection	horizontal: ±20°
	vertical: ±20°
Angular resolution:	<0.002°
Pointing stability:	<0.01°/hour (after warming-up)

7.3.4 Video Camera

Video system:	CCIR/PAL	
Sensor:	color CCD 1/4", 752x582 pixels	
Signal-to-noise ratio:	>50dB	
Zoom:	72x (4x digital zoom)	
Lens:	F 1.4 / f = 4.1...73mm, auto focus, auto iris	
	18-fold motor-driven zoom	
Angle of view (horizontal):	> 48°...2.7°	
Minimum stand-off distance:	@ wide end:	10mm
	@ tele end:	800mm
Minimum illumination:	3 lux	

7.3.5 Dimensions

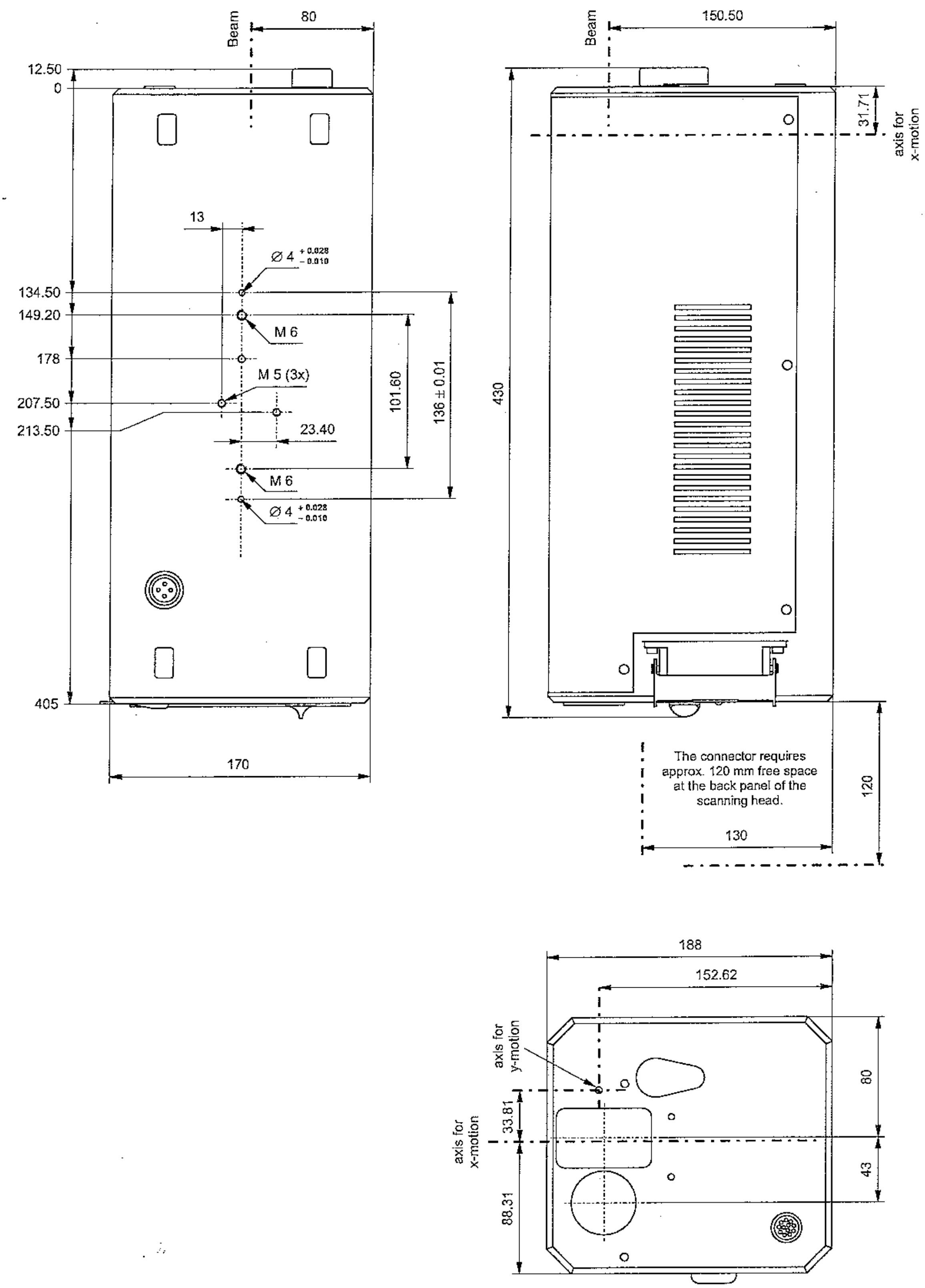


Figure 7.2: Views of the scanning head OFV-056

7.4 Workstation PSV-PC

Industrial Workstation

Mains voltage:	workstation with voltage selector: 115/230VAC, 50/60Hz, adjustable on the back panel workstation with wide range input: 100...240V, 50/60Hz
Power consumption:	max. 350VA
Processor:	min. Pentium III, 700MHz
Hard disk drive (HDD):	> 18GB
Operating system:	Microsoft® Windows2000®
Network board:	Ethernet card
CD drive/writer:	refer to user manual of the drive manufacturer
Housing:	industrial PC housing

Desktop PC

Mains voltage:	workstation with voltage selector: 115/230VAC, 50/60Hz, adjustable on the back panel workstation with wide range input: 100...240V, 50/60Hz
Power consumption:	max. 350VA
Processor:	min. Pentium III, 700MHz
Hard disk drive (HDD):	> 18GB
Operating system:	Microsoft® Windows2000® or WindowsXP®
Network board:	Ethernet card
CD drive/writer:	refer to user manual of the drive manufacturer
Housing:	desktop PC housing

Data Acquisition

PSV-Model	**PSV 300-H**	**PSV 300-F**	**PSV 300-U**
Data acquisition board	PCI-4452	PCI-6111	PCI-4451
Input channels simultaneously	4	2	2
Resolution	16bit	12...16bit effectively (depending on the bandwidth)	16bit
Maximum bandwidth	80kHz	1MHz	40kHz
Maximum number of FFT lines	6400 optional 12800	6400 optional 12800	3200 optional 6400

For further information, please refer to the manual of the data acquisition board which is installed on the workstation. Switch on the workstation and in the Start menu of the task bar, select Programs > National Instruments > NI-DAQ > Documents. There click on the corresponding manual for the data acquisition board of your PSV model.

7.5 Motorized Pan-Tilt Stage PSV-Z-017 (optional)

Mains voltage:	115/230 VAC, 50/60 Hz, adjustable on the connector box
Power consumption:	max. 30 W
Operating temperature:	−20°C...+50°C (−4°F...122°F)
Relative humidity:	max. 95%, non-condensing
Maximum angle of rotation:	pan (horizontal): ±90°
	tilt (vertical): ±84° (limited by limit switch)
Rotation velocity:	horizontal: 6°/sec.
	vertical: 5°/sec.
Backlash:	±0.5° (testing moment 10 Nm)
Dimensions:	top mount: 276 mm × 149 mm × 286 mm
Weight:	12 kg
Max. load:	18 kg

Appendix A: Optional Accessories for the Scanning Head OFV-056

A.1 Coaxial Unit and Accessories

A.1.1 Close-Up Unit OFV-056-CF97 or OFV-056-CF99

You can scan small objects at short distance using the close-up unit shown in figure A.1. Thereby the beam path of the laser is overlaid to the video image to equalize the parallax error.

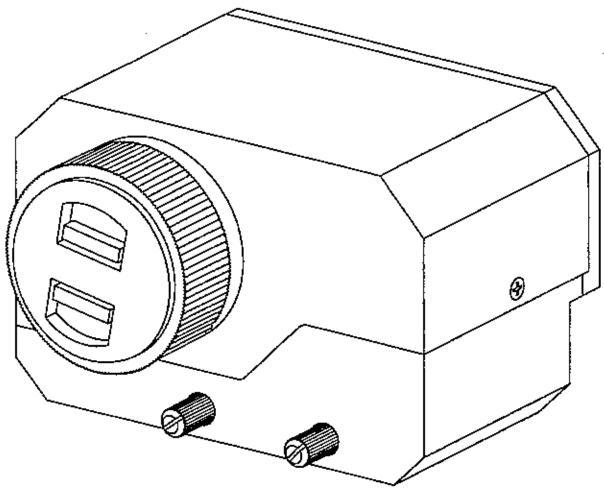


Figure A.1: Close-up unit OFV-056-C

To ensure a clearly visible laser spot on the video image, only a small part of the laser light is used for the video camera. The size of that part depends on the back scattering properties of the surface. Two models of the close-up unit are available which have different special coated beam splitters:

- **OFV-056-CF97** for mat surfaces
  (reduces the intensity of the laser light by 97%)
- **OFV-056-CF99** for highly reflective surfaces
  (reduces the intensity of the laser light by 99.8%)

Technical Specifications

Max. scan angle in x-direction:	±5°
Max. scan angle in y-direction:	±4°
Dimensions:	135 mm x 90 mm x 100 mm and figure A.2
Weight:	1.3 kg

Block Filter OFV-056-F

If the intensity of the laser light is still too high the supplied helium neon block filter should be additionally mounted. The block filter is screwed directly to the the camera aperture of the scanning head and reduces once more the intensity of the laser light back scattered to the video camera by 98%.

Close-Up Lenses

Together with the close-up unit a set of close-up lenses with different focal distances (1, 2 and 4 diopters) is delivered. A maximum of two close-up lenses or one close-up lens and the block filter can be mounted. The close-up lenses are also screwed directly to the camera aperture of the scanning head before mounting the close-up unit. The stand-off distances and the scan fields of the close-up lenses and of combinations of the lenses are shown in table A.1.

Table A.1: Stand-off distances and scan fields of the close-up lenses

Lens or combination	Stand-off distance[1]	Min. scan field (X x Y)	Nom. scan field[2] (X x Y)	Max. scan field (X x Y)	Spot diameter[3]
Diopters	mm	mm	mm	mm	µm
2	320...450	5 x 4	20 x 16	70 x 55	40
2 + 1	250...350	4 x 3	16 x 8	60 x 45	30
4	200...260	3 x 2.4	12 x 10	50 x 40	25
4 + 1	175...215	2.5 x 2	10 x 8	45 x 34	20
4 + 2	152...175	2 x 1.6	8 x 6.4	40 x 30	15

[1] measured from the front panel of the scanning head

[2] at 18x optical zoom

[3] with front lens model MR

Mounting the Close-Up Unit

For transportation the close-up unit is secured on the back with a transparent perspex plate. For mounting the close-up unit, you proceed as follows:

1. Before mounting, undo the perspex plate and keep it in a safe place.
2. If required first screw the close-up lenses or the block filter to the camera aperture.
3. Fix the close-up unit on the front of the scanning head using the two knurled screws.

Caution!

Pay attention to the correct fit of the precision pins and **only** hand-tighten the knurled screws!

Dimensions

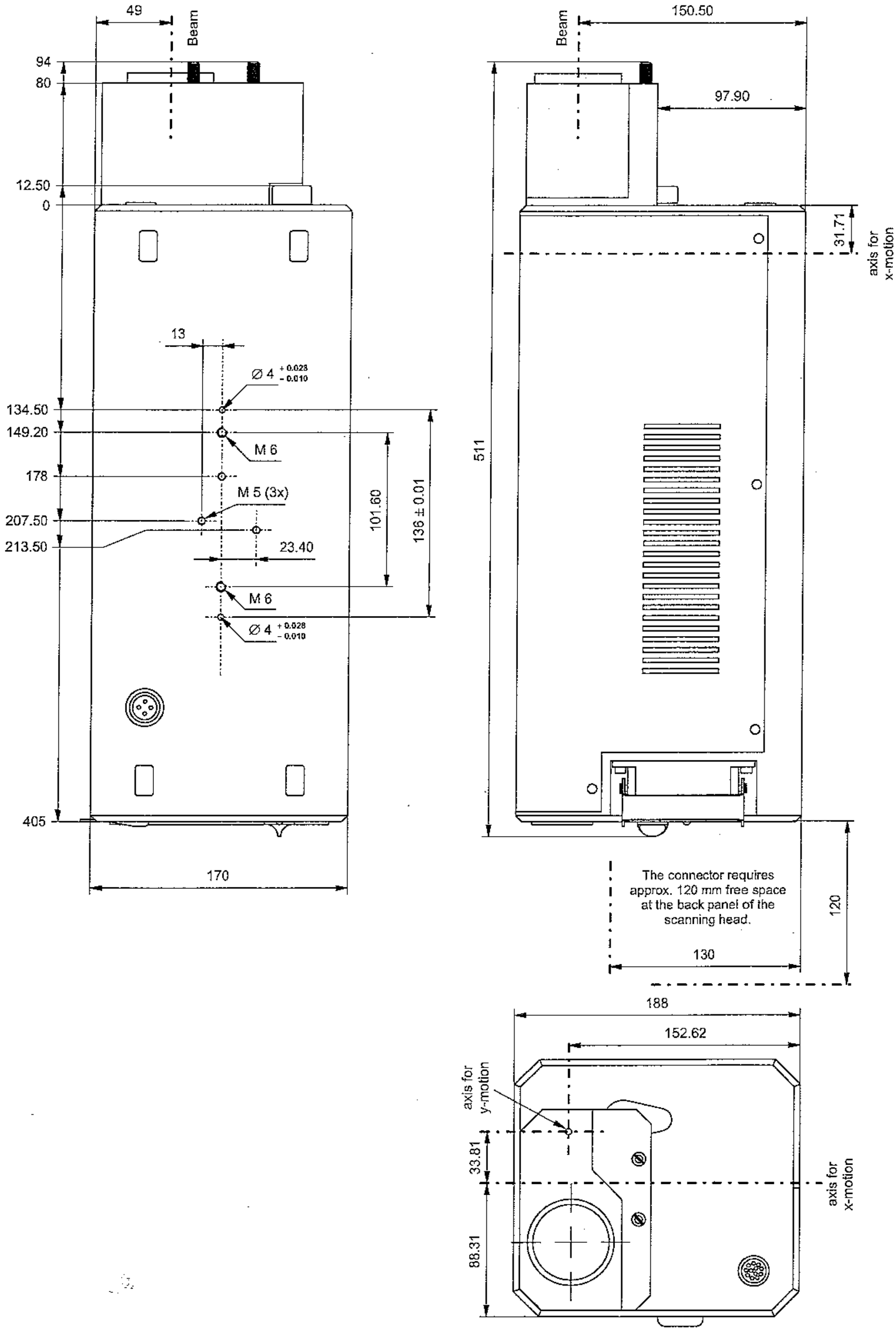


Figure A.2: Views of the scanning head with close-up unit mounted

A.1.2 Micro Scan Lenses OFV-CL-xxx

By attaching the micro scan lenses, scan fields down to 1 mm x 1.2 mm are achieved at a fixed stand-off distance. The specialty of the micro scan lenses is that the laser beam nearly perpendicular meets the measurement surface as also shown in figure A.3 for the OFV-CL-150. Without loss of signal quality, mirror like objects can be scanned up to a tilt of ±4°.

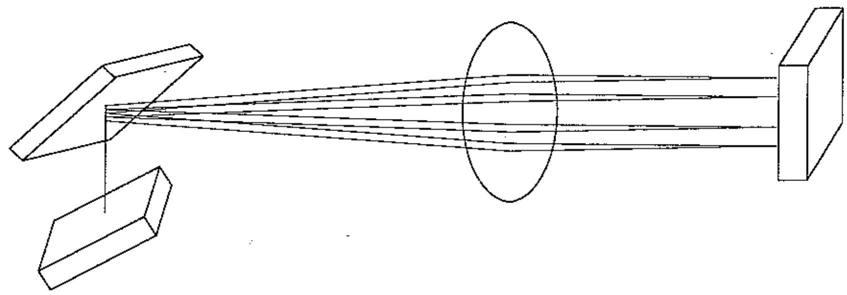


Figure A.3: Function principle of the micro scan lenses

Assembly

Undo the protective cap from the objective of the close-up unit and screw the micro scan lens onto the objective.

Technical Specifications

The stand-off distances and scan fields of the different micro scan lenses are shown in table A.2.

Table A.2: Stand-off distances and scan fields of the micro scan lenses

Micro scan lens	Stand-off distance[1] mm	Min. scan field (X x Y) mm	Nom. scan field[2] (X x Y) mm	Max. scan field (X x Y) mm	Spot diameter[3] µm	Depth of field mm
OFV-CL-80	160	1.2 x 1.0	5 x 4	14 x 10	7	0.4
OFV-CL-150	230	1.8 x 1.3	7 x 5	23 x 17	13	1.3
OFV-CL-300	380	2.6 x 3.5	10 x 14	46 x 35	25	5.0

[1] measured from the front panel of the scanning head

[2] at 18x optical zoom

[3] with front lens model MR

The nominal scan field values are suitable for orientation. Stronger zoom is achieved by interpolation which might reduce the quality of the video image.

Fiber Optical Ring-Light PSV-Z-056

To enhance the quality of the video image the optional fiber optical ring-light can be mounted on the micro scan lenses OFV-CL-80 and OFV-CL-150. For mounting the ring-light, you proceed as follows:

1. Mount the ring-light on the micro scan lens and hand-tighten the knurled screw.
2. Undo the protective cap from the other end of the fiber cable.
3. Insert the fiber cable into the 'Modulamp' receptacle of the light source and tighten the fiber optic positioning thumbscrew.

Warning!
Never look directly at the ring-light when the light source is switched on!

For more information about the light source, please refer to the user manual of the manufacturer.

A.2 Vertical Test Stand PSV-Z-018

You can adjust the stand-off distance of the mounted scanning head precisely using the vertical test stand shown in figure A.4. The test stand is especially suitable for scanning very small parts with the close-up unit on the scanning head.

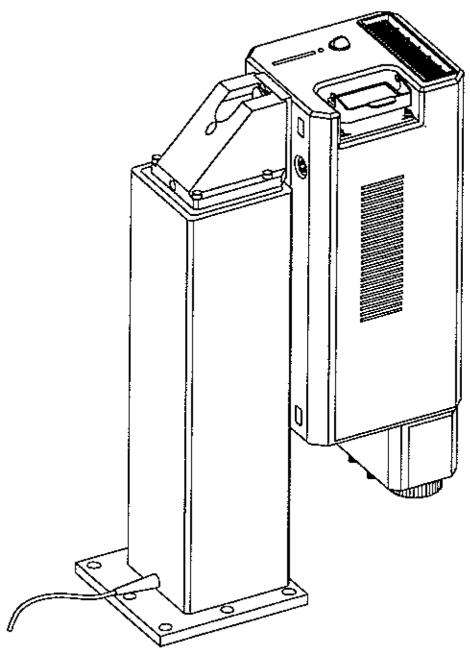


Figure A.4: Vertical test stand PSV-Z-018 with scanning head and close-up unit mounted

Assembly

For mounting the scanning head at the telescope drive, you proceed as follows:

1. Fix the telescope drive at the measurement location using the 6 screws of the assembly kit (refer to figure A.5, picture 1).

   Use either the metric screws ***or*** *the separately packed screws with thread basing on inch-system (1/4-20x 1/2"UNC).*

2. If applicable, undo the quick release hexagonal plate or the mounting plate for the pan-tilt head from the scanning head.

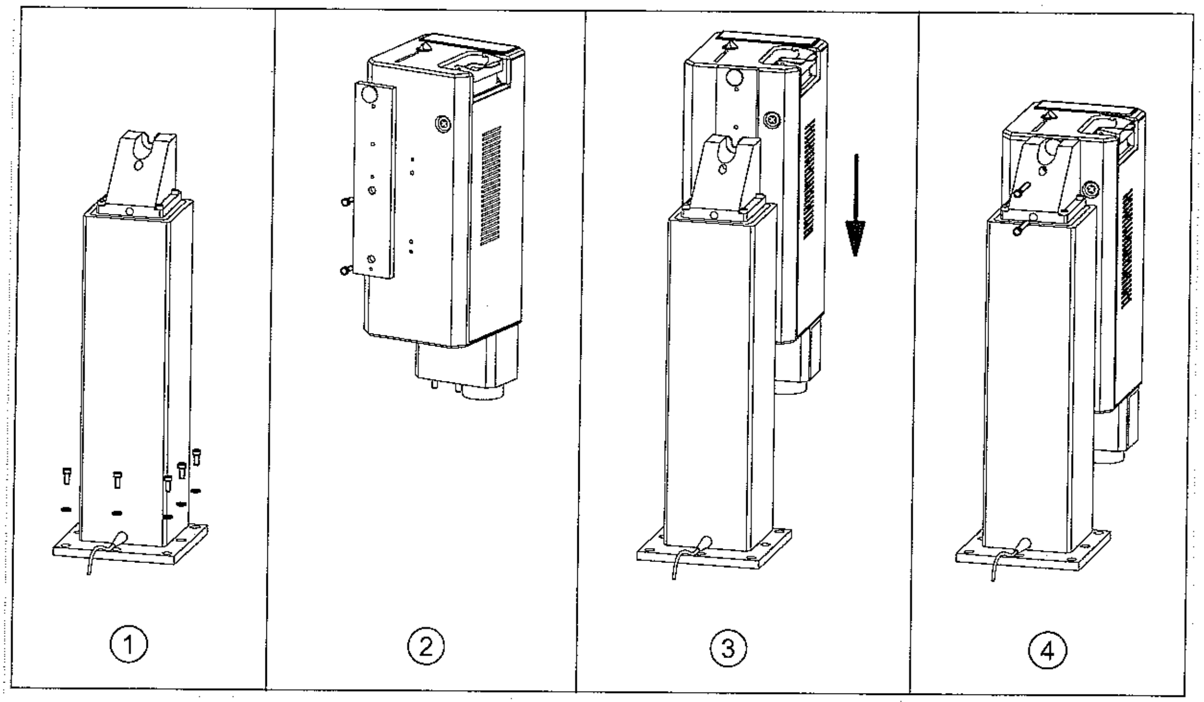


Figure A.5: Mounting the scanning head to the telescope drive

3. Attach the adapter plate on the underside of the scanning head as shown in figure A.5, picture 2.
4. Hang up the scanning head with the adapter plate above at the telescope drive (refer to figure A.5, picture 3).
5. Secure the scanning head by fixing the adapter plate to the telescope drive using 2 Allen screws (refer to figure A.5, picture 4).

Cabling

For the electrical connection of the test stand, you proceed as follows:

1. Connect the cable of the telescope drive to the motor connection **3** of the drive control in figure A.6.
2. Plug the hand set cable into the Sub-D jack **2** in figure A.6.

3. Plug the mains cable into connection **1** of the drive control and into a wall outlet providing protective grounding.

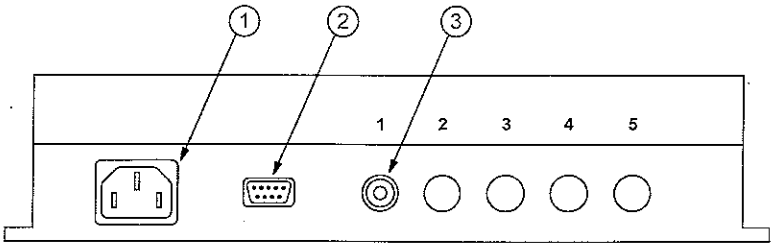


Figure A.6: Connections on the drive control

4. To move the scanning head upstairs, press the arrow key ↑ on the hand set. Move the scanning head downstairs by pressing the arrow key ↓ on the hand set.

5. If you press the arrow key for more than approximately 2 seconds, the motor switches over to fast mode. After approximately 3 seconds the motor reaches its maximum velocity. For fine positioning, the arrow key can be repeatedly pressed briefly.

Technical Specifications

Drive control

Mains voltage:	230V/50Hz **or** 115V/50-60Hz
Power output:	24VDC/5A
Protection rating:	IP66
Operating temperature:	0°C...+40°C (32°F...104°F)
Dimensions:	130mm x 80mm x 360mm
Weight:	2.8kg

Telescope drive

Protection rating:	IP30
Operating temperature:	+10°C...+40°C (50°F...104°F)
Operating time - intermittent:	max. 1min. (9min. break)
Operating time - continuous:	max. 2.5min.
Velocity stages:	3
Max. velocity:	5.5mm/s
Min. travel:	approx. 0.1mm
Max. travel:	300mm
Dimensions:	180mm x 180mm x 590mm (+ 300mm throw)
Weight:	13.8kg

A.3 Hand Set OFV-310 (optional)

You can focus the laser beam using the optional hand set OFV-310 shown in figure A.7.

Note!
Never use the optional hand set OFV-310 together with the hand set PSV-Z-051 (refer to section 5.6)!

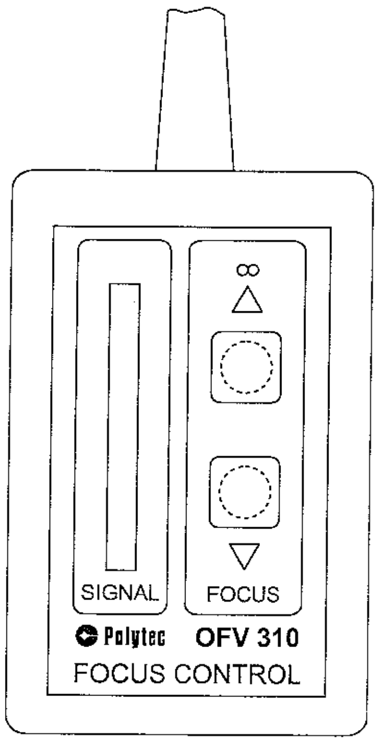


Figure A.7: Hand set OFV-310

The optional hand set OFV-310 is connected to the jack REMOTE FOCUS on the back of the controller. Using the two keys, the laser beam is focused as follows:

- Focusing on infinity: key Δ
- Focusing close-up: key ∇

If you press the keys for more than approximately one second, the motor switches over to fast mode. For fine positioning, the keys can be repeatedly pressed briefly. At the end of the adjustment range, the motor stops automatically and the respective directional symbol Δ or ∇ lights up.

There is also a signal level display on the hand set which helps you to optimize the focus. The signal shown is identical to that on the scanning head and on the display of the controller.

Appendix B: Basics of Measurement Procedure

B.1 Theory of Interferometric Velocity and Displacement Measurement

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 $\Delta\varphi$ between the two beams according to the equation

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

The phase difference $\Delta\varphi$ is a function of the path difference ΔL between the two beams according to

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

where 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 $\Delta L = \Delta L(t)$. 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.

On scattering from the object the object beam is subjected to a small frequency shift which is called Doppler shift f_D and is a function of the velocity component in the direction of the object beam according to

$$f_D = 2 \cdot \frac{|v|}{\lambda} \qquad \text{Equation B.3}$$

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.3 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

$$f_{mod} = f_B + 2 \cdot \frac{v}{\lambda} \qquad \text{Equation B.4}$$

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

B.2 Optical Configuration in the Scanning Head

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

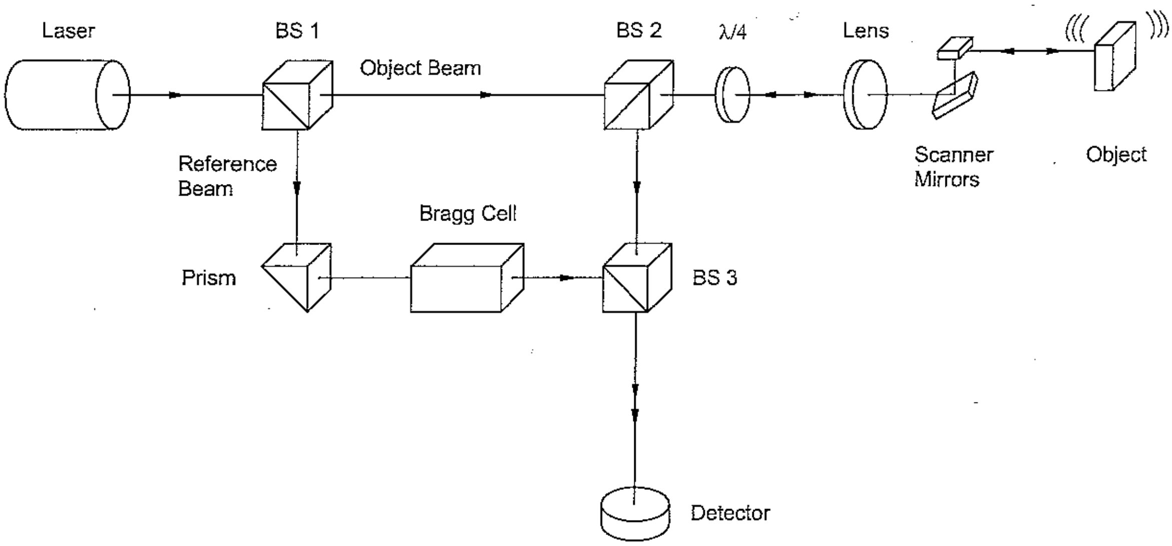


Figure B.1: Optical configuration in the scanning head

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 $\lambda/4$-plate, is then focussed 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 $\lambda/4$-plate, and deflects the object beam to the beam splitter BS3. As both arms of the 'internal' interferometer are symmetrical, the optical path difference between the object beam and the reference beam vanishes within the interferometer. The resulting path difference is equal to twice the distance between the beam splitter BS2 and the object.

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.

Appendix C: Functional Description of the Controller

C.1 Overview

The main function of the controller is to demodulate the radio frequency signal (RF signal) provided by the interferometer in the scanning head. The frequency of the signal is the carrier of the velocity information. Secondary functions such as human interfacing, display and filters improve the user friendliness of the system. An overview of the functional structure of the controller is shown in figure C.1.

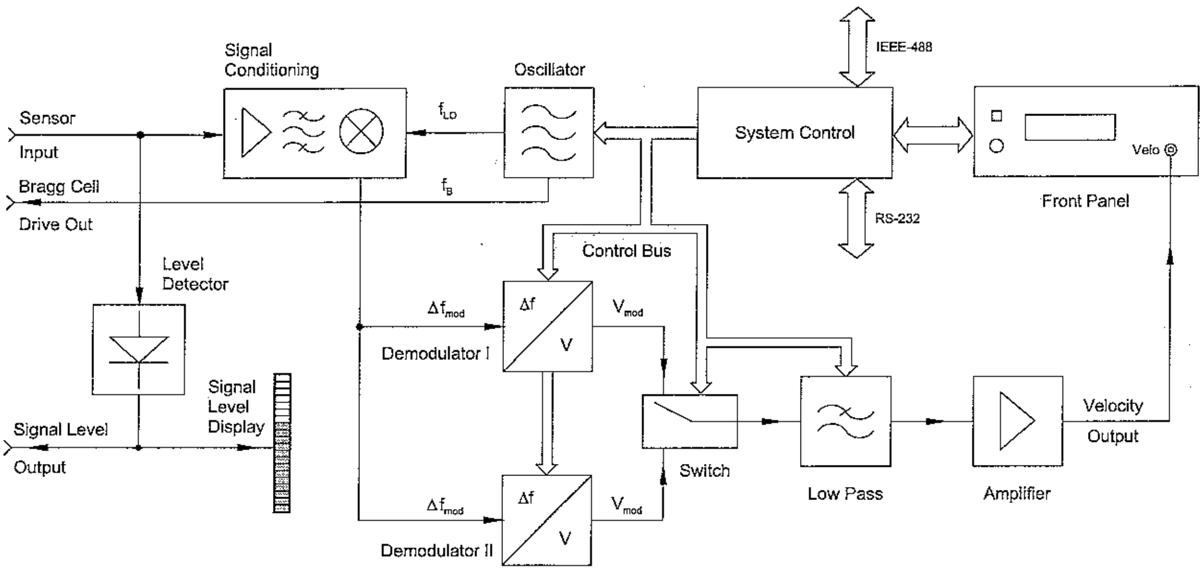


Figure C.1: Block diagram of the controller OFV-3001 S

The RF signal from the scanning head (sensor input) initially passes the functional block signal conditioning where it is pre-processed to optimally drive the following blocks. Subsequently follows the velocity signal decoding. If the controller is fully equipped there are two velocity decoders installed (demodulator I and demodulator II).

The velocity is modulated on the radio frequency of the input signal. In the velocity decoder, an AC-voltage is generated which is proportional to the instantaneous velocity of the object with the aid of so-called FM-demodulators.

The individual demodulators require different reference frequencies which are in a fixed relationship to the driver frequency of the Bragg cell in the interferometer. They are generated in the central oscillator block, synchronized with the driver signal for the Bragg cell.

The velocity decoder is followed by a low pass filter which suppresses spurious RF components and limits the bandwidth of the output signal to reduce background noise. Via the system control, various cutoff frequencies can be set for the low pass filter.

The last block in each signal path is an amplifier which scales the output signals and can optimally drive subsequent signal processing units.

The system control manages communication of the controller with the environment via the front panel and workstation interfaces and also the internal setting of all parameters for the individual functional blocks.

C.2 Signal Conditioning

The RF signal from the scanning head first of all has to be pre-processed to optimally drive the various demodulators. The signal conditioning includes the following functions:

- Measurement of the input signal level
- Stabilization of the signal amplitude
- Limitation of the bandwidth
- Dropout reduction via the tracking filter
- Down-mixing of the frequency

Measurement of the input signal level

The measurement of the input signal level is required to provide the user with information of the back scattering properties of the object and as a help to optimally focus the laser beam. The level is converted to a logarithmically scaled DC voltage. This signal is visualized on the scanning head and on the controller as a bar display and is available at the BNC jack SIGNAL for external usage.

Stabilization of the signal amplitude

Stabilization of the signal amplitude is necessary for the following signal processing steps as the input signal level can fluctuate by several orders of magnitude due to the extremely different back scattering properties of the objects.

Limitation of the bandwidth

Limitation of the bandwidth at the input of the signal processing electronics is required because, for low velocities, only a narrow section of the system bandwidth is occupied by the FM signal. In the remaining bandwidth only noise is recorded. For this reason, at the input section of the controller, a switchable filter is installed which limits the noise bandwidth depending on the velocity measurement range set.

Dropout reduction via tracking filter

The dropout reduction via tracking filter plays a very important role in optical signal processing. The light scattered back from the object has a speckled nature, i.e. at any instant the detector sees a light or a dark speckle. The low signal amplitude of the dark speckle can lead to loss of signal, so-called dropouts. When decoding the velocity, this interruption of the input signal causes short but high noise signals, so-called spikes which make it very difficult to analyze the output signal. These dropouts are effectively reduced by a so-called tracking filter integrated in the input section of the controller. This is done by an electronic circuit to regenerate high frequency signals based on the principle of the phase locked loop (PLL).

The principle of signal regeneration by the tracking filter is based on replacing the input signal with a distorted amplitude by a stable signal from a voltage controlled oscillator which is synchronized with the frequency and the phase of the input signal. Suitable circuit design can make it possible to maintain the synchronized condition approximately, even if the input signal is temporarily lost. The mechanical analog for this design is a flywheel which may lose a small portion of its energy if the driving force is briefly interrupted but continues to run at almost the same number of revolutions per minute and can drive a subsequent mechanism without disruption. It is easy to see that this effect gets better, the higher the inertia of the wheel is. At the same time the flywheel however, loses the ability to follow rapid changes in the revolutions per minute, i.e. the dynamic response of the drive system gets worse. The same correlation also applies to the electronic tracking filter which thus always represents a compromise between the regeneration effect and the dynamic tracking behavior of the input signal. Basically, good dropout elimination or noise suppression is always involved with limited dynamic response. If the maximum acceleration is exceeded, the synchronization between the input signal and the oscillator is lost (the tracking filter loses lock) which leads to drastic signal distortions at the signal output. Practical advice for setting the tracking filter can be found in section 4.2.3.

The internal structure of the tracking filter circuit is shown in figure C.2. The function of the voltage controlled oscillator (VCO) has already been mentioned. The control signal which synchronizes the oscillator is generated in the phase detector which monitors the phase difference between the input signal and the oscillator signal. The dynamic characteristics of the configuration are mainly determined by the internal low pass filter. The maximum acceleration which the tracking filter can still follow depends on the filter bandwidth. The low pass time constant is switched between SLOW and FAST via the system control and thus adapts the dynamic characteristics to the application. The tracking filter can be turned off via a bypass if the accelerations are too high or in the case of good optical signals.

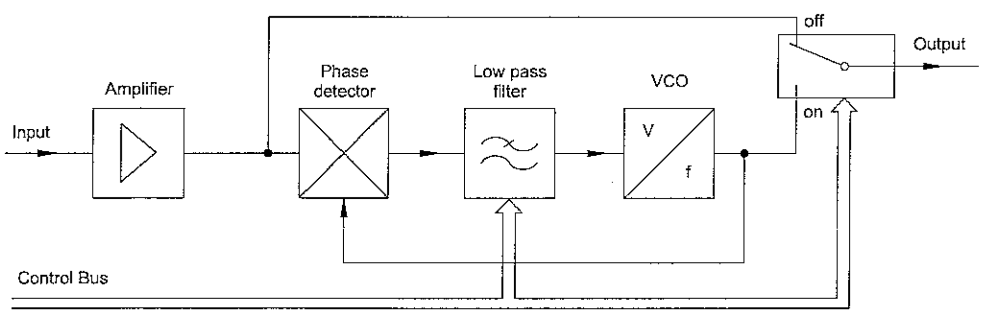


Figure C.2: Block diagram of the tracking filter circuit

Down-mixing of the frequency

Down-mixing of the frequency in the input section is required to convert the carrier frequency of the input signal from 40.4 MHz originally to lower intermediate frequencies. With these intermediate frequencies, the velocity decoder can work optimally in the individual measurement ranges. Down-mixing is carried out by a mixing process which does not affect the modulation content of the FM signal. The variable frequency f_{LO} is produced by the so-called local oscillator in a fixed relationship to the drive frequency of the Bragg cell.

C.3 Oscillator Section

The oscillator section generates all drive frequencies for operating the other subassemblies in the vibrometer. The drive frequency for the Bragg cell is of central importance as it directly determines the optical frequency offset in the interferometer and thus the center frequency of the carrier signal.

The variable mixing frequency f_{LO} is automatically set by the system control dependent on the selected velocity measurement range.

C.4 Velocity Decoder

C.4.1 The Various Velocity Decoders

Technically it is just about impossible to attain all desirable and realizable characteristics of the velocity decoder in a single universal subassembly. The modular concept of the controller thus permits the use of three different velocity decoders whereby a maximum of two can be installed at the same time. The selection of the decoders depends on the application. The models available are the OVD-04, OVD-04HF and PLL-DC which feature the following characteristics.

OVD-04

The OVD-04 as a broad band decoder is suitable universally for almost all vibrometer applications in the frequency range up to 250 kHz. Four measurement ranges from 10 $\frac{mm}{s}$/V to 1 000 $\frac{mm}{s}$/V cover most technical applications with sufficient amplitude resolution. Characteristic is the excellent amplitude and phase frequency response with extremely good amplitude flatness up to the highest frequencies. A special feature of the OVD-04 is the DC capability of the measurement ranges 125 $\frac{mm}{s}$/V and 1 000 $\frac{mm}{s}$/V. For detailed information, please request the respective application note.

OVD-04 HF

The OVD-04HF is a special version of the OVD-04 which provides an extended frequency range up to 1.5 MHz when operating in the measurement ranges 25 $\frac{mm}{s}$/V; 125 $\frac{mm}{s}$/V and 1 000 $\frac{mm}{s}$/V.

PLL-DC

The PLL-DC is a decoder which has been specially developed for applications at the lower end of the velocity and frequency range of vibrations. It is an excellent supplement to the broad band decoder OVD-04, as with its three measurement ranges 1 $\frac{mm}{s}$/V, 5 $\frac{mm}{s}$/V and 25 $\frac{mm}{s}$/V it extends the application range for low frequencies to cover also very low velocities. The lower frequency limit of the PLL-DC is 0 Hz, i.e. there is no amplitude roll-off at very low frequencies. Thus it is optimally suited for vibration measurements over long distances on buildings or other structures with low resonance frequencies.

C.4.2 Operating Principle

The velocity decoder determines the essential measurement properties of the vibrometer. Velocity decoding is in principal an FM demodulation process which converts the velocity dependent Doppler frequency of the interferometer signal into an AC voltage. The linearity and bandwidth of the demodulator determine the accuracy of the vibrometer. In contrast to FM radio which works with the same modulation procedure, considerably higher frequency deviations occur in the vibrometer which make significantly higher demands on the demodulators:

FM radio:	max. frequency deviation 75 kHz, max. modulation frequency 53 kHz (Stereo)
Vibrometer:	max. frequency deviation 32 MHz, max. modulation frequency 1.5 MHz

In the OFV-3001S controller, different respectively optimally adapted demodulators are switched on in the individual velocity measurement ranges. The decoders and measurement ranges are selected via the system control and the internal bus. At the same time, the corresponding settings on the subassemblies oscillator and signal conditioning are carried out internally.

C.4.3 Low Pass Filter

The signal generated by the FM demodulator always contains spurious RF components and its noise bandwidth corresponds with the maximum frequency of the respective measurement range. A subsequent low pass filter suppresses the RF components and limits the noise bandwidth according to its cutoff frequency. This makes a rough adaptation of the measurement bandwidth to the application possible which makes the signal evaluation in the time domain significantly easier due to the improved signal-to-noise ratio.

The filters are adjusted via the system control. In position OFF the low pass filter has no effect. With the filter switched on, its influence on both amplitude and phase of the measurement signal has to be taken into consideration. The filter characteristics as well as rules of thumb for using them are provided in section 4.2.2.

Appendix D: Declaration of Conformity

CE

Konformitätsbescheinigung / Declaration of Conformity

für / for

Gegenstand / Objekt :	**Scanning Vibrometer**
Controller Typ / Model :	**OFV-3001-SU3/ -SU5/ -SF6/ -SH6** **ID 31955 / ID 31965 / ID 31969 / ID 31966**
Sensor Typ / Model :	**OFV 056** **ID 31956**
Junction Box / Model :	**PSV-Z-040-U, PSV-Z-040-F, PSV-Z-040-H** **ID 31971, ID 31972, ID 32615**

Der Hersteller / The manufacturer

Polytec GmbH
Polytec Platz 5-7
76337 Waldbronn / Germany

bestätigt das Einhalten der Richtlinien 89 / 336 / EWG und 73 / 23 / EWG
confirms the compliance with the directive 89 / 336 EEC and 73 / 23 / EEC.

Das Gerät stimmt überein mit den folgenden Normen / The unit comply to the following standards:

EN 50825 - 1	Sicherheit von Laser-Einrichtungen / Safety of laser products
EN 61010	Sicherheitsbestimmungen für elektrische Meß-, Steuer-, Regel- und Laborgeräte / Safety requirements for electrical equipment for measurement, control and laboratory use
EN 50081 - 1 / **EN 50081 - 2**	Elektromagnetische Verträglichkeit (EMV) Fachgrundnorm Störaussendung Electromagnetic compatibility / Emission - EN 55011 Grenzwertklasse: B (FCC Class B)
EN 50082 - 1 / **EN 50082 - 2**	Elektromagnetische Verträglichkeit (EMV) Fachgrundnorm Störfestigkeit Electromagnetic compatibility / Immunity - VDE 0843 - 2... - 5 (IEC 801 - 1... - 5)

Ausgestellt von / Issued by

Hild Seil

Polytec GmbH

18.12.2000
Datum / Date

Figure D.1: PSV 300 declaration of conformity

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Polytec Deutschland

POLYTEC GmbH

Polytec-Platz 1-7
D-76337 Waldbronn

Tel.: (07243) 604-0
Fax: (07243) 699 44
E-mail: info@polytec.de
Internet: http://www.polytec.de

POLYTEC Physik Instrumente
Vertriebs- und Beratungsbüro Berlin
Schwarzschildstraße 1
D-12489 Berlin

Tel.: (030) 6392-5140
Fax: (030) 6392-5141
E-mail: polytecberlin@polytec.de
Internet: http://www.polytec.de

Polytec International

Germany (D)
POLYTEC GmbH
Polytec-Platz 1-7
D-76337 Waldbronn

Tel.: (+49) 7243 604-0
Fax: (+49) 7243 699 44
E-mail: info-vi@polytec.de
Internet: http://www.polytec.com

France (F)
Polytec PI/RMP S.A.
32, rue Délizy
F-93694 Pantin Cédex

Tel.: (+33) 1-48 10 39 30
Fax: (+33) 1-48 10 08 03
E-mail: info@polytec-pi.fr
Internet: http://www.polytec-pi.fr

Great Britain (GB)
Lambda Photometrics Ltd.
Lambda House, Batford Mill
GB-Harpenden,
Hertfordshire AL5 5BZ

Tel.: (+44) 1582-76 43 34
Fax: (+44) 1582-71 20 84
E-mail: info@lambdaphoto.co.uk
Internet: http://www.lambdaphoto.co.uk

Japan (J)
PI-Polytec KK
Akebono-cho 2-38-5
Tachikawa-shi
J-Tokyo 190

Tel.: (+81) 425-26 73 00
Fax: (+81) 425-26 73 01
E-mail: info@pi-polytec.co.jp

USA East
Polytec PI, Inc.
16 Albert Street
Auburn, MA 01501

Tel.: (+1) 508-832 34 56
Fax: (+1) 508-832 05 06
E-mail: info@polytecpi.com
Internet: http://www.polytecpi.com

USA West
Polytec PI, Inc.
1342 Bell Avenue, Suite 3 A
Tustin, CA 92780

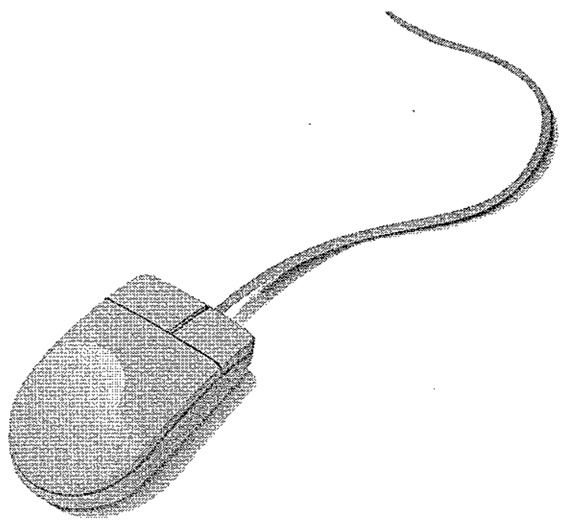
Tel.: (+1) 714-850 18 35
Fax: (+1) 714-850 18 31
E-mail: info@polytecpi.com
Internet: http://www.polytecpi.com

Polytec

Software Manual

Polytec Scanning Vibrometer

Software 8.3



PSV 200
PSV 300
PSV 400
PSV 300-3D
PSV 400-3D
MSV 300
MSV 400
MSA 400

Contents

1 Quick-start

This introduction will quickly familiarize you with important functions of the measurement system based on an FFT measurement. For this purpose, first of all run a scan and then evaluate it using some of the software functions. Use an object with simple geometry for the scan. If you have a function generator, use it to excite the object and then use this signal as a reference signal for the measurement. If you do not have a function generator, you can also excite it by other means.

☞ Although you can also make a measurement without a reference signal, if you do you will not be able to animate the vibration during evaluation.

Preparation

1. Connect up the measurement system and start it as described in the hardware manual.
2. If available, connect the reference signal to the jack REF 1 on the front of the junction box.
3. Start the software. To do so, double-click the icon PSV on the desktop. You will find more information on this in section 2.5.
4. If the software has not been started in Acquisition mode, go into acquisition. To do so, in the toolbar of the application window, click . You will find more information on this in section 2.6. You will now see the video window at the top and an analyzer at the bottom. On the left you will see the project browser (refer also to section 2.7.4 and on the right the scanning head control (refer also to section 2.7.1).
5. Select Setup > Preferences. The dialog Preferences appears.
6. Display the page Devices.
7. From the list Junction Box, select the junction box which is connected to the PC.
8. If you are using a function generator, then set the connection for Generator (internal or GPIB).
9. Display the page Scanning Head.
10. In the list Scanning Head, select the scanning head you have connected.
11. Click OK.
12. Only with the option VDD: Run test mode as described in section 6.6.

You will find more information on setting up the software in chapter 3.

Set the Optics

You set the optics using the scanning head control. See also section 4.1 on this.

13. Point the scanning head at the object, either manually or using the optional pan-tilt stage.
14. Zoom in the video camera so that the object appears as large as possible in the video window. To do so, use the slider Zoom in the field Camera.
15. Now focus the video camera. To do so, first of all point the laser beam at the top left corner of the video image. Otherwise the light from the laser beam disrupts the video camera focusing automatically. To adjust the laser beam, use the icons Position. Then click Autofocus in the field Camera.
16. Then point the laser beam at the object again.
17. Focus the laser beam with the icons and . As an option, you can automatically focus the laser beam using the icon . You will find more information on this in section 4.4.
18. Align the coordinates on the live video image with the measurement plane. To do so, click or select Setup > Align Coordinates. The software will maximize the video window. Distribute the alignment points evenly over the whole measurement surface. If, for example, you want to scan a rectangular surface, it would make sense to choose four alignment points near the corners.
19. Move the laser beam to an alignment point on the object using the icons Position in the scanning head control.
20. In the live video image, point the mouse precisely at the laser beam and click. You can now see a target there. If the laser beam is not precisely in the middle of the target, click again.
21. Repeat steps 19 and 20 for at least three more alignment points.
22. Once you have aligned all points, click again or select Setup > Align Coordinates.

You will find more information on aligning coordinates in section 4.2.

☞ To be able to import 3D geometries in 3D point mode (optional), you also have to carry out a 3D alignment. See section 4.2.4 on this.

Defining Scan Points

23. Go to scan point definition. To do so, in the toolbar of the application window, click . The software maximizes the video window and displays a graphics toolbar.

24. Go to standard mode. To do so, in the graphics toolbar, click .

25. First of all delete all scan points which may already be defined. To do so, select Edit > Select All and then Edit > Delete.

26. In standard mode the software will superimpose a global grid on the live video image. If the grid is not visible, display it. To do so, click . You can define scan points at the grid points. First of all, define the density of the grid points. To do so, in the graphics toolbar, enter a value in both the fields X: and Y: respectively (for example 20).

27. Now draw a rectangle as large as possible over the object. To do so, first of all click .

28. Check whether the icon is active. If yes, then click it to deactivate it (refer also to section 5.1.4).

29. Point the mouse approximately at the center of the object under investigation. The cursor becomes a cross.

30. Press the control key and the mouse button simultaneously and drag across to a corner point of the area you want to scan. First of all release the mouse button and then the control key.

31. You will see the rectangle you have drawn with a red edge and white squares which mark the edge. You will see the scan points as blue points inside the rectangle.

32. You have now finished defining scan points. Click in the toolbar of the application window again to quit scan point definition.

33. Now point at the live video image and click a scan point. The laser beam moves to this point on the object. Click additional scan points to check and see if the laser beam is positioned exactly on the scan points.

You will find more detailed information on scan point definition in chapter 5.

Setting the Parameters

34. In the toolbar of the application window, click A/D. The dialog Acquisition Settings appears.

35. Display the pages in the dialog from left to right and set the parameters there. The suitable settings depend on the object. If you know suitable settings, then set them. If not, use the settings in table 1.1.

Table 1.1: Parameters for an example measurement

Page	Settings
General	Measurement Mode: FFT Averaging: Off Remeasure: active
Channels[1]	Vibrometer: Active, Range 10V, Coupling DC, Quantity Velocity Reference 1: Active, Range 10V, Coupling DC, Quantity Voltage
Filters	Channel Vibrometer: Filter Type No Filter, Int/Diff Velocity (0) Channel Reference 1: Filter Type No Filter
Frequency	Bandwidth: 10kHz From: 0kHz To: 10kHz FFT Lines: 400
Window	Channel Vibrometer: Rectangle Channel Reference 1: Rectangle
Trigger	Source: Off
SE	Channel Vibrometer: Channel Reference 1: not active Speckle Tracking: active Slider: Fast
Vibrometer	Velocity: lowest available measurement range Tracking Filter: Slow Low Pass Filter: Off
Generator	Active: active

[1] Only with option VDD: Some parameters on the page Channels are not available or are fixed.

36. Click OK.

You will find detailed information on the parameters for data acquisition in chapter 7.

Single Point Measurement

37. If available, start signal output from the function generator. To do so, in the toolbar of the application window, click .
38. Start a continuous measurement. To do so, in the toolbar of the application window, click . The analyzer displays the measurement signal on the vibrometer channel.

☞ Autoscale the y-axis. To do so, in the toolbar of the analyzer, click .

39. Click a scan point in the video window. The software will position the laser beam on the object at this scan point. Check whether the display OVER in the scanning head control is permanently red. If yes, then the measurement range for the velocity is being exceeded at this scan point.
40. Repeat step 39 for a few additional scan points.
41. If the display OVER is red at several scan points, increase the measurement range for the velocity. To do so, click again, display the page Vibrometer and select the next highest measurement range in the list Velocity. Then click OK.
42. Repeat steps 40 to 41 until the measurement range for the velocity is no longer exceeded.
43. Stop the continuous measurement. To do so, in the toolbar of the application window, click .

You will find detailed information on making measurements in chapter 6.

Scanning

44. Start the scan. To do so, in the toolbar of the presentation window, click . The dialog Save As appears.
45. Navigate to the saving location and enter the file name.

☞ If you have the project browser displayed (refer to section 2.7.4), you will then automatically be shown the directory marked there as saving location.

46. Click Save. The scan starts. The software immediately saves every scan point measured.
47. In the video window you can follow the progress of the scan. See chapter 9 on this.

Displaying Data

Select data sets

48. Display a spectrum. To do so, in the toolbar of the analyzer, click and select FFT in the pop-up menu.

49. Click to autoscale.

50. For spectra, you can display other signals apart from the measurement signal. To do so, click and select Acceleration in the pop-up menu. Click again to autoscale.

51. Display the magnitude of the acceleration signal together with its phase. To do so, click and select Mag.&Phase in the pop-up menu.

Zoom

52. Zoom the range between 5kHz and 10kHz. To do so, point the mouse at the x-axis at 5kHz. The cursor becomes a magnifying glass.

53. Press the mouse button and drag to the right to 10kHz.

54. Undo zooming. To do so, click .

Set a cursor

55. Activate a cursor. To do so, click .

56. Set the cursor in the analyzer. To do so, click in the diagram. A vertical line appears at the point which you have clicked.

Read data

57. You can see the cursor's coordinates in the legend. If the legend is not visible on the right in the analyzer, select Analyzer > Legend to display it.

58. Move the cursor to the right or left using the mouse. The data in the legend is updated simultaneously.

You will find detailed information on displaying data in chapter 8.

Now you have finished the introduction. You will find further example measurements in section 6.7.

2 First Steps

Polytec's Scanning Vibrometer measures the two-dimensional distribution of vibrations. In the measurement system, the software has the following functions:

- controlling the hardware
- defining scan points
- setting parameters for data acquisition
- generating excitation signals (as an option)
- acquiring digital data
- saving data
- displaying data and evaluating it.

First of all, read the following sections to familiarize yourself with the basics of how to work with the software.

2.1 System Requirements

So that you can work optimally with the software, please make sure that the following components have been installed:

- National Instruments driver NiDaq 6.9.3 (recommended)
- Microsoft® DirectX 9
- Current Service Packs for Windows® 2000 or Windows® XP, you will find detailed information on this in the Release Notes

Please use either Windows® 2000 or XP as your operating system.

2.2 Installing the Software

To install the software, proceed as follows:

☞ When installing the software, please make sure you pay attention to the supplements and special features in the Release Notes!

1. Only for a new installation: Install the required hardware as described in both your hardware manual under Cabling and in the manual for your data acquisition board.
2. Check that your hardlock (dongle) is available and has been installed correctly.
3. Switch on your PC and log in with administrator rights. See your operating system manual on this.
4. Install the required software as described in the file \\PSV\ReleaseNoteseng.doc on your PSV CD.

Now you have finished the installation. Should any problem occur during installation, please contact Polytec.

2.3 Integration of the Hardware

Caution!
Do not change any address or interrupt settings! This could prevent the software from running properly.

You can control two Polytec vibrometers using the software and as an option, an external function generator as well. Refer also to section 6.7.2 or section 6.7.6. Connect up the devices as described in your hardware manual.

IEEE-488/GPIB

If you control some devices via IEEE-488/GPIB, then we recommend you set the following addresses:

- Vibrometer controller 1: IEEE-488/GPIB address 5
- Vibrometer controller 2: IEEE-488/GPIB address 4
- Function generator: IEEE-488/GPIB address 10.

RS-232

If you control vibrometers via RS-232, then the software recognizes the controller connected to the lower COM port as vibrometer controller 1.

2.4 Controlling the Hardware with the PSV-A-PDA (as an Option)

With the optional PSV-A-PDA, you can also call up several software functions, such as focusing the laser beam, defining and deleting scan points, etc.

2.4.1 Starting the PDA

To start the PDA and to call up the required function, proceed as follows:

1. Install the PDA as described in your hardware manual.
2. Make sure that your WLAN Access Point is ready to use and switch it on as described in your hardware manual.
3. Switch the PDA on.
4. Switch WLAN on the PDA on as described in the manufacturer's manual.

5. Select Start > Programs in the PDA menu bar and touch PDASoft. The user interface of the PDA software appears.

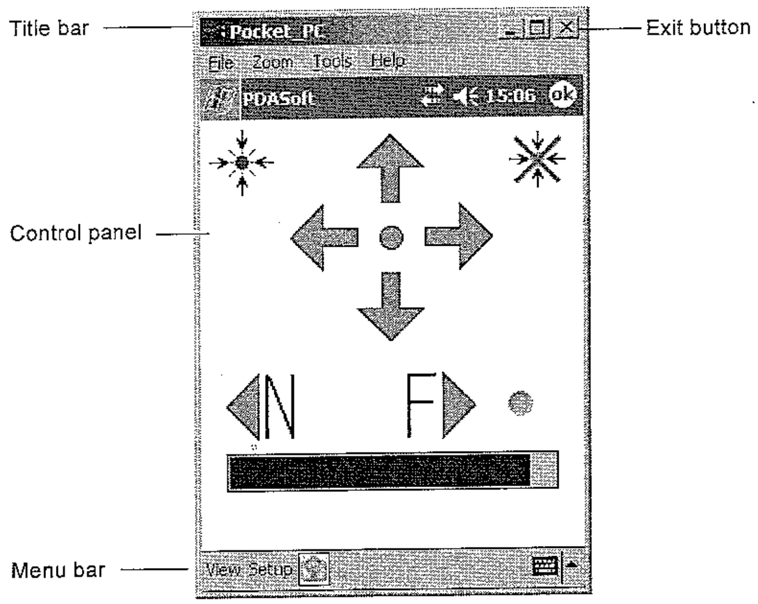


Figure 2.1: Control window of the PDA

Control panel You can use this control panel to call up and execute the PDA functions. You will find more information on this in section 4.2.2 and section 4.2.5.

Menu bar The menu bar contains additional functions. You will find more information on this in section 2.4.2. Apart from that, you make the connection to the PSV system here. To do so, touch the icon .

Exit button Touch the icon to exit the PDA software.

The PDA supports the following software functions:

- controlling the optics (refer to section 4.1.2)
- switching the scanning heads (only PSV-3D, refer to section 4.2.5)
- defining and deleting alignment points (refer to section 4.2)
- defining and deleting scan points (refer to section 5.3)

2.4.2 Adapting the IP Address

So that the PDA can communicate with the PSV software, the IP address of the network board which the WLAN Access Point is connected to must be entered in PDA. On delivery of the PSV system, the correct IP address is set. If you have to change the address at a later point in time, proceed as follows:

☞ You can only change the IP address if the PDA is not connected to the PSV system. If required, touch the icon to disconnect it.

1. Select Setup > Preferences in the PDA menu bar. The dialog Edit Settings appears.

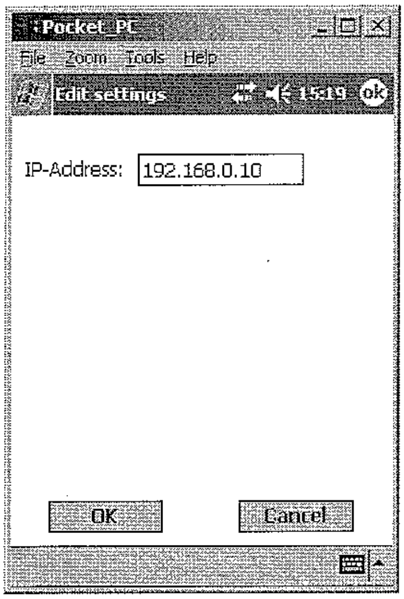


Figure 2.2: Dialog Edit Settings

2. Touch the icon in the menu bar. A keyboard is shown in the dialog.

3. Use this keyboard to enter the new IP address and touch OK.

2.5 Starting the Software

To start the software, proceed as follows:

1. Check that the hardlock has been correctly installed on the PC.
2. Connect up the PSV and start it as described in your hardware manual.
3. Then afterwards switch the PC on.
4. After a short while you will be asked to log in. Refer to the operating system manual on this. In the condition the PC is supplied in, you have to log in as administrator. A password has not been set prior to delivery.
5. Double-click the icon PSV on the desktop or select Start > PSV.
6. Change to acquisition mode. The application window appears. You may receive an error message and information on it (refer to section 2.6).

You can now work with the software.

2.6 Acquisition Mode and Presentation Mode

In the software you work in two different modes: Acquisition and Presentation. You can use some functions in both modes. Acquisition mode is not available in the desktop version.

Presentation mode

To go to presentation mode, click or select View > Presentation.

Acquisition mode

To get into acquisition mode, click or select View > Acquisition.

When changing into acquisition mode, the software searches the interfaces of the PC for external devices and initializes them. You may receive an error message and information on it. You can switch off this error message as described in section 3.5.

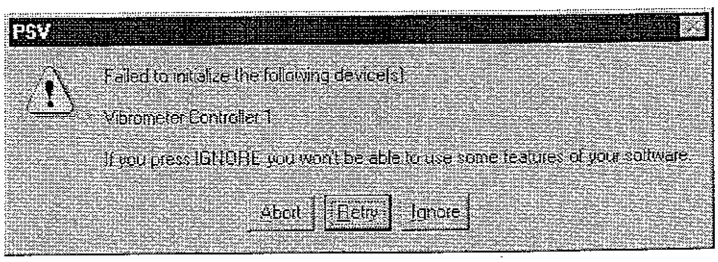


Figure 2.3: Error message when changing into acquisition mode

7. If you want to check the connection between the devices and if necessary correct it, select Setup > Preferences and open the page Devices.

2.7 Windows in the Software

2.7.1 Application Window

After starting the software, the application window appears. At the top you will see the title bar, menu bar and toolbar, at the bottom the status bar. In the menu View, you can show (hide) the toolbar and the status bar.

Initially the application window is empty. By clicking you change into acquisition mode. There you will see the video window, an analyzer and the project browser. The windows are described in the following sections in detail.

By clicking you can display further analyzers.

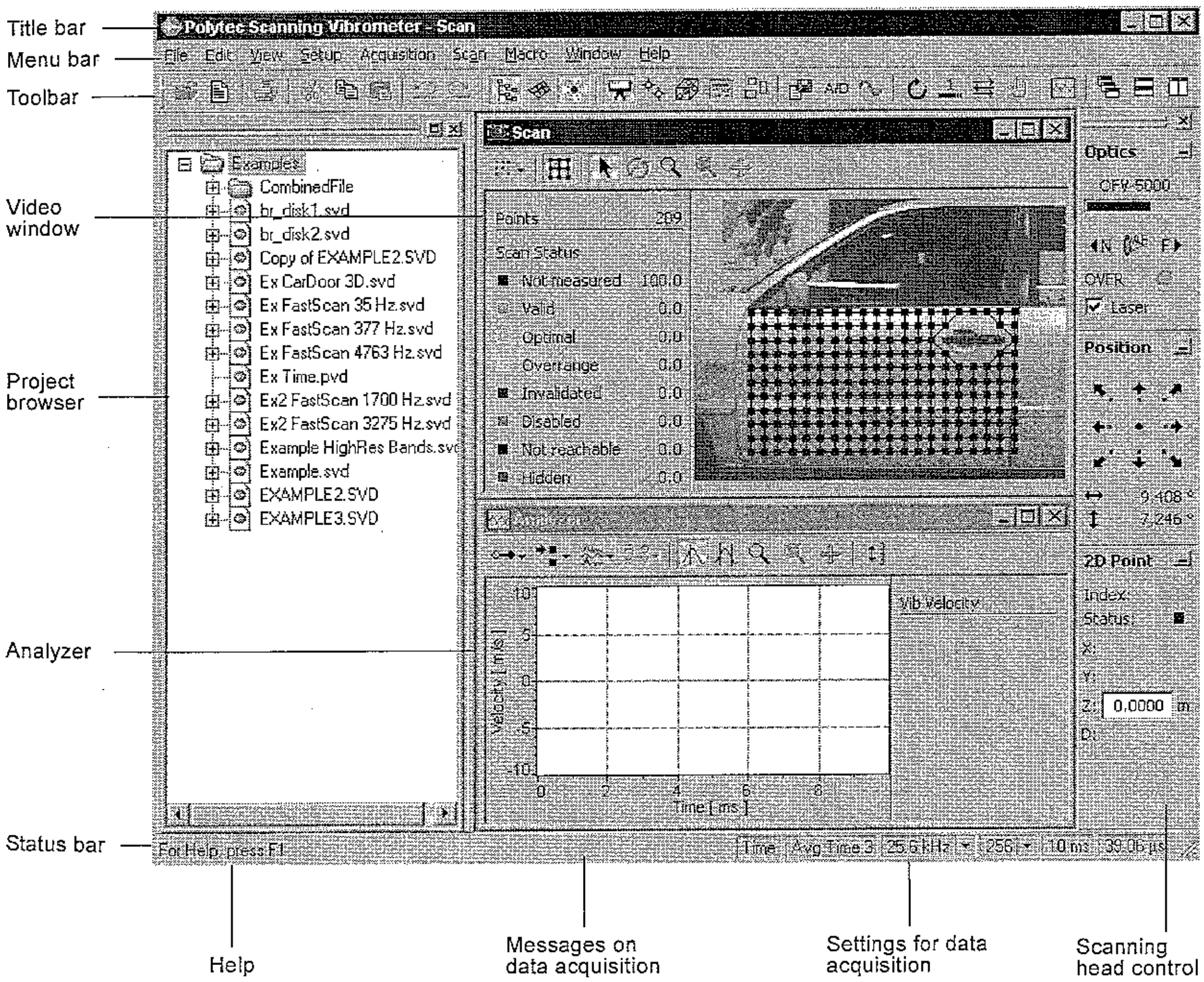


Figure 2.4: Example of the application window in acquisition mode

In the application window you can display and evaluate data. To do so, you can use various windows:

- In acquisition mode: a video window, any number of analyzers.
- In presentation mode: any number of presentation windows and analyzers.

If you restart the software, then the arrangement and signal selection of the most recent windows will be restored.

Menu bar

Every menu contains a group of commands for working with the software. Some menus are only visible if an analyzer or a presentation window is open.

Toolbar

By clicking the icons, you can execute some commands quickly which you would otherwise have to select in the menus.

Status bar

On the right, the status bar shows several settings for data acquisition. On the left, in certain situations, you will see a short help text. Point the mouse at one of the settings on the right, for example, and leave the cursor there for a moment. Then you will see on the left which parameter it is for. For more information on how to get help in the software, see section 2.10.

When making a measurement, messages on data acquisition can appear in the middle of the status bar. See section 6.4 on this.

Scanning head control

In acquisition mode you can show (hide) the scanning head control in the application window. To do so, click  or select View > Scanning Head. You adjust the optics using the scanning head control. See section 4.1 on this.

2.7.2 Video window

The video window displays the live image of the video camera in the scanning head.

Open

The video window appears when you change into acquisition mode.

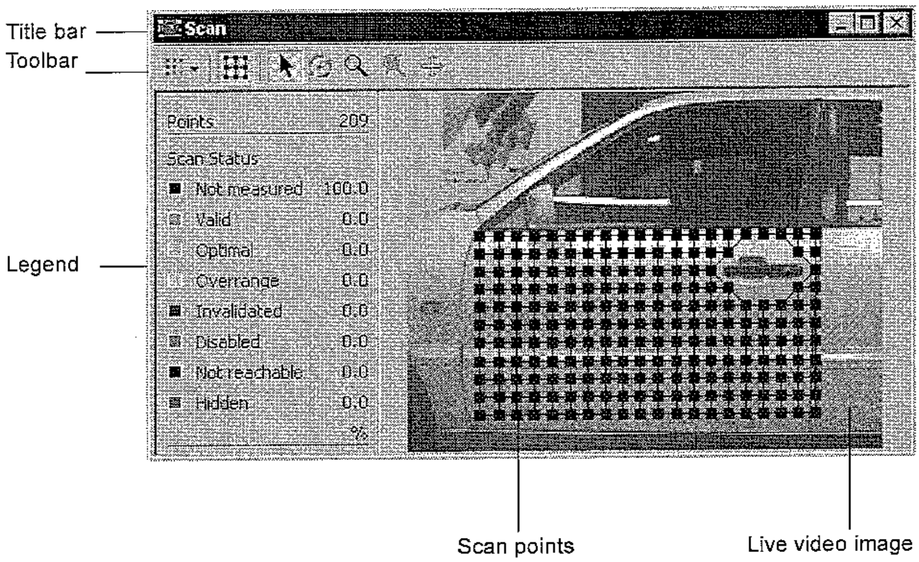


Figure 2.5: Example of the video window

Live video image

In the live video image, you control the position of the laser beam, define scan points and follow the progress of a scan. You adjust the settings of the live video image (contrast, brightness, color) as described in section 4.7.

Toolbar

By clicking the icons, you can execute some commands quickly which you would otherwise have to select in the menus. To change between the 2D view and the 3D view, click 3D. If you change from the 2D view to the 3D view, a snapshot of the live video image is shown as a fixed-image. You can also use the mouse to set the line of sight directly in the video window. To do so, click . The mouse cursor becomes a . Drag in the direction you require.

To change the view of the scan point status, click . Please see section 8.1 on this as well.

Scan points

If scan points are defined, you can show (hide) them in the video window. To do so, click or select View > Scan Points. You see the scan points as squares in different colors. These colors show the status of the scan points.

Legend

On the left you see a legend for the status of the scan points. The legend also shows the number of defined scan points and the estimated time needed for the scan. The display of the scan point status changes depending on which status view you have selected.

Zoom function

In the video window you can zoom in on sections of the image and can pan the zoomed sections. You will find the necessary tools in the toolbar of the application window, refer also to section 2.8.

2.7.3 Analyzers

Analyzers show measurement data and evaluated data in x-y diagrams. You can follow current measurements in analyzers or use them to display measurement data from a file. In presentation mode, an analyzer can also be part of a presentation window. See section 2.7.5 on this.

Open

An analyzer appears if you

- go into acquisition mode
- start a measurement
- open a single point measurement.

If an analyzer is open, the menu bar of the application window is extended by menus for working with analyzers. To open further analyzers, click or select Window > New Analyzer.

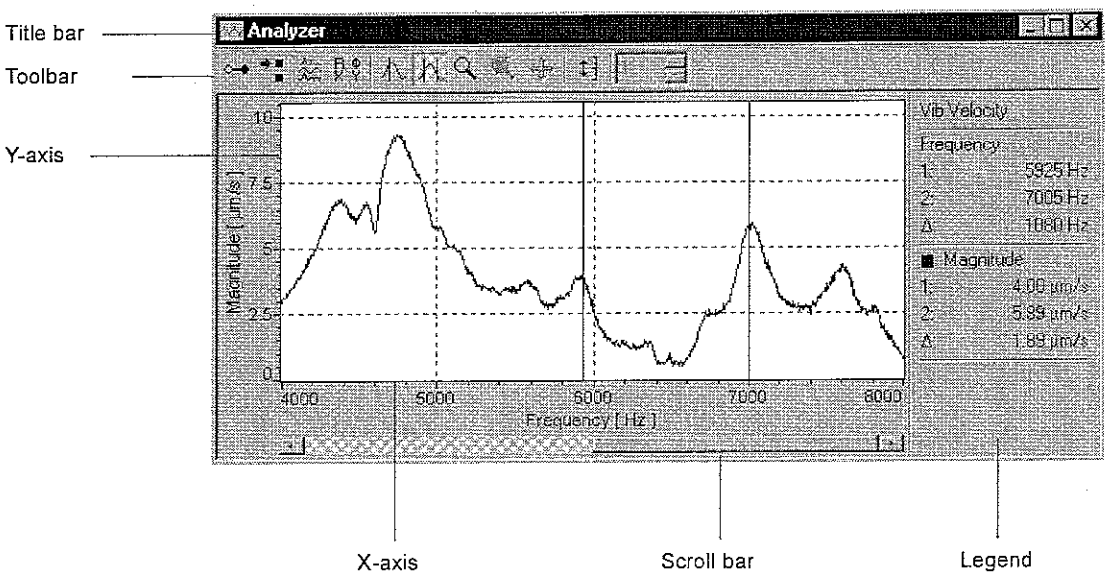


Figure 2.6: Example of an analyzer

Title bar

If an analyzer has the function of a measurement window, you will see the name Analyzer in the title bar. If you have already saved the measurement or have opened a measurement, you will see the file name in the title bar.

Toolbar

You can show (hide) the toolbar by selecting Analyzer > Toolbar. By clicking the icons you can quickly execute some commands from the menu Analyzer.

Diagram

You can see the data graphically in x-y diagrams. You can set up the look of the diagrams and the graphs yourself.

Legend On the right you can show (hide) a legend for the diagrams. To do so, select Analyzer > Legend.

Zoom function In the analyzer you can zoom on sections of the diagram and can pan the zoomed section. In the toolbar of the analyzer you will find the necessary tools, refer also to section 8.2.1.

Scroll bar You can use the scroll bar to scroll if you have zoomed the x-axis.

2.7.4 Project Browser

In the project browser you can display folders in a tree structure with the subdirectories and files in them. To do so, open a program on file management, e.g. Microsoft® Explorer and use the mouse to drag the required folder or folders into the project browser. These folders can now be managed from here. Please note that all actions are executed directly in the respective folder.

☞ The folders in the project browser are not copies, but are direct links to folders on your harddisk or network drives! Changes made in the project browser, e.g. deleting or renaming subdirectories and files are carried out in parallel in your file management and in reverse.

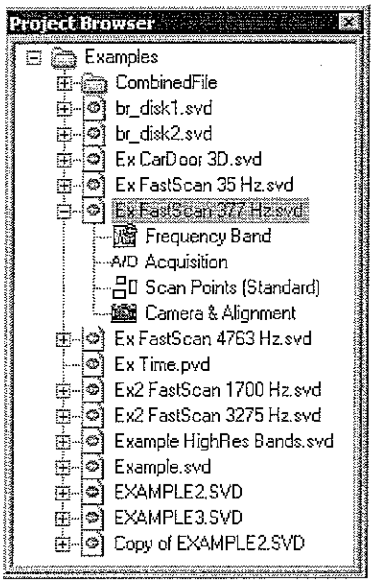


Figure 2.7: Example of the project browser

☞ You can not transfer individual files to the project browser.
You can remove folders again. To do so, click the folder with the right mouse button and select Remove in the pop-up menu. You can also delete individual files.

The contents of the project browser remain saved, even after the program is stopped. The display of contents is user-specific.

Open

To open the project browser, click or select View > Project Browser. You can adapt the way the project browser is displayed, i.e. make it smaller and move it to another part of the screen. If you drag the project browser near to one of the edges of the software window and release the mouse button, the project browser is automatically placed next to the corresponding window edge. Click in the title bar of the project browser to reduce its size again and position it freely in the software window.

Add directory

To add another project directory to the project browser, click in the project browser with the right mouse button, however do not click in a file or a folder. Select Add Project Folder in the pop-up menu. The dialog Select Folder appears. Navigate to the required directory and click Select.

☞ Alternatively you can also select File > Add Project Folder.

Click a file or a folder with the right mouse button to edit the contents in the project browser. The commands shown in the pop-up menu are different depending on the level in the tree structure, the type and number of objects selected and the mode you are currently working in (acquisition or presentation). The individual commands are explained in the following.

Explorer: Click here if you want to display the selected folder in Microsoft® Explorer additionally. This command is only available for folders.

Refresh: Click here to update the display of folders and files in the project browser.

Remove: Click here if you want to remove the selected objects from the project browser, but do not want to delete them. This command is only available for folders on the top level.

Rename: Click here if you want to give the selected object a different name.

Delete: Click here if you want to irrevocably delete the selected objects. Before deleting them permanently, you have to confirm a safety check. This command is only available for files.

☞ You can only delete settings if they are saved in their own file (*.set) (refer to section 10.2.7 and section 10.1.3). You can not delete the settings of a measurement file.

Load: If you select Load, then the setting files (.set) that you selected in the project browser are loaded. See also section 10.1.3 on this.

Open: In principle, you can open files from all programs installed on your PC in the project browser. Click Open and the selected file will be opened using the corresponding program. If you open a file with the extension svd, a presentation window will open. If you select a file with the suffix spd, the signal processor will open (as an option).

New Window: Click here if you want to display the file you have already opened in a second window again.

Info: Click here if you want to display the file information on the file you have already opened. See also section 10.1 on this.

Close: Click here if you want to close the selected file.

Save As: Click here if you want to save the selected file under a different name or in another directory.

Paste: This command is only available if you are using the optional signal processor (refer also to section 8.6). If you have copied data in the signal processor, you can insert this data into the selected file by using the command Paste.

Edit: If you select Edit, a macro window will appear with the macro you selected in the project browser.

Run: If you select Run, then the macro you selected in the project browser is executed.

Properties: This command is only available to you for combined files. You will then see the dialog Create Combined File with the individual files in the set order. See also section 8.5 on this.

Copy and move

You can copy files or folders in the project browser into other directories. To do so, mark them and holding the left mouse button pressed, drag the marked objects onto the required directory.

To move files or folders in the project browser, proceed as described above. Hold the shift button pressed while you are dragging with the mouse.

2.7.5 Presentation Window

In presentation windows you analyze scans in 2D and 3D diagrams.

Open

A presentation window appears when you open a scan. The menu bar of the application window is then extended by menus for working with presentation windows. You can then open further presentation windows by selecting Window > New Window.

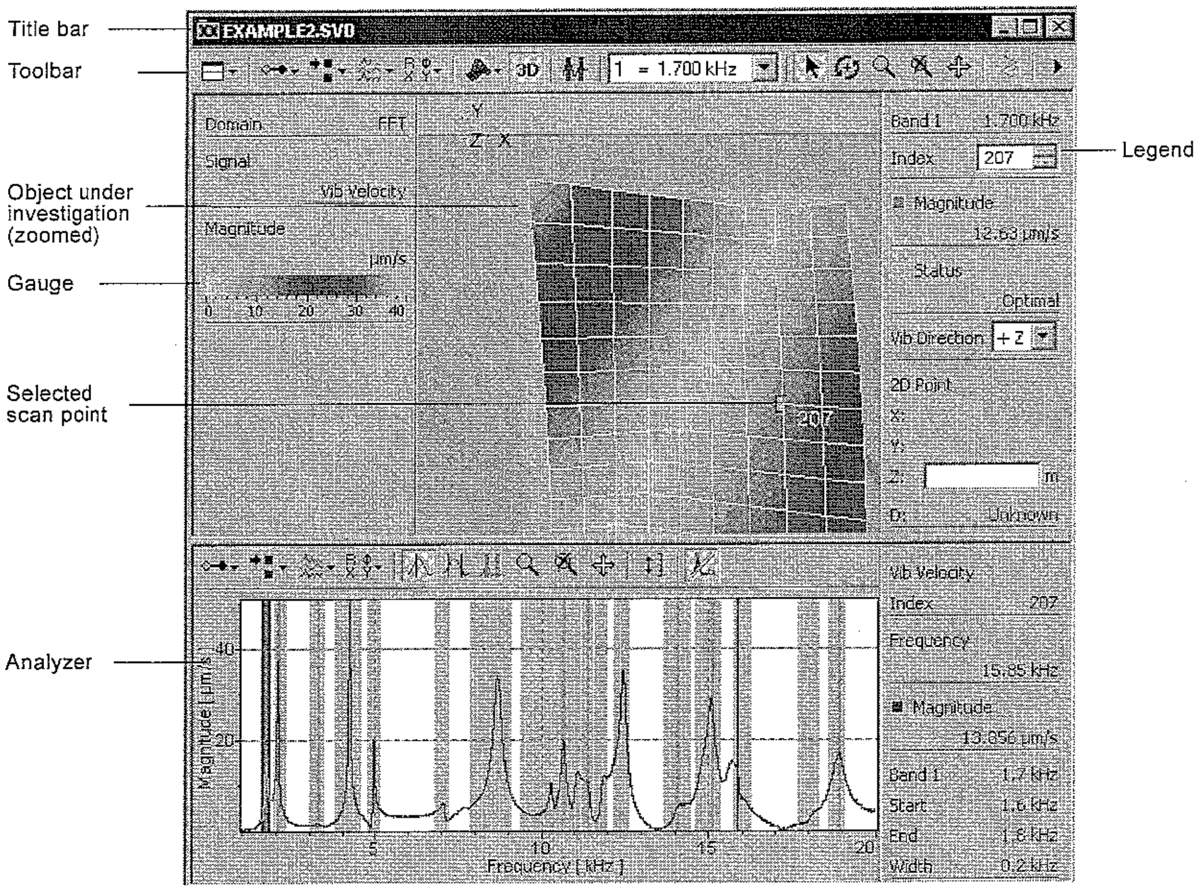


Figure 2.8: Example of a presentation window in the Single Scan Point view

Toolbar

You can show (hide) the toolbar by selecting Presentation > Toolbar. By clicking the icons you can quickly execute some commands from the menus Setup, Presentation and Animation.

View

You can display the presentation window in different views. To do so, click and select the view required in the pop-up menu. You can also select Presentation > View.

Object

You see the object in all views. You can present the object in different ways. To do so, click and select the view style required in the pop-up menu. You can also select Presentation > View Style.

Gauge

On the left you can show (hide) a gauge for color-coding. To do so, select Presentation > Gauge.

Zoom function In the presentation window you can zoom on the object in all views and in all view styles and also pan the zoomed section. You will find the necessary tools in the toolbar of the presentation window, refer also to section 2.8.

Analyzer In the views Single Scan Point, Average Spectrum and Profile you will see an analyzer at the bottom of the presentation window. See section 2.7.3 on this.

Legend On the right you can show (hide) a legend for the data displayed. To do so, select Presentation > Legend.

2.7.6 Signal Processor (as an Option)

You can use the signal processor to recalculate measurement data for further analysis and then compare the results with the original data. You can read section 8.6 to find out how to work with the signal processor.

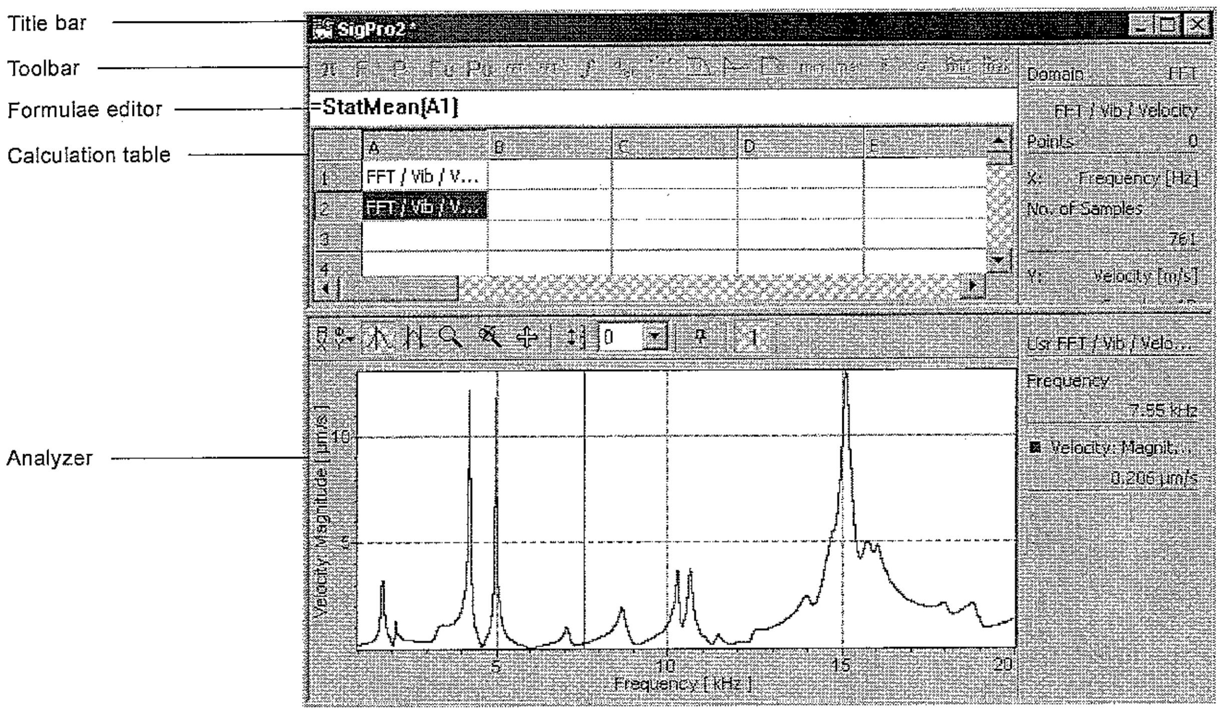


Figure 2.9: Example of recalculating measurement data in the signal processor

Toolbar In the toolbar you will find the most important arithmetic operations you can execute with the signal processor. By clicking the icons, you can transfer the formulae directly to the formulae editor instead of having to enter them using the keyboard. The icons are active as soon as the cursor is in the formulae editor.

Formulae editor You are shown the content of the selected table cell in the formulae editor. This is also where you enter text or formulae which are to appear in the selected cell.

Calculation table You enter the measurement data and the formulae in the cells of the calculation table. By linking the individual cells via the formulae, the software can make various calculations using the measurement data and then display the results at any point in the computing chain. Apart from that, you can also enter comments into the cells.

Analyzer The signal processing results are shown as a graph in the analyzer.

2.7.7 Arranging Windows

You can arrange all open windows in the application window using the commands in the menu Window.

New window To open further analyzers or presentation windows, click or select Window > New Analyzer.

Cascade You can arrange all windows over each other so that only the title bar and the y-axis name are visible respectively. To do so, click or select Window > Cascade.

Tiling horizontally and vertically You can display all open windows so that they are completely visible and maximum size. To do so, click or . You can also select Window > Tile Horizontally or Window > Tile Vertically.

Close all To close all open windows, select Window > Close All.

Window list At the bottom of the menu Window you will find a list of open windows. To activate a window – i.e. move it to the foreground – click it in the list.

2.8 Zooming in Windows

You can zoom on image sections in both the video window and also in the presentation window. You will find the necessary tools in the toolbars of the application window and of the presentation window.

Zoom If you would like to take a closer look at a certain section of the image in either the video or the presentation window, you can zoom on it.

☞ The zoom function is executed by the graphics card in your PC, not by the video camera in the scanning head. This means that the resolution of the image may deteriorate slightly when zooming. However you do not have to carry out a new alignment - unlike when zooming with the camera.

Zooming in on the object helps you define the points and carry out alignment more accurately, thus enabling you to present the data more precisely. This is an advantage, particularly if your object under investigation has complex geometry or if your scan points are very close together.

To zoom in on a video or presentation window, proceed as follows:

1. Click . The mouse cursor becomes a magnifying glass with a plus sign.
2. Holding the left mouse button pressed, draw a rectangle around the area of the image which you want to zoom in on. You can repeat this step several times.

☞ If you zoom in the video window, on the left in the legend a smaller view of the measurement object will appear with a frame marking the zoomed section of it. This means you can always ascertain which part of the object under investigation you are currently viewing.Once maximum magnification has been attained, you will receive a message.

or

3. You can also zoom in the presentation window by scrolling down with the middle mouse button (mouse wheel).

Pan the image section

You can pan the zoomed image section.

☞ Depending on the video board, the image section selected may not pan smoothly, but may move across the screen in small jumps.

To do this, you have the following options:

1. Using the middle mouse button (mouse wheel) click in the zoomed view in the video window. Hold the mouse button pressed and pan the image section. If you have given the middle button a special function (e.g. double-click), then you will have to proceed as described in step 2.
2. In 3D point mode (APS, refer to section 5.4) and during alignment (refer to section 4.2)click and pan the image section while holding the left mouse button pressed.

Zoom out

You can zoom out again.

To undo zooming, scroll up with the middle mouse button (mouse wheel).

To undo all previous zoom actions at once, click .

Exit zooming

To leave the zoom function again, click . The last image section selected remains.

2.9 Printing

You can print out analyzers, presentation windows and signal processors. The title of the window as well as the date and time are automatically printed as a header.

Print setup

To set the paper size, feed and orientation, select File > Print Setup. The dialog Print Setup appears. Here you can select the current printer and set up the page.

Preview

To see a print preview, select File > Print Preview.

Start

To print out the active window, click or select File > Print. If you want to print out a signal processor or if you have selected the view Single Scan Point, Average Spectrum or Profile in the presentation window, you can define whether you only want to print one of the graphics or both. The dialog Print will then appear. Here you can select the printer and set up further print properties. To start printing, then in the dialog Print click OK.

2.10 How to Get Help

You can get help in the software as online help and through short explanations of commands. You can also display the version of the software and the software options which are installed.

Online help

To open the online help, click or select Help > Contents.

Context-sensitive help

For dialogs and windows you can get context-sensitive online help. There are several ways of doing this:

1. Activate the window or dialog you need help with. To do so, click it.
2. Press the key F1. The corresponding page of the online help appears.

or

When a dialog is open, then click Help in this dialog. The corresponding page of the online help appears.

Explanation of commands

For icons and commands you can also get explanations without opening the online help. To do so, point the mouse at the command or the icon and leave the cursor there for a moment. The explanation appears on the left in the status bar. For icons you will also see a brief description on a yellow background next to the cursor.

Software version and options

To display the version of the software, select Help > About PSV. The dialog About Polytec Scanning Vibrometer appears. To display the installed software options, click Options in the dialog.

You can also display information on the operating system, the memory and on the available space on the harddisk. To do so, click System Info.

3 Setting up the Software

Before making a measurement, you have to set up the software for data acquisition.

☞ In almost all views and modes, you can use the right mouse button to call up additional menus which contain several commands and functions often needed at this point.

To set up the software, proceed as follows:

1. Go to acquisition mode. To do so, click or select View > Acquisition.

☞ You can also set some options in presentation mode.

2. Select Setup > Preferences. The dialog Preferences appears.
3. The dialog contains several pages, each with a group of parameters. To display a certain page, click the name of the group.
4. Set the parameters on all pages. You will find information on this in section 3.1, section 3.2, section 3.3 and section 3.4.
5. When you have set all parameters, click OK.

Test mode (only with option VDD)

6. If you have installed the option VDD (with VDD decoder), run test mode. See section 6.6 on this.

PSV-3D

The measurement system PSV-3D enables you to measure and display vibration vectors in three dimensions.

☞ The settings in the software apply for all three controllers respectively. For this reason, no distinction is made on the user interface between the individual devices.

3.1 Devices

On the page Devices you set which measurement system and which external devices you want to control with the software.

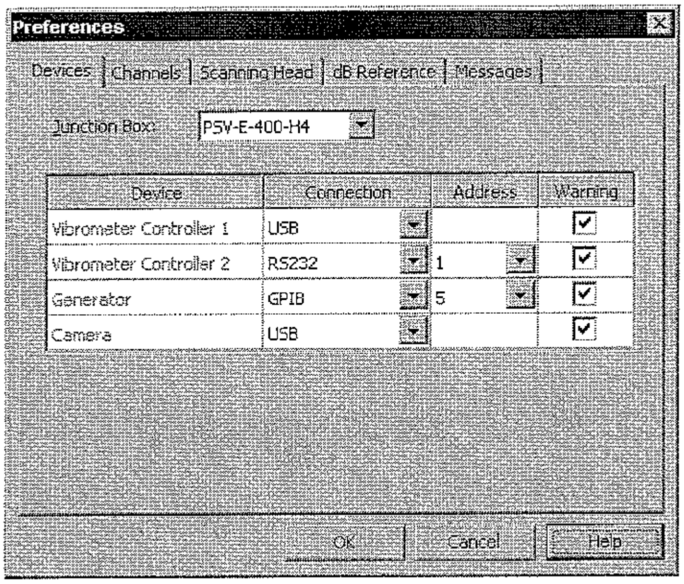


Figure 3.1: Page Devices

Junction Box: This list is only active for certain hardware configurations. Junction boxes connected via the USB interface are recognized automatically and displayed.

To use the option VDD, you must select the junction box VDD-Z-010, VDD-Z-011 or MSA-E-400 (VDD). In this case it is not possible to connect up a controller which is remotely controlled. Only the reference signal is connected, but not the vibrometer signal.

Connection: Here you can select which interfaces should be searched to look for external devices.

For the vibrometer controller you can either have the available interfaces automatically searched for devices (Auto) or you can state where the devices are connected (RS-232 or GPIB). You will speed up the start of the application with a fixed preference. If the vibrometer controller is connected via the USB interface, it will be recognized automatically. Then you do not have to make any more settings for this controller.

If you are using a generator, you can also state whether the device is integrated into the PC (internal) or whether it is an externally connected device.

Address: If you have given a fixed connection, then select the address here or carry out an automatic search for it.

Warning: If you change into acquisition mode or have changed any settings, then the software will search the PC's interfaces for external devices and initialize them. Here you mark the devices which you want a warning message issued for if the software can not find them.

☞ These warnings are not shown if under Setup > Preferences on the page Messages you have selected Errors or Show none (refer also to section 3.5).

Activate PSV-3D

You can operate the PSV-3D in 1D mode (PSV-3D (1D)) and in 3D mode (PSV-3D (3D)). In contrast to 3D mode, in 1D mode the signals of every scanning head are displayed and processed without transforming the coordinates. The channels measured are described as Vib Top, Vib Left and Vib Right.

PSV-3D in 3D mode

To activate PSV-3D in 3D mode, select the junction box PSV-Z-3D-H or PSV-E-400-3D.

The first device shown to you in the list is the PSV-3D Multiplexer. This enables you to control all three controllers from the PC via a single RS-232 or USB cable using the software. Apart from that, here you can select the video cameras which you would like to use to view the object. If you have arranged the scanning heads relatively far apart, then we recommend that you select the optional video camera Center.

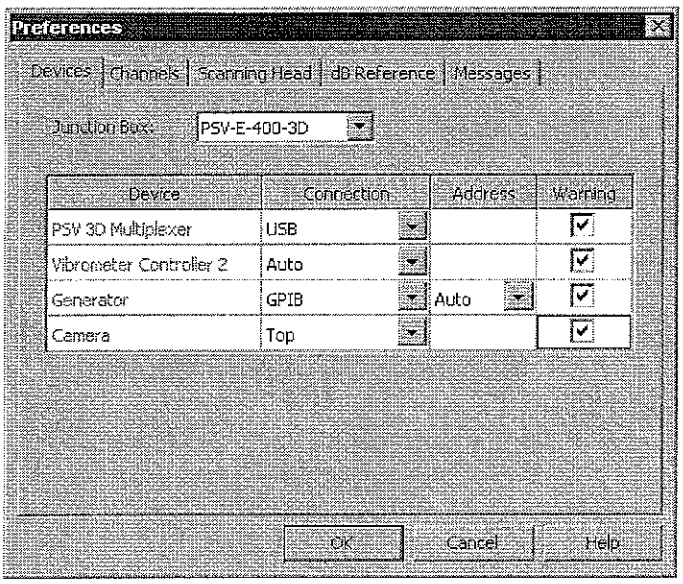


Figure 3.2: Page Devices for the PSV-3D

If you are not using the video camera Center and the scanning heads are mounted close to each other, then the camera Left is closest to the middle.

You will find information on connecting up the PSV-3D in the separate hardware manual.

PSV-3D in 1D mode

There are two applications for 1D mode:

- fault diagnosis for 3D mode
- operating the PSV-3D with just a single scanning head (as a standard scanning vibrometer)

☞ If you make a measurement in 1D mode and only use the scanning head Top, then select the video camera Top.

Fault diagnosis

If you have any misgivings about the measurement results in 3D mode being correct, you can make a 1D measurement without coordinate transformation and check the plausibility of the vibration signals in this mode. The limitations mentioned in the following apply.

Standard scanning vibrometer

If you operate the PSV-3D with just one scanning head, then you have to deactivate the other two scanning heads. To do so, click A/D and open the page Channels, refer also to section 3.2. Deactivate the top two scanning heads.

However you can also use the other two scanning heads to make reference measurements. To do so, click A/D and identify the scanning heads as reference channels.

☞ The scanning head Top can not be used as a reference channel.

Once you have identified the scanning heads as reference channels, they are not moved during scanning and can also not be controlled via the video image. Move the reference scanning heads using the icons Position in the scanning head controller. You will find more information on this in section 4.1.

To activate 1D mode, proceed as described above. However select the junction box PSV-Z-3D-H (1D).

If the scanning heads have not been defined as reference channels, but simply as Channel, then they are moved during scanning and every scanning head supplies separate 1D information.

3.2 Channels

On the page Channels you set which channels you want to use to control Polytec vibrometers.

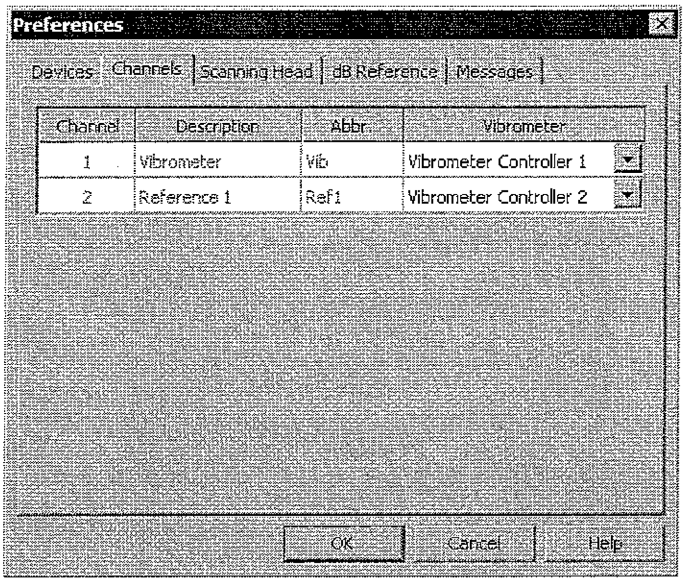


Figure 3.3: Page Channels

Channel: The number of channels displayed depends on which data acquisition board(s) you are using and which junction box has been selected on the page Devices (refer to section 3.1). However, the number of channels is only updated if you close the dialog Preferences by clicking OK and then reopening it.

Description: A meaningful name for every channel is shown here.

Abbr. An abbreviated name for every channel is given here.

Vibrometer: In this column, a channel is only active if: a Polytec vibrometer is connected, the vibrometer had already been switched on before changing into acquisition mode, and on the page Devices, the correct connection has been set. Here you select which vibrometer provides the signal for this channel. You can use the software to control the connected vibrometers as described in section 6.7.6. For certain hardware configurations and measurement modes, channels are already permanently connected.

In the following tables you will see the allocation of digital channels to the different connections from the individual junction boxes.

Channel	Junction box			
	PSV-Z-040-H	PSV-Z-040 -F, -U	PSV-Z-3D-H (3D/1D)	MSV-Z-040
1	VELO	VELO	VELO TOP	VELO
2	REF 1	REF	VELO LEFT	REF
3	REF 2	-	VELO RIGHT	-
4	REF 3	-	REF	-

Channel	Junction box		
	PSV-E-400	PSV-E-400-3D-H (3D/1D)	MSA-E-400
1	VELO	VELO TOP	VELO IN
2	REF 1	VELO LEFT	REF IN
3	REF 2	VELO RIGHT	-
4	REF 3	REF	-
5	REF 21[1]	REF 21[1]	-
6	REF 22[1]	REF 22[1]	-
7	REF 23[1]	REF 23[1]	-
8	REF 24[1]	REF 24[1]	-

[1] with PSV-E-408

Channel	Junction box					
	VIB-Z-010	VIB-Z-012	VIB-Z-014	VIB-Z-015	VIB-Z-016	VIB-Z-017
1	SIG IN	VELO	VELO	CHANNEL 1	VELO	VELO
2	REF IN	REF 1	REF 1	CHANNEL 2	REF 1	REF 1
3	-	-	REF 2	-	REF 2	REF 2
4	-	-	REF 3	-	REF 3	REF 3

Channel	Junction box		
	VDD-Z-010	VDD-Z-011	MSA-E-400 (VDD)
1	Vibrometer signal[1]	Vibrometer signal[1]	Vibrometer signal[1]
2	REF IN	REF 1	REF IN
3	-	-	
4	-	-	

[1] Only with option VDD: The vibrometer signal is not fed in through the junction box, it is only available directly in the software.

With the junction boxes VIB-Z-012, VIB-Z-016, PSV-E-400 and PSV-E-400-3D you can select ICP® for the reference channels and also switch the differential input for all channels on or off. You will find additional information on this in section 7.2.2 under the keywords ICP and Differential Input and also in your hardware manual.

If in addition to the junction box PSV-E-400 or PSV-E-400-3D respectively, you are also using the junction box PSV-E-408, you can use a second data acquisition board (PCI-4452) to measure four additional reference channels. Principal Component Analysis (refer to section 7.2.1) is also available.

Assigning channels for the PSV-3D

With the PSV-3D, you can only adjust settings on the page Channels if you also have an additional reference (single point) vibrometer connected.

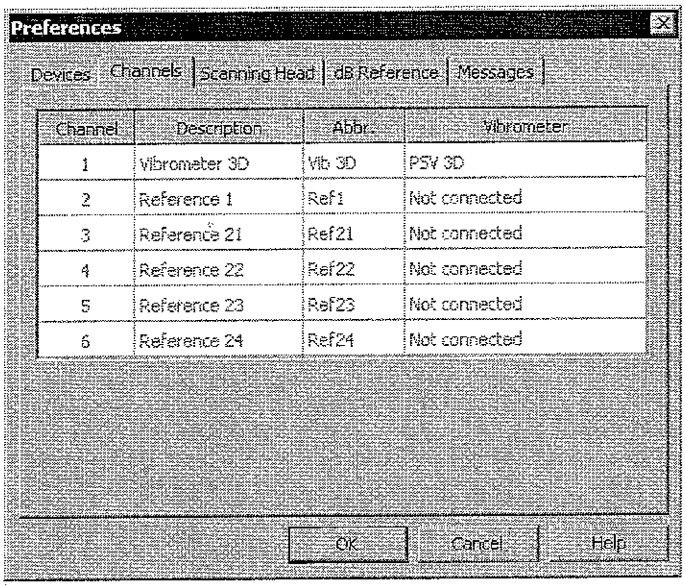


Figure 3.4: Page Channels for the PSV-3D

3.3 Scanning Head

You can set up the optics of the measurement system on the page Scanning Head.

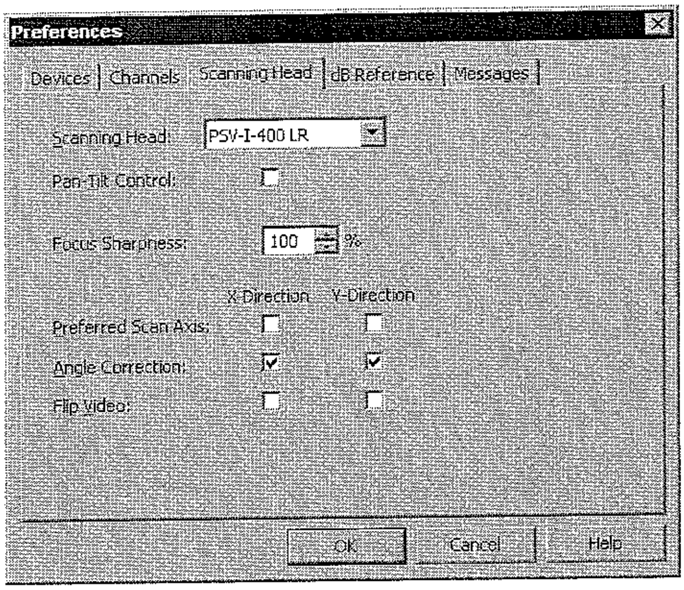


Figure 3.5: Page Scanning Head

Scanning Head: Select the scanning head of your measurement system here. The scanning head PSV-I-400 is delivered with the LR (Long Range) front lens as standard, as an option you can also have the MR (Mid Range) front lens. It is necessary to make a distinction between the two front lenses in the software to calculate the depth of focus correctly. Only PSV 200: Select the OFV-055F if your scanning head is equipped with a color camera.

Pan-Tilt Control: This line only appears if you have selected the scanning head OFV-056 or PSV-I-400 above. Tick the box if you want to control the optional pan-tilt stage using the software.

Focus Sharpness: This line only appears if you have selected the scanning head PSV-I-400 LR or MR. You can set the depth of focus here. The smaller the value you select, the less often the focus is corrected during a measurement. The standard value is 100%. However you can also set values to be greater than 100%. But please note that frequent readjustment of the focus can considerably increase the measurement time.

☞ So that focus is adjusted during the measurement, in the menu Scan you have to select the command Focusing during Scan.

Preferred Scan Axis: Here you select how the laser beam is to be moved when scanning. If the scan points are to be hit row by row, select the x-axis. If the scan points are to be hit column by column, select the y-axis. In the latter case the scanning time is shorter, as the scanner mirror for the y-axis is smaller and thus has a shorter settling time. If you do not mark any of the boxes, the software independently optimizes the order in which the scan points are hit.

Angle Correction: The vibrometer measures vibrations parallel to the laser beam. If the laser beam is at an oblique angle to the measurement surface, then an angle error occurs. Here you select whether the software is to correct the angle error for the respective axis. The angle correction only provides correct measurement values if you are measuring a flat surface at right angles to the scanning head. You should switch off angle correction for curved surfaces.

Flip Video: These boxes are only automatically activated for certain video boards. Here you can mirror the live video image on the x- or y-axis and thus, if necessary, set it up properly again. Normally the appropriate boxes for the scanning head have already been selected. However you can also change the setting as necessary, if, for example, you redirect the laser beam with external mirrors and thus obtain a flipped image, or if the scanning head has been mounted in such a way that it generates a flipped image.

Arrangement of scanning heads for the PSV-3D

With the PSV-3D you can mount the scanning heads tilted to one side. The software will compensate for this tilt if you move the beam with the icons Position in the scanning head control (refer to section 4.1). So that the laser beams can travel in the required direction, you have to set the tilt angle for every scanning head. Two configurations have already been predefined:

- staggered horizontally 
- star shaped 

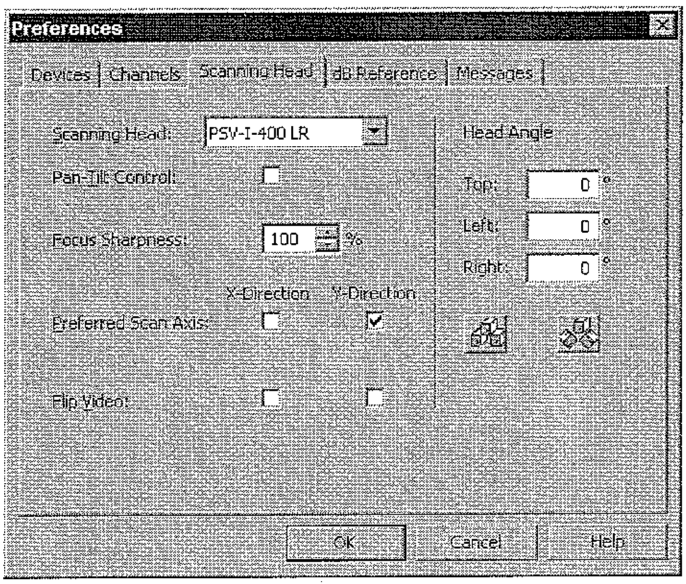


Figure 3.6: Page Scan head for the PSV-3D

Head Angle: Click  if you have the scanning heads mounted so that they are staggered horizontally. Click  if you have the scanning heads mounted in a star shape. In both of these cases, the tilt angles will be entered automatically.

If you have mounted the scanning heads with a different tilt, then please enter the values yourself.

☞ The function Angle Correction is not available in 3D mode.

Special features for the MSA

If you are using the MSA, you have other optional settings in the page Scanning Head.

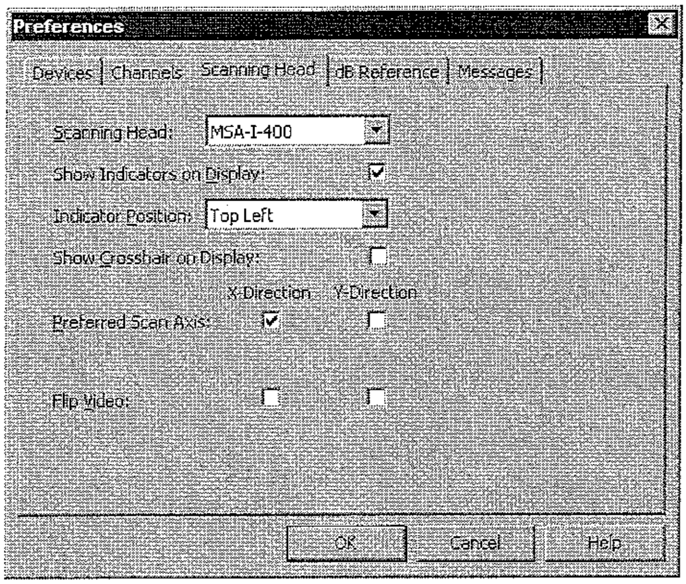


Figure 3.7: Page Scanning Head for the MSA

Scanning Head: Here you are shown the MSA-I-400 as the scanning head.

Show Indicators on Display: Tick this box if the indicators for the activity of the laser beam (on/off) and for the signal level on the MSA monitor are to be displayed.

Indicator Position: Here you select at which position on the MSA monitor the indicators are to be shown.

Show Crosshair on Display: Tick this box if a crosshair is to be shown on the MSA monitor. You can use this crosshair to help you accurately find the center of the screen and launch the laser beam precisely.

3.4 dB Reference

On the page dB Reference you can define dB = 0. You can thus directly follow an online measurement with a certain dB reference.

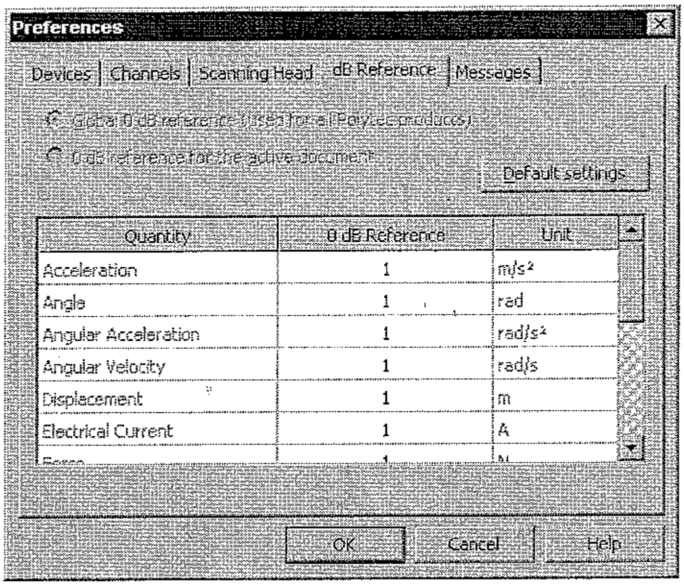


Figure 3.8: Page dB Reference

☞ Changes you make here only have an effect on the global 0 dB reference (applies to all Polytec products). If you want to change the local 0 dB reference for the active document, you have to open the page in presentation mode. See also section 8.4 under 0 dB reference on this.

Default settings: Click here if you want to recover the original settings for the 0 dB reference.

Quantity: All available physical variables are shown here.

0 dB Reference: Here you can define the factor for the respective unit.

Unit: The unit for the respective physical variable is shown here.

Example:

Variable	**0 dB Reference**	**Unit**
Displacement	2e-3	m

The 0 dB reference for the variable Displacement is 2 mm.

☞ If you want to evaluate combined signals (e.g. Vib & Ref1, see also section 8.4 on this), define the 0 dB reference for both variables.

3.5 Messages

On the page Messages you can select which system messages you would like to have displayed:

- If you would like to see all messages (notes, errors and warnings), then select Show all.
- If you would like to be informed of warnings and errors, then select Warnings.
- If you would only like to see error messages, then select Errors.
- If you do not want to receive any system messages at all, then select Show none.

☞ Message windows which contain queries or advise you of faulty input will appear in any case.

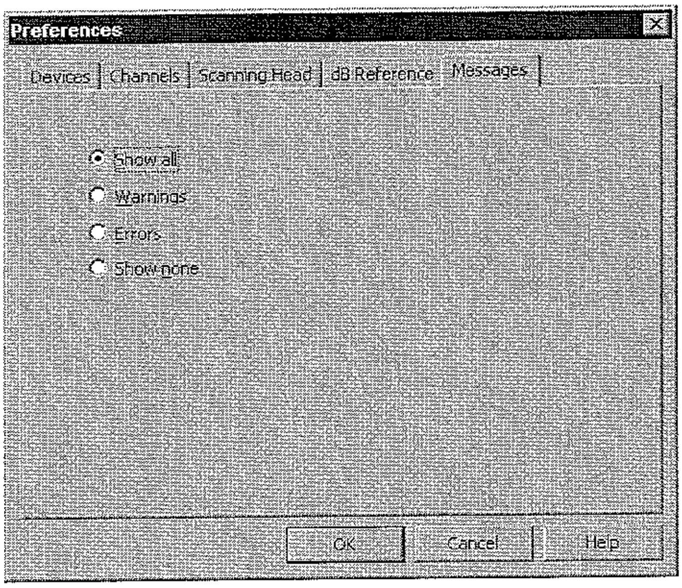


Figure 3.9: Page Messages

4 Setting the Optics

Depending on your measurement system, you may be able to control certain optics functions using the software. See section 4.1.1 on this. Alternatively you can use the optional PDA. See section 4.1.2 on this.

To define scan points on the live video image and to move the laser beam using the mouse, you have to align the coordinates on the live video image with the measurement plane. See section 4.2 on this.

You adjust the settings of the live video image (contrast, brightness, color) as described in section 4.7.

4.1 Controlling the Hardware

For the PSV 400 and the PSV 300 you can use the software to control all the optics and the optional pan-tilt stage.

For the MSA 400 or MSV/MMA 400 with the sensor head OFV-551/-552 respectively, you can use the software to position the laser beam and also remotely control the beam shutter and the optional dimmer on the sensor head. You set the other functions using the hardware. See your hardware manual on this.

For the MSV/MMA 300 with the sensor head OFV-511/-512 you can only position the laser beam with the software. You set the other functions using the hardware. See your hardware manual on this.

For the PSV 200 you can only use the software to focus and position the laser beam. You control the video camera and the optional pan-tilt stage with the video box. See your PSV 200 manual on this.

☞ You can remotely control the connected vibrometer controller. To do so, proceed as described in section 7.2.8 or use the range changer in the status bar.

4.1.1 Controlling the Optics with the Software

To control the optics with the software, proceed as follows:

1. Go to acquisition mode. To do so, click  or select View > Acquisition.
2. If you do not see the scanning head control in the application window, then click  to display it. You can also select View > Scanning Head.

3. Only scanning head MSV and MSA-I-400: From the list Lens, select the magnification which your microscope is set at.

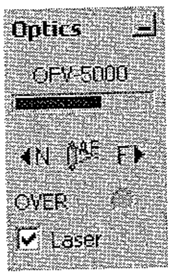
☞ If you can not see the list Lens in the scanning head control, then first of all set up the software for your measurement system. See chapter 3 on this.

4. If necessary, maximize the video window. To do so, in the title bar of the video window on the right, click .

5. If necessary, adjust the focus of the live video image. See section 4.7 on this.

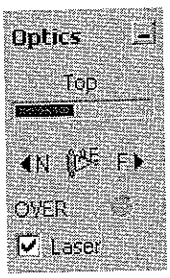
6. Using the icons in the scanning head control, you can now work as described in the following.

Focus the laser beam



Focus the laser beam with the icons (close-up) and (infinity). With the PSV 400 you can also focus the laser beam automatically with the icon . You will find more information on this in section 4.4. Above the icons you will see the optical signal level shown as a bar. This makes manual focusing easier. The Led OVER shows when the set measurement range is exceeded. In this case it lights up red. If it lights up permanently, then you have to select the next highest measurement range.

Switch the laser beam on or off



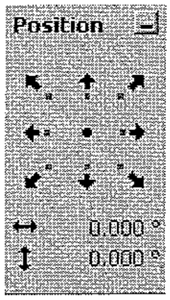
If you are using the junction box PSV-E-400 or PSV-E-400-3D, for every scanning head you will see the box Laser. Click the boxes to switch the respective laser on or off.
If you are using the optional geometry scan unit, then the box Laser for the scanning head Top is not active. In this case it is not the optical signal level of the vibrometer controller that is shown but that of the geometry scan unit. If the geometry scan unit receives too much light, the LED OVER lights up. If there is not enough light available, the signal level display disappears. This means you can tell whether your measurements will provide an acceptable result.
To display the signal level, the geometry scan unit has to continuously determine the lighting conditions. This is why the laser beam flashes approx. every 2 seconds.

If an additional vibrometer controller is connected and active, then another field is shown in the scanning head control. As this vibrometer controller is not connected up to the system via the junction box, you can not switch any laser beam on and off here. The display for signal level and overrun of the measurement range as well as focusing the laser beam are however available to you as described above.

Dim the laser beam (as an option)

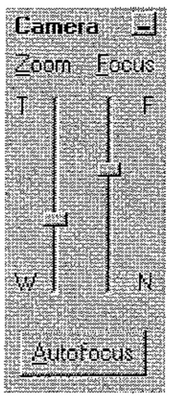
If you are using the junction box MSV-E-400 and the scanning head MSA-I-400, you can control the beam shutter and use it to switch the laser on and off. To do so, click the box Laser. You can also switch the laser beam on or off directly by pressing the button Laser on the sensor head. Refer to the sensor head manual on this. Apart from that, in the scanning head control, the slider Laser Dimmer is shown as an option. By moving this slider with the mouse in the direction Max. you can reduce the light intensity of the laser beam.

Position the laser beam



You move the laser beam with the icons Position. To do so, click the icon for the direction required. If you click ·, the laser beam is positioned in such a way that it is emitted at a right angle to the front panel of the scanning head (position 0; 0).
Under the icons you will see the position of the laser beam related to the horizontal and vertical axis.

Zoom the video camera

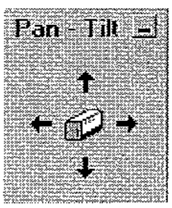


You zoom the video camera with the slider Zoom. Using the mouse you can roughly set the slider. If the slider is active, you can fine-tune it with the arrow keys ↑ and ↓. (To activate the slider, click it.)

Focus the video camera

You focus the video camera with the slider Focus. Using the mouse you can roughly set the slider. If the slider is active, you can fine-tune it with the arrow keys ↑ and ↓. (To activate the slider, click it.)
You can also focus automatically. To do so, click Autofocus. Automatic focusing can take several seconds during which the software is inactive.

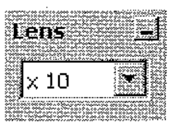
Pan-tilt stage (as an option)



You control the motorized pan-tilt stage with the icons Pan-Tilt. If you can not see the icons in the scanning head control, then first of all activate the pan-tilt stage for the software. See section 3.3 on this.

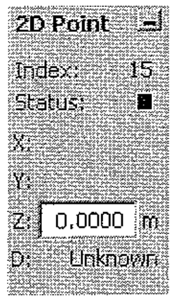
To pan the scanning head, click ← or →. To tilt the scanning head, click ↑ or ↓.

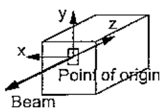
Set the zoom factor for the microscope



If you are using the scanning head MSA-I-400 or MSV, here you select the zoom factor set on the microscope. The software uses the zoom factor set to calculate the position of the laser on the measurement object and displays this in µm under the icons Position.

Enter coordinates of axes

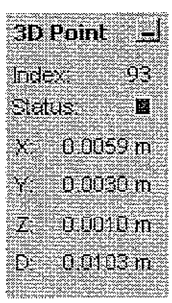




The element 2D Point is displayed if there is a 2D geometry.
Right at the top the Index of the selected scan point is shown, below that its Status (refer to section 8.1 as well). Enter the distance between the scanning head and the measurement object in the empty field and press Enter. Of the three axes, the one for which you can define the distance depends on the direction of the vibrometer channel in the dialog Acquisition Settings (refer to section 7.2.2). The figures next to this apply to the direction +Z.
As the axis which shows the distance of the measurement object from the scanning head is in the opposite direction to the laser beam, the coordinate for the object always has the inverse sign. If you enter the distance between the measurement object and the scanning head as z-coordinate, the software calculates the x and y coordinates of the respective scan point under the assumption that the object is flat and is positioned vertically to the 0° direction of the laser beam. The z coordinate is thus the same for every scan point. The origin of the coordinate system is the point at which the laser beam is emitted in 0° direction from the front panel of the scanning head.

☞ The coordinate which shows the distance of the object from the scanning head is used as a preset for the object distance when exporting the geometry in Universal File Format and ME'Scope-Format.
For measurements with the close-up unit PSV-A-410 or OFV-056-C, you have to add 41 mm to the stand-off distance. This corresponds to the optical path length inside the close-up unit (see also section 10.2.3 and section 10.2.4).

3D Point



The element 3D Point is displayed if there is 3D geometry.
Right at the top, the Index of the selected scan point is displayed. Below that, the coordinates (X, Y, Z) of the scan point are displayed. The coordinate system used here is the one which you determined with the 3D alignment (refer to section 4.2.4).
The software calculates the distance D, i.e. the distance between the selected scan point and the point at which the laser beam in 0° direction intersects the plane of the front of the scanning head. For the PSV-3D, the distance to the scanning head Top is always given.

4.1.2 Controlling the Optics with the PSV-A-PDA

To control the optics with the optional PDA, start the PDA as described in section 2.4. The user interface of the PDA software appears.

Position the laser beam

Move the laser beam with the icons ⇩, ⇧, ⇦ and ⇨. To do so, touch the icon for the direction required. If you touch ◉, the laser beam is positioned in such a way that it is emitted at a right angle to the front panel of the scanning head (position 0; 0).

Focus the laser beam manually (PSV-1D)

Focus the laser beam manually with the icons ◀N (close-up) and F▶ (infinity). Below the icons you will see the optical signal level shown as a bar. This makes manual focusing easier. The signal level displayed is identical to that in the software and on the scanning head. The LED next to the icons shows when the set measurement range is exceeded. In this case it lights up red. If it lights up permanently, then you have to select the next highest measurement range.

Automatically focus the laser beam

With the PSV 400 you can also focus the laser beam automatically with the icon AF. See section 4.4 on this.

4.2 Aligning Coordinates

To define scan points on the live video image and to move the laser beam using the mouse, you have to align the coordinates on the live video image to the measurement plane. As you are aligning two-dimensional coordinate systems, you have to align at least two points with different x- and y-coordinates.

How?

You can align the coordinates with the software as described in the following sections. However you can also use the optional PDA to help you. See section 4.2.2 on this.

When?

You have to realign when you

- are working at a different stand-off distance
- have zoomed the video camera.

Tips

The following tips make it easier to align:

- The more points you align, the more precisely the software positions the laser beam.
- Distribute the alignment points evenly over the whole measurement surface. If, for example, you want to scan a rectangular surface, it would make sense to choose four alignment points near the corners.
- Align those points which you want to position precisely when scanning.
- To increase the precision, you can zoom in on sections of the image. Read section 2.8 on this.

PSV-3D

If you are using the PSV-3D, then you are making a measurement with three independent scanning heads. This means that you have to start by carrying out a standard alignment for every single scanning head as described in section 4.2.1.

After that, you have to carry out a 3D alignment to position the three laser beams on one geometry point and have to transmit the vibration data into the coordinate system of the object under investigation. 3D alignment is described in section 4.2.3.

☞ A 3D alignment without previous standard alignment is possible. To make a measurement however, you will need both.

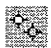
4.2.1 Carrying out Standard Alignment with the Software

You always have to carry out this alignment for the PSV. It is only necessary for the PSV-3D if you want to make a measurement.

☞ If you want to import geometry data in 3D point mode, you also have to carry out a standard alignment first.
You will find detailed information on geometry import in section 5.4.

Alignment with the scanning head control

For standard alignment, proceed as follows:

1. Click  or select Setup > Align Coordinates. The software maximizes the video window and displays the scanning head control.
2. Move the laser beam with the icons Position in the scanning head control to an alignment point on the object, refer also to section 4.1.
3. In the live video image, point the mouse precisely at the laser beam and click. You can now see a target there.
4. If the laser beam is not precisely in the middle of the target, repeat step 3.
5. Repeat steps 2 and 4 for at least one other alignment point.

☞ When you select a new scanning head for alignment, the alignment points of the other scanning heads which have already been defined are saved.

6. Once you have aligned all points, click  again or select Setup > Align Coordinates.

Special features for PSV-3D

If you are carrying out standard alignment with PSV-3D, please also pay attention to the following points:

1. For the PSV-3D define at least four alignment points for each scanning head. When doing so, the following applies:
   - In the case of simple level surfaces, it often already suffices to use four to six alignment points to get good results.
   - The larger the surface, the greater the deviations, particularly in the areas close to the edge.
   - If the results of the alignment are not satisfactory (see below: section Test, step 3), then define at least ten alignment points per scanning head.
2. To select the individual scanning heads, use the list in the scanning head control or click the right mouse button on the video image and select one of the scanning heads (Top, Left or Right) in the pop-up menu.
3. Once you have defined all alignment points for one scanning head, then select the other two scanning heads one after the other as described in step 2 and define the alignment points for these scanning heads in the same way.

Alignment using the mouse

With a bit of practice, you can position the laser beam more quickly for alignment by using the mouse to move it to approximately the right place first. If necessary, you can then use the scanning head control for fine-tuning as described above.

1. Hold the middle mouse button (mouse wheel) pressed and drag across the video image with it. The laser beam follows the mouse pointer, although not very precisely yet, as the alignment has not yet been carried out.

☞ If you have allocated a special function to the middle mouse button (e.g. double-click), then this method of alignment is not available.

2. If necessary, move the laser beam using the icons Position in the scanning head control to the right position and proceed with the alignment as described above in step 3.

Alignment with auto-alignment

If you are using one of the graphics cards ATI Radeon® 9000 Pro, 9600 Pro or 9600 XT, you can carry out automatic alignment. To do this, proceed as follows:

1. Click in the video image with the right mouse button and select Auto Align in the pop-up menu.
2. In the video image, click the point on the object at which you want to define the alignment point. The software will automatically position the laser beam there and define an alignment point.

☞ This function is not available for the MSV.

Delete alignment points

To delete an individual alignment point, click it with the right mouse button and select Delete in the pop-up menu.

To delete all the alignment points for one scanning head, click with the right mouse button in the video image and select Delete All in the pop-up menu.

Abort the alignment

You can abort the alignment at any time. To do so, click or select Setup > Align Coordinates. You will be given a message that the alignment was not finished correctly and you can now decide whether you want to repeat it or not.

Test

Now test the alignment as follows:

1. If the scan points are shown in the live video image, click to hide them.
2. Point at the live video image and click a point on the measurement plane. The laser beam moves to this point on the object.
3. Check if the position of the laser beam corresponds to that of the point clicked. If this is not the case, repeat the alignment.

☞ The live video image shows a two-dimensional image of the three-dimensional object. For this reason, the laser beam does not precisely hit points which are not on the measurement plane.
Only PSV-3D: If you want to define scan points in Scan Point Definition mode, then it is necessary for the laser beam and the point clicked on the screen to match as accurately as possible (refer above to Alignment with the scanning head control, step 3). If you import via UFF or teach-in the scan points, then an approximate match is good enough.

4. Repeat steps 2 and 3 for a few more alignment points.

4.2.2 Carrying out Standard Alignment with the PSV-A-PDA (as an Option)

To carry out a standard alignment with the optional PDA, you essentially proceed as described in section 4.2.1. Use the PDA to position the laser beam and to define the alignment points. To do this, proceed as follows:

1. Click or select Setup > Align Coordinates. The software maximizes the video window and displays the scanning head control.
2. Start the PDA as described in section 2.4. The user interface of the PDA software appears.

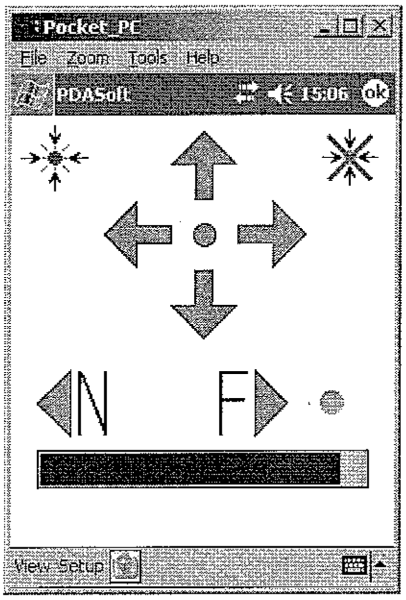


Figure 4.1: User interface of the PDA software

Position the laser beam

3. Center the laser beam by touching the icon with the stylus.
4. Position the laser beam by touching the corresponding icon for the direction , , or .

☞ If you touch an arrow icon for more than approx. one second, the PDA switches to fast forward.
For fine adjustment you can always briefly touch the icon again.

Define alignment points

5. You define an alignment point by touching the icon .

Delete alignment points

6. You can delete an alignment point by positioning the laser beam on the alignment point and touching the icon .

Directly head for alignment points

You can use the optional PDA to directly head for the defined alignment points with the laser beam.To do this, proceed as follows:

1. Select View > Toggle Points in the PDA menu bar.

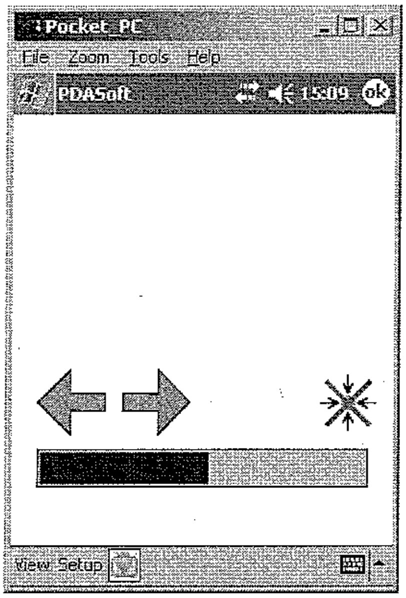


Figure 4.2: Directly head for alignment points

2. Touch the icons ⇦ or ⇨. The laser will directly head for the defined alignment points backwards or forwards.

Select the scanning head (PSV 3D)

If you are using the PSV-3D, you can also select the scanning heads with the PDA software.

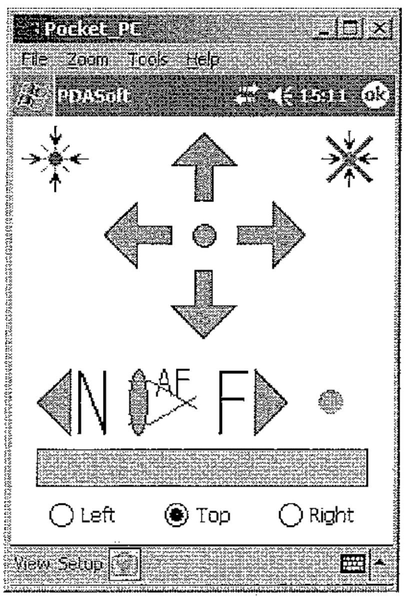


Figure 4.3: User interface of the PDA software for the PSV-3D

To select one of the three scanning heads, touch the corresponding icon ○ Left ◉ Top ○ Right.

You can define, delete and directly control the alignment points for every scanning head as described above.

4.2.3 3D Alignment

This alignment must be carried out for the PSV-3D. It is only necessary for the PSV if you want to import geometry data in 3D point mode (as an option) or want to acquire geometries with the geometry scan unit PSV-A-420 (as an option). It determines the position and the alignment of the scanning heads in the coordinate system of the object under investigation.

☞ With the micro scanning lenses PSV-A-CL80, PSV-A-CL150 and PSV-A-CL300 it is not possible to carry out 3D alignment! The close-up unit without micro-scanning lenses does not affect 3D-alignment.

You need the coordinate description of at least four points on the object in a cartesian coordinate system. Ideally you import these points as a Universal File directly from an external program (e.g. CAD or modal analysis). You can also enter the coordinates manually after measuring your object. You can directly determine the coordinates with the optional geometry scan unit PSV-A-420. Then you will also only need at least 3 points for the 3D alignment.

Careful alignment is an important prerequisite for an optimal measurement result. For this reason, please pay attention to the following points:

- Pay attention to the position of the coordinates on the object!
  If all the coordinates are in one plane, then this can lead to inaccurate results, even on a flat object. If necessary, use an object with several spatial planes for the alignment.
- Pay attention to the number of alignment points on the object!
  In principle for an alignment, it is enough to define four alignment points. For the best possible results however, you should align at least five points.

☞ Ideally, the selected alignment points should cover the whole volume of the object. For this reason they should not all be in one plane.

- It is best if two people position the laser beam. One person operates the software, the other watches the movements of the laser beam directly on the object.
  Alternatively you can use the hand set PSV-Z-051 or the optional PDA. See the respective hardware manual on this.
  The more precisely the alignment is carried out, the better the measurement result will be. **So please take your time defining the alignment points!**

For 3D alignment, in principle you proceed as described in the following. You will find detailed information on the individual steps in section 4.2.4.

Select the unit

1. Open the dialog 3D Alignment and select the unit of length (mm or m).

Set the coordinates

2. Put the coordinates of the alignment points in the table. You can enter the coordinates manually or import them.

Define alignment points

3. Choose a scanning head, position the laser beam to point at the required points on the object one after the other and define the alignment points.

Assign the coordinates

4. Assign the coordinates to the alignment points.

5. Repeat step 3 for both the other scanning heads.

Specify quality

6. Then enter the accuracy with which the alignment points on the object and the coordinates in the table approximately correspond to each other.

Calculate the alignment

7. Calculate the alignment and if necessary, correct the alignment points.

If you are using the optional geometry scan unit, you proceed slightly differently than described here. Refer to section 4.2.6 or section 4.2.7.

4.2.4 Carrying Out 3D Alignment Using the Software

☞ If you are using the PSV-3D in 1D mode, you only have to carry out the 3D alignment for the scanning heads which are not marked as reference.

For 3D alignment, proceed as follows:

1. Click or select Setup > Align 3D Coordinates.

2. Click or select Setup > Dialog 3D Alignment.

   You can also click the video image with the right mouse button and select Dialog 3D Alignment in the pop-up menu. The dialog 3D Alignment appears. Depending on the system you are making the measurement with (PSV-3D or PSV with the option Data Import: Geometry), either all three scanning heads are shown in the dialog or only one.

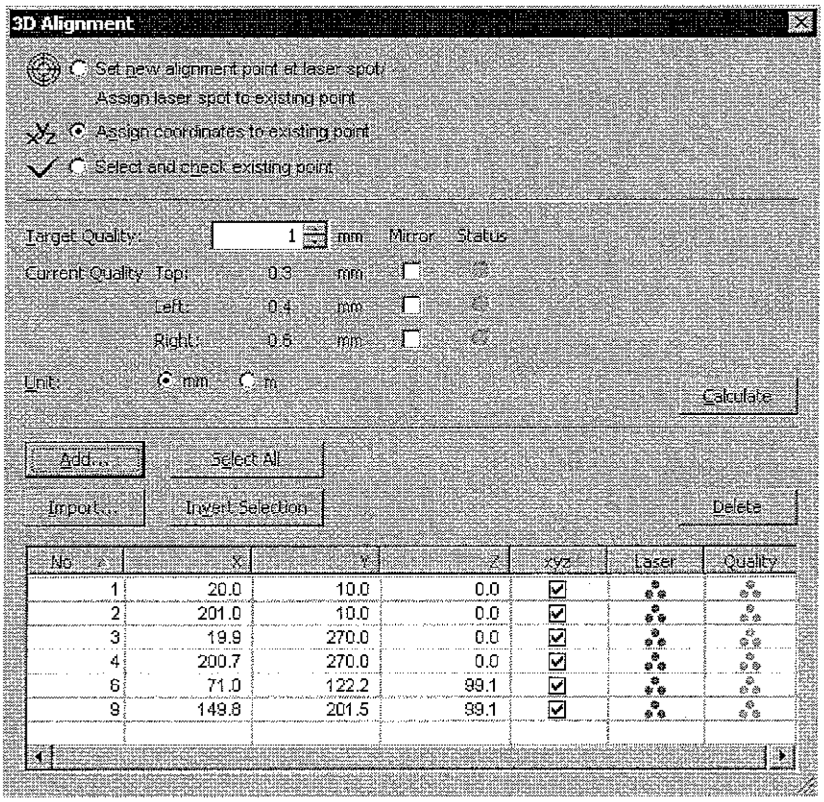


Figure 4.4: Dialog 3D Alignment for the PSV-3D

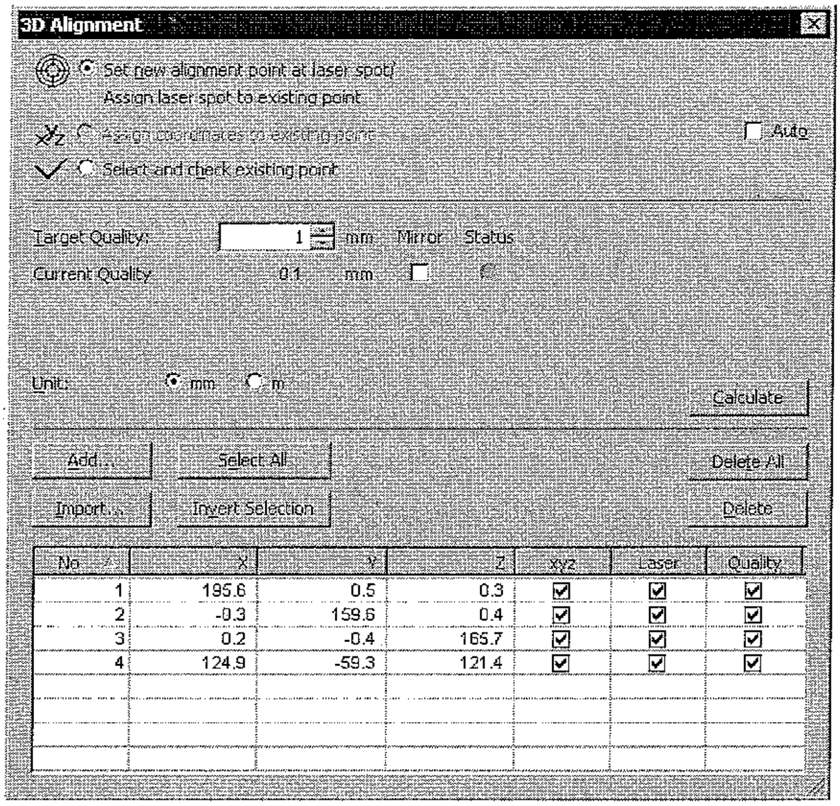


Figure 4.5: Dialog 3D Alignment for the PSV with the option Data Import: Geometry

☞ You can sort the entries in the table in ascending or descending order in every column. To do so, click the head of the respective column.

Select the unit

3. Select the unit for the coordinates (mm or m).

Set the coordinates

4. Enter at least four object coordinates for every scanning head. These coordinates can be the same for all three scanning heads, but this is not necessary.

   If you want to import the coordinates e.g. from a CAD program, then click Import. Then enter the file which you want to import the values from.

☞ When importing, all the coordinates which already exist will be deleted!

☞ If you are importing geometry from a file in Universal File format which does not contain data set 164 with the units of the coordinates, you have to enter a scaling factor in the dialog 3D Alignment, refer to figure 4.6. The factor 1 stands for the unit m, the factor 0.01 for the unit cm etc.

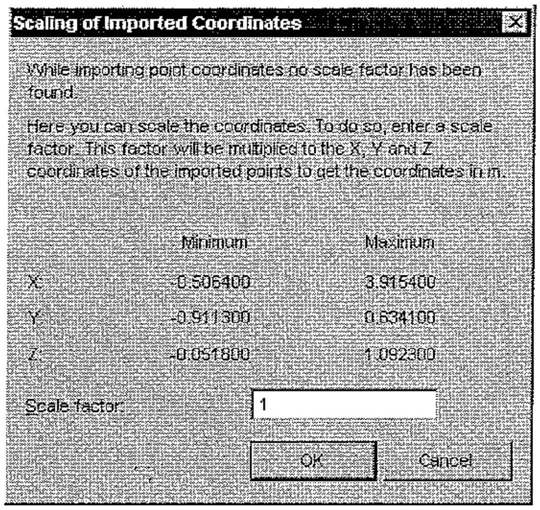


Figure 4.6: Dialog Scaling of Imported Coordinates

If you enter the coordinates manually, click Add. The dialog Add Point Coordinates appears.

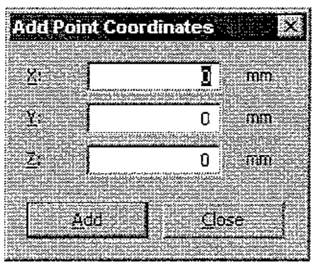


Figure 4.7: Dialog Add Point Coordinates

Enter the values in the fields X, Y and Z and click Add. Once you have entered all the coordinates, click Close or press the Escape key to leave the dialog.

Delete individual coordinates

If the table contains too many coordinates, you can delete individual coordinates. To do so, mark one or more coordinates and click Delete.

Or:

Mark the coordinates you want to keep, click Invert Selection and then Delete. This way you will delete all the undesired coordinates at once.

Delete all coordinates

If you want to delete all coordinates, click Select All and then Delete.

☞ If alignment points on the video image are already linked with the coordinates in the table, then the coordinates assigned to the points are deleted, the alignment points themselves however remain.

Select the scanning head

5. In the scanning head control, select a scanning head, or with the right mouse button, click in the video image and select one of the scanning heads (Top, Left or Right) in the pop-up menu.

6. Now you can move the laser beam using the icons Position in the scanning head control.

   Alternatively you can also use the mouse directly. Using the middle mouse button (mouse wheel), click in the video image. This will make the laser beam jump to your mouse pointer. To position the beam, press the middle mouse buttonand drag with the mouse until the laser beam is positioned on the required point on the object.

☞ To increase the accuracy when hitting the required point, zoom the video image. See section 2.8 on this.
If you have assigned a special function to the middle mouse button (e.g. double-click), position the laser beam using the icons Position in the scanning head control.

Defining alignment points

7. Once you have found the precise position, in the dialog 3D Alignment, select Set new alignment point at laser spot/Assign laser spot to existing point. Now in the video image, click the point which the laser beam is currently at. An alignment point will now be defined there.

   The alignment point is marked using a black circle. This icon shows you which scanning head you are currently aligning:

   designates the left, the right and the top scanning head.

☞ If you define alignment points with identical coordinates for two or all three scanning heads, the respective circular icons will be superimposed on each other while you align the scanning heads one after the other. If for example you give the same coordinates to one alignment point for the left and right scanning head and have aligned both scanning heads, you will be shown .

8. In this manner define all alignment points.

☞ On the PSV the icon appears immediately

Delete alignment points

To delete an alignment point, click it in the video image with the right mouse button and select Delete in the pop-up menu.

To delete all the alignment points for the selected scanning head, click in the video image with the right mouse button and select Delete All in the pop-up menu.

Assign coordinates

9. Then in the dialog 3D Alignment, select Assign coordinates to existing point.

10. In the dialog 3D Alignment, mark the first coordinate in the table and click the relevant alignment point in the video image. In the column xyz a tick will appear which shows that the coordinates in this line are now assigned to an alignment point. The circle in the video image is now shown in bold and the marker in the table moves on one line.

☞ In the dialog 3D Alignment in the table column Laser, you will see which scanning heads you have already assigned to the respective alignment point. The three dots in the icon stand for the three laser beams Top, Left and Right. Once the first scanning head has been aligned, the respective dot in the icon is marked red.

11. Now assign the other coordinates in the table to the alignment points.

12. Define the alignment points for the other two scanning heads as described above.

☞ As soon as all three scanning heads have been aligned, a tick will appear in the column Laser instead of the icon.

Use mirrors

If you make the measurement with the aid of mirrors, e.g. to scan sides of the object which you can not reach directly with the laser beam, you have to define all scan points for the respective scanning head on the reflection of the object and also align the coordinates on the mirror. Apart from that, tick the corresponding box in the dialog 3D Alignment in the column Mirror.

Specify quality

13. In the field Target Quality enter the value by which the alignment points deviate from the given coordinates (e.g. 1 mm).

Calculate the alignment

Once you have defined the alignment points for all three scanning heads and have assigned coordinates to them, you can calculate the alignment.

14. Click Calculate. The software will now carry out an alignment for each scanning head. The quality of this alignment is displayed in the dialog for every scanning head. If none of the quality values calculated is greater than the value in the field Target Quality, then the alignment was successful.

    You can check the quality for the scanning heads and also for the individual alignment points. In the column Quality the points are marked green for which the quality value for the respective scanning head is lower than the value in the field Target Quality. The LED Status in the dialog 3D Alignment also shows whether the quality of the alignment of individual points is sufficient. If the LED lights up green, then the quality is good. If the LED lights up yellow, then the quality is worse than the target quality but you can use the alignment. If the LED lights up red, then the alignment is not valid.

☞ You can also make a measurement if not all the alignment points are positioned exactly. To increase the quality of the measurement results, you can delete the alignment points or reassign laser positions to them as described in the following.
You can also initially increase the tolerance limit in the field Target Quality to find out what the deviation between the alignment point and the object coordinate is.

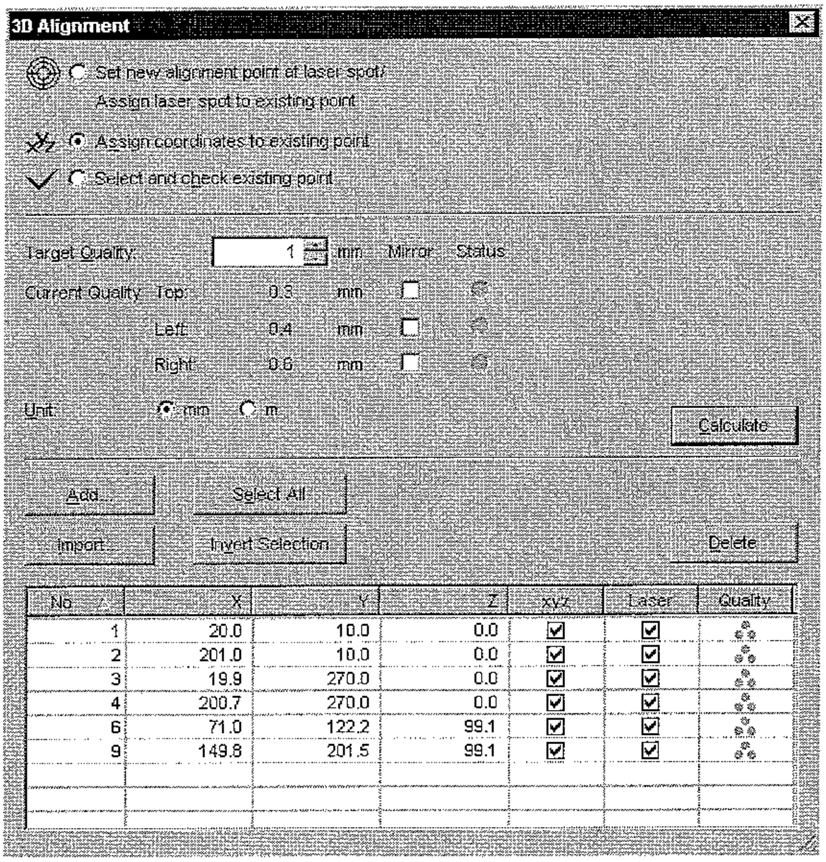


Figure 4.8: Successfully calculated 3D Alignment

Reassign the laser position

You can also reassign a new laser position to existing alignment points to increase the quality of the measurement results.

15. To do so, in the dialog 3D Alignment, select Set new alignment point at laser spot/Assign laser spot to existing point. Then move the relevant laser beam to the alignment point and click the point with the left mouse button. The new laser position is used to calculate the alignment again.

Abort the alignment

You can abort the alignment at any time. To do so, click or select Setup > 3D Alignment. You will be given a message that the alignment was not finished correctly and you can now decide whether you want to repeat it or not.

Check alignment points

You can also retrospectively compare the assignment of the alignment points on the video image to the points in the table in the dialog 3D Alignment.

16. To do so, in the dialog 3D Alignment, select Select and check existing point.
17. Then click an alignment point in the video image. If this point already has coordinates assigned to it, then the corresponding line in the table is marked blue.

    Or:

    Click a line in the table. The corresponding alignment point is displayed blue in the video image. If there is a valid 3D alignment for all scanning heads, then the laser beams are moved to the positions calculated for the x, y and z coordinates. You can visually control the quality of the alignment at the respective point. The more precisely the beams are superimposed, the greater the quality of the alignment will be.
18. Click to leave the dialog 3D Alignment.

Clear assignment

If you have already assigned coordinates to an alignment point, delete the respective table lines in the dialog 3D Alignment. The assignment of the alignment point to the coordinates is removed.

4.2.5 Carrying Out 3D Alignment with the PSV-A-PDA

To carry out a 3D alignment with the optional PDA, you essentially proceed as described in section 4.2.4. You use the PDA to select the scanning heads, to position the laser beam and to define the alignment points. To do so, proceed as follows:

1. Click or select Setup > Align 3D Coordinates.
2. Click or select Setup > Dialog 3D Alignment.

Select the unit and define coordinates

3. Select the unit and define the coordinates as described in section 4.2.4.

4. Start the PDA as described in section 2.4. The user interface of the PDA software appears.

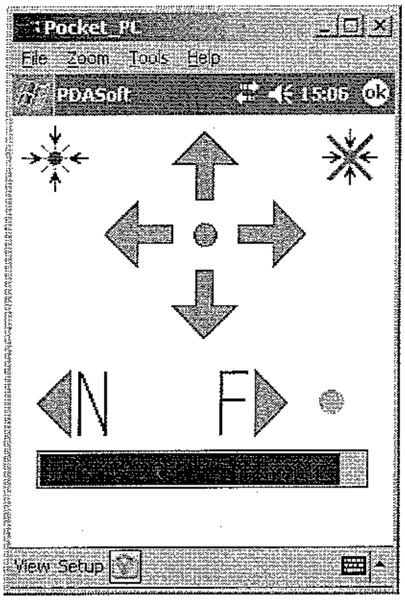


Figure 4.9: User interface of the PDA software

Position the laser beam

5. Center the laser beam by touching the icon with the stylus.
6. Position the laser beam by touching the corresponding icon for the direction , , or .

☞ If you touch an arrow icon for more than approx. one second, the PDA switches to fast forward. For fine adjustment you can always briefly touch the icon again.

Define alignment points

7. You define an alignment point by touching the icon .

Delete alignment points

8. You can delete an alignment point by positioning the laser beam on an alignment point and touching the icon .

Select the scanning head (PSV 3D)

If you are using the PSV-3D, you can also select the scanning heads with the PDA software.

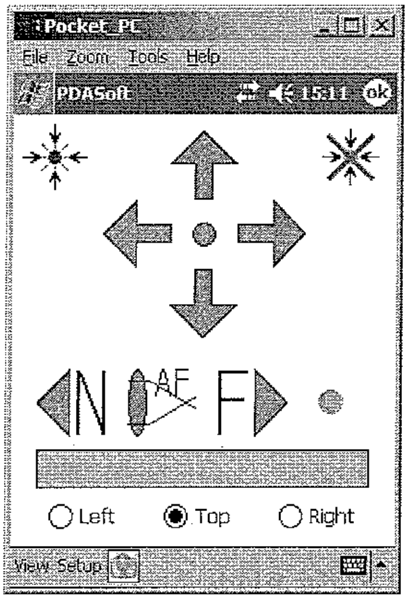


Figure 4.10: User interface of the PDA software for the PSV-3D

9. To select one of the three scanning heads, touch the corresponding icon ○ Left ◉ Top ○ Right.

You can define and delete the alignment points for every scanning head as described above.

Assign coordinates and calculate alignment

10. Now proceed as described in section 4.2.4, i.e. assign coordinates to all alignment points, specify the quality and calculate the alignment.

Directly head for alignment points

If there is a calculated 3D alignment, you can directly head for the defined alignment points with the laser beam. To do this, proceed as follows:

1. In the dialog 3D Alignment, select Select and check existing point.

2. Select View > Toggle Points in the PDA menu bar.

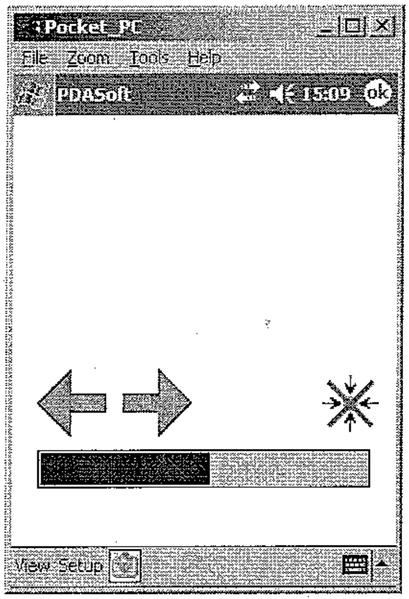


Figure 4.11: Directly head for alignment points

3. Touch the icons or . The laser directly controls the defined alignment points backwards or forwards.

☞ If you delete an alignment point, there is no valid 3D alignment any more and you can no longer directly head for the alignment points.

4.2.6 3D Alignment for the PSV with the Geometry Scan Unit (as an Option)

You can use the geometry scan unit to carry out a simplified 3D alignment as an alternative to section 4.2.4.

1. If you have not carried out a standard alignment yet, do it now as described in section 4.2.1or section 4.2.2.

2. Click or select Setup > Align 3D Coordinates. You can also click in the video image with the right mouse button and select Dialog 3D Alignment in the pop-up menu. The dialog 3D Alignment appears.

3. Tick the box Auto. In place of the buttons above the table, the list Coordinate Definition Mode is displayed, instead of the column xyz, the column Distance.

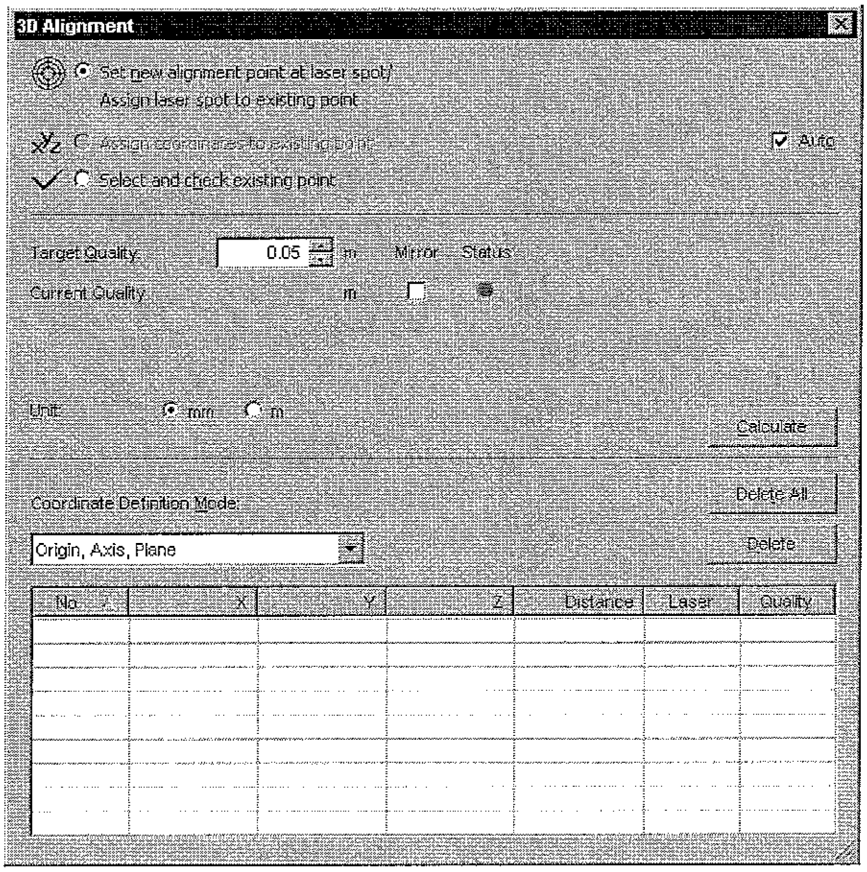


Figure 4.12: Dialog 3D Alignment for alignment with the geometry scan unit

You have the following ways of defining the coordinate system:

- Mark the origin, any point on the positive x, y or z axis and any point on a positive half plane limited by the selected axis.
  Example: 0, +x, x/+y
- Mark any point respectively on the positive x, y and z axis.
- Mark any three points and enter all the coordinates of these points.

These possibilities are described in detail in the following.

☞ When defining every alignment point, the software automatically switches over to the geometry laser and carries out a distance measurement to the alignment point. When defining the alignment points, you can save time by activating the geometry laser first to avoid having to switch over. To do so, select Scan > Geometry Laser.

Specify Origin, Axis, Plane

To set the coordinate system in this way, proceed as follows:

1. Select Origin, Axis, Plane from the list Coordinate Definition Mode.
2. Position the laser at the origin of the coordinate system.
3. Define an alignment point as also described in section 4.2.4. The alignment point is automatically displayed in the list in the dialog 3D Alignment. In the column Distance the distance measured to this alignment point is entered. In the column Laser it shows that the point has been defined.
4. Click the alignment point with the right mouse button and select Origin in the pop-up menu. A 0 will appear next to the alignment point. The coordinates of the point at the origin (0/0/0) are shown.
5. Move the laser beam and define a second alignment point on one of the positive axes, e.g. on the positive x-axis. The point and its distance from the scanning head are shown in the list in the dialog 3D Alignment.
6. Click the alignment point with the right mouse button and select Point on +x-axis in the pop-up menu. An +X will appear next to the point; an arrow will be drawn through the point. The distance and the coordinates (+x/0/0) of the point are shown.
7. Move the laser beam again and define a third alignment point on one of the half planes limited by the selected axis, e.g. on the x /+y plane. The point and its distance from the scanning head are shown in the list in the dialog 3D Alignment.
8. Click the alignment point with the right mouse button and select Point on x/+y-plane in the pop-up menu. An X/+Y will appear next to the point. The distance and the coordinates (x/+y/0) of the point are shown.
9. Click Calculate. The software will calculate all the coordinates of the alignment points and enter them in the list. At the same time it determines the position of the scanning head in this coordinate system.

Specify Three Points on Axes

To set the coordinate system in this way, proceed as follows:

1. Select Three Points on Axes from the list Coordinate Definition Mode.
2. Position the laser beam at a point in the video image which the x-axis of the coordinate system is to pass through.
3. Click the alignment point with the right mouse button and select Point on +x-axis in the pop-up menu. An +X will appear next to the point; an arrow will be drawn through the point.
4. Repeat steps 2 and 3 for one more alignment point each on the y and z-axis.
5. Click Calculate. The software will calculate all the coordinates of the alignment points and enter them in the list. At the same time it determines the position of the scanning head in this coordinate system.

Specify Points with free Coordinates

To specify the coordinate system in this way, the object coordinates have to be known. Please proceed as follows:

1. Select Points with free Coordinates from the list Coordinate Definition Mode.
2. Position the laser beam at any point on the video image.
3. Click the alignment point with the right mouse button and select Points with Free Coordinates in the pop-up menu. The dialog Assign Coordinates appears.

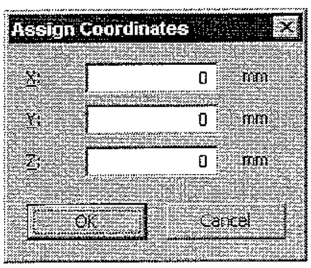


Figure 4.13: Dialog Assign Coordinates

4. Here you enter the coordinates of the alignment point and click OK. XYZ will appear next to the point.
5. Repeat steps 2 to 4 for a total of four to seven alignment points.
6. Click Calculate. The software calculates the position and location of the scanning head in the coordinate system.

4.2.7 3D Alignment for the PSV 3D with the Geometry Scan Unit

1. If you have not carried out a standard alignment yet, do it now as described in section 4.2.1.

2. Select the scanning head Top.

3. If applicable, select Scan > Geometry Laser to activate the geometry laser.

4. Click or select Setup > Align 3D Coordinates. You can also click the video image with the right mouse button and select Dialog 3D Alignment in the pop-up menu. The dialog 3D Alignment appears, refer to figure 4.12.

5. Tick the box Auto. In place of the buttons above the table, the list Coordinate Definition Mode is displayed, instead of the column xyz, the column Distance.

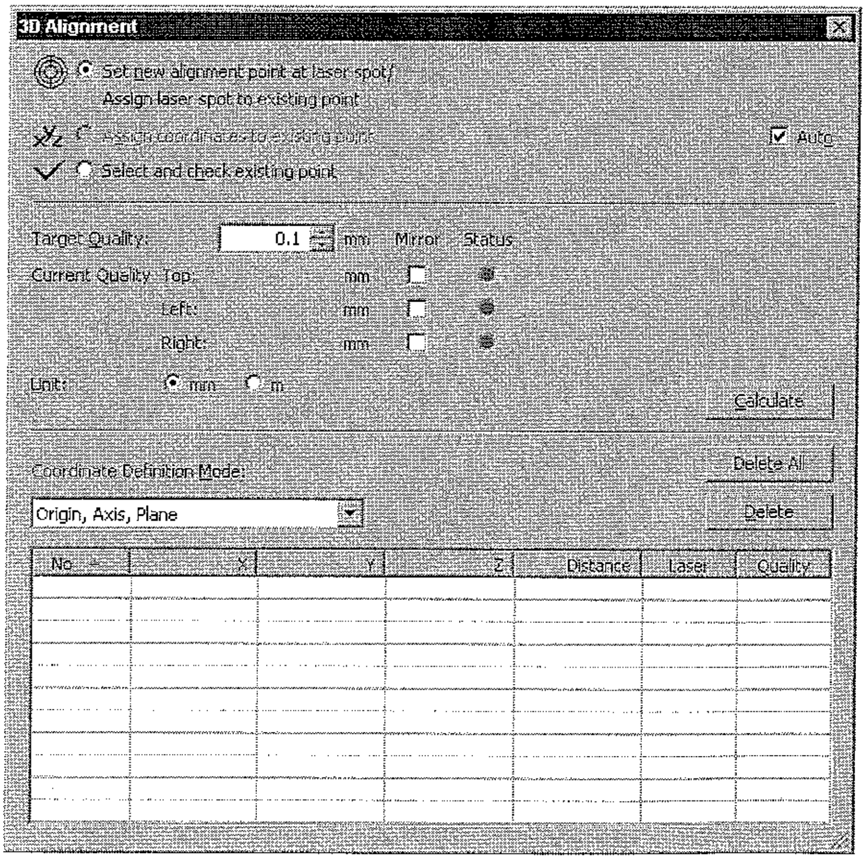


Figure 4.14: Dialog 3D Alignment for alignment with the geometry scan unit

You can define the coordinate system in the following ways:

- Mark the origin, any point on the positive x, y or z axis and any point on a positive half plane limited by the selected axis.
  Example: 0, +x, x/+y
- Mark any point respectively on the positive x, y and z axis.
- Mark any three points and enter all the coordinates of these points.

These possibilities are described in detail in the following.

Specify Origin, Axis, Plane

To set the coordinate system in this way, proceed as follows:

1. Select Origin, Axis, Plane from the list Coordinate Definition Mode.
2. Position the laser at the origin of the coordinate system.
3. Define an alignment point here as also described in section 4.2.4. The alignment point is automatically displayed in the list in the dialog 3D Alignment. In the column Distance the distance measured to this point is entered. The column Laser shows that the alignment point has been set for the scanning head Top.

4. Click the alignment point with the right mouse button and select Origin in the pop-up menu. A 0 will appear next to the point. The coordinates of the point at the origin (0/0/0) are shown.

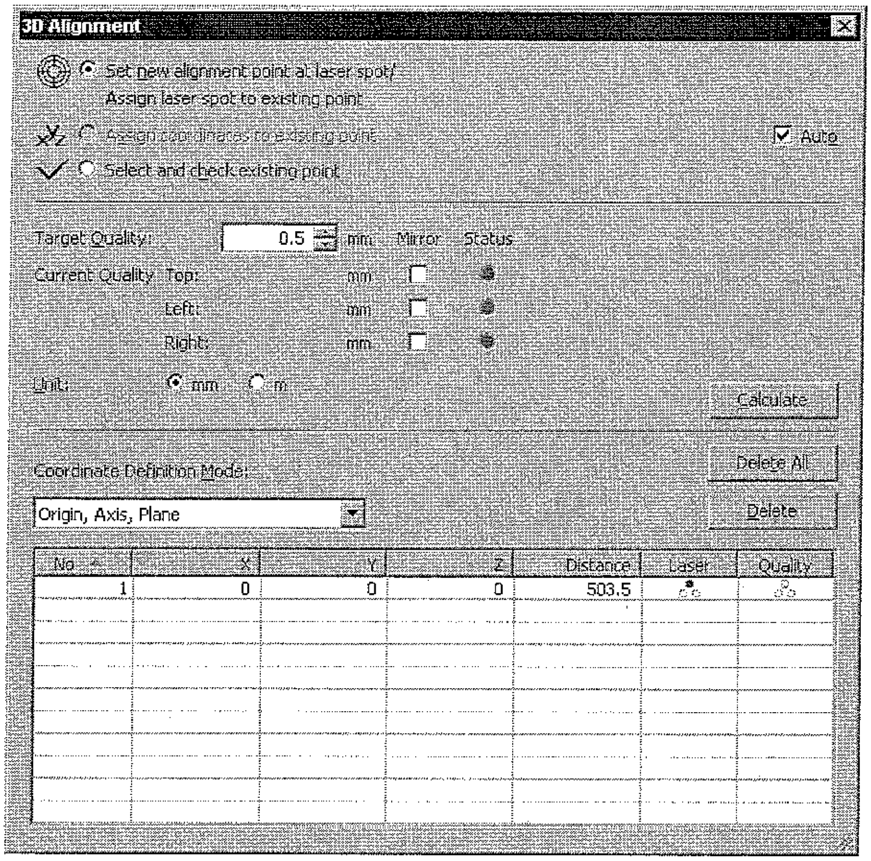


Figure 4.15: Dialog 3D Alignment for alignment with the geometry scan unit

5. Move the laser beam and define a second alignment point on one of the positive axes, e.g. on the positive x-axis. The point and its distance from the scanning head are shown in the list in the dialog 3D Alignment.

6. Click the alignment point with the right mouse button and select Point on +x-axis in the pop-up menu. +X will appear next to the point. The distance and the coordinates (+x/0/0) of the point are shown.

7. Move the laser beam again and define a third alignment point on one of the half planes limited by the selected axis, e.g. on the x /+y plane. The point and its distance from the scanning head are shown in the list in the dialog 3D Alignment.

8. Click the alignment point with the right mouse button and select Point on x/+y-plane in the pop-up menu. An X/+Y will appear next to the point. The distance and the coordinates (x/+y/0) of the point are shown.

Now define four to seven alignment points each for the scanning heads Left and Right as described in the following. The alignment points for the three scanning heads do not have to be coincident. However, the scanning head Top also has to be able to reach the alignment points for the scanning heads Left and Right.

9. First of all, position the scanning head Top at the points at which you want to set alignment points for the scanning heads Left and Right and then define the points. This will enable you to see whether you can reach all required alignment points with the scanning head Top. In addition to that, the distance of every point is already measured.
10. Define the alignment points for the scanning heads Left and Right as described in section 4.2.4.
11. Click Calculate. The software will calculate all the coordinates of the alignment points and enter them in the list. At the same time it determines the position of the scanning heads in this coordinate system, refer to figure 4.17.

Specify Three Points on Axes

To set the coordinate system in this way, proceed as follows:

1. Select Three Points on Axes from the list Coordinate Definition Mode.
2. Position the laser beam at a point in the video image which the x-axis of the coordinate system is to pass through.
3. Click the alignment point with the right mouse button and select Point on x-axis in the pop-up menu. An +X will appear next to the point; an arrow will be drawn through the point.
4. Repeat steps 2 and 3 for one more alignment point each on the y and z-axis.
5. Now define four to seven alignment points each for the scanning heads Left and Right as described in the following. The alignment points for the three scanning heads do not have to be coincident. However, the scanning head Top also has to be able to reach the alignment points for the scanning heads Left and Right.
6. First of all, position the scanning head Top at the points at which you want to set alignment points for the scanning heads Left and Right and then define the points. This will enable you to see whether you can reach all required points with the scanning head Top. In addition to that, the distance of every point is already measured.
7. Define the alignment points for the scanning heads Left and Right as described in section 4.2.4.
8. Click Calculate. The software will calculate all the coordinates of the alignment points and enter them in the list. At the same time it determines the position of the scanning heads in this coordinate system.

Specify Points with free Coordinates

To set the coordinate system in this way, proceed as follows:

1. Select Points with free Coordinates from the list Coordinate Definition Mode.
2. Position the laser beam at any point on the video image.
3. Click the alignment point with the right mouse button and select Point with free coordinates in the pop-up menu. The dialog Assign Coordinates appears.

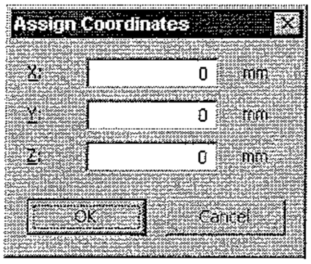


Figure 4.16: Dialog Assign Coordinates

4. Here you enter the coordinates of the point and click OK. XYZ will appear next to the point.

☞ If the coordinates of the alignment points are not precisely known, please also refer to section 4.2.8.

5. Repeat steps 1 to 4 for a total of four to seven alignment points.

Define four to seven alignment points each for the scanning heads Left and Right in the same way as described in the following. The alignment points for the three scanning heads do not have to be coincident. However, the scanning head Top also has to be able to reach the alignment points for the scanning heads Left and Right.

6. First of all, position the scanning head Top at the points at which you want to set alignment points for the scanning heads Left and Right and then define the points. This will enable you to see whether you can reach all required points with the scanning head Top. In addition to that, the distance of every point is already measured.
7. Define the alignment points for the scanning heads Left and Right as described in section 4.2.4.

8. Click Calculate. The software calculates all the coordinates of the alignment points and enters them in the list. At the same time, it determines the position of the scanning heads in this coordinate system.

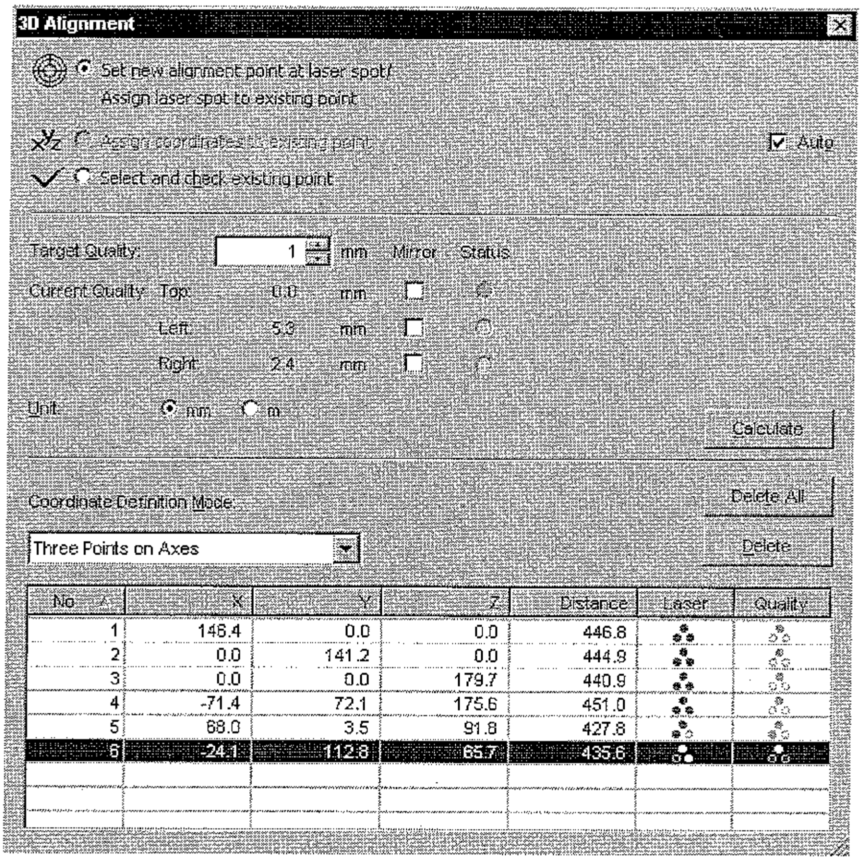


Figure 4.17: Successful 3D Alignment

4.2.8 Editing 3D Alignment Points

You can also edit 3D alignment points which have already been defined, this means for example

- defining object system alignment points as normal alignment points
- retrospectively changing the coordinate definition mode
- editing alignment points in the mode Points with free Coordinates
- defining alignment points for which you do not know the precise coordinates

Object system points as normal alignment points

To define an object system alignment point as a normal alignment point, click it with the right mouse button and select Alignment Point in the pop-up menu. The alignment point remains but it is no longer an object system alignment point, see also section 4.2.6 and section 4.2.7on this. The special identification which identified it as such disappears as well.

Change the coordinate definition mode

Independently of which definition mode you define the alignment points in (Origin, Axis, Plane; Three Points on Axes; Points with free Coordinates), you can still retrospectively change the definition mode. To do this, proceed as follows:

1. In the dialog 3D Alignment, select another definition mode. The object system alignment points become normal alignment points, their identification disappears. If a valid alignment had already been carried out however, the coordinates of the alignment points are retained.

2. Click the alignment point you want to edit with the right mouse button and select the corresponding command in the pop-up menu (refer also to section 4.2.6 andsection 4.2.7).

Retrospectively correct alignment points with free coordinates

To correct free coordinates of alignment points which have already been set, proceed as follows:

1. Click an alignment point with the right mouse button and select Point with free coordinates in the pop-up menu. The dialog Assign Coordinates appears (refer also to figure 4.16).

2. Here you enter the correct values and click OK.

Define alignment points with coordinates which are not precisely known (PSV 3D)

If you have defined alignment points in the definition mode Points with free Coordinates without knowing the precise coordinates of these alignment points, or if you have not been able to precisely localize the alignment points on the object, proceed as follows:

☞ Prerequisite: You have defined 3 to 7 alignment points with the scanning head Top in the definition mode Points with free Coordinates as described in section 4.2.6 or section 4.2.7.

1. Use the scanning head Top to define 4 to 7 additional alignment points at position which you can also reach with the scanning heads Left and Right. The software thereby measures the distance between each point and the scanning head Top. The alignment points are displayed in the dialog 3D Alignment.

☞ Do not define these alignment points as object system alignment points!

2. Now define these alignment points one after the other also with the scanning head Left and the scanning head Right.

3. Click Calculate. The software initially calculates a 3D alignment for the scanning head Top using the alignment points with free coordinates. This then means that the position and alignment of the scanning head Top are known approximately in this coordinate system. The actual quality for the scanning head Top is not optimal because the coordinates of the alignment points can not be given exactly.

Then the software calculates the coordinates of the other alignment points for the scanning heads Left and Right. To do this, it uses the mirror angles from the scanning head Top at these alignment points, the distances these points are from the scanning head Top and the position and alignment of the scanning head Top. The coordinates of these alignment points are displayed in the dialog 3D Alignment.

With the aid of these coordinates, the alignment for the scanning heads Left and Right is now calculated, i.e. their position and alignment is determined within the coordinate system of their alignment points. (The alignment points of the type Point with free Coordinates do not play any part in this as they have only been defined for the scanning head Top.) The actual quality for the scanning heads Left and Right is significantly better than that for the scanning head Top, because the coordinates of the alignment points used have been determined directly on the object under investigation.

4. Select Select and check existing point in the dialog 3D Alignment.

5. Click the entries in the list of coordinates one after the other. The three laser beams are thereby positioned with the aid of the calculated 3D alignment and the 3D coordinates of the selected alignment point.

6. Use the object under investigation to check how far the three individual laser beams are apart from each other. The distance should be in the range of the actual qualities of the scanning heads Left and Right.

This means that the software has determined the relative position of the scanning heads to each other with greater precision than the relative position of the scanning heads to the coordinate system of the alignment points with free coordinates. Therefore the laser beams generally intersect well at sample points, the coordinates of which have been determined for example with a geometry scan. However, please note that importing geometries can still lead to inaccuracies. This is because the imported alignment points are in the coordinate system of the Points with free Coordinates and the relative position of the scanning heads to the coordinate system thus determined is only inaccurately known. If necessary, you can carry out a geometry scan after the geometry import to improve the results.

4.3 Carrying out a Geometry Scan (as an Option)

If you are using the scanning head PSV-I-400 with the optional geometry scan unit PSV-A-420, you can also determine the distance between the scanning head and the object even if you do not know the object geometry.

☞ If you are using the PSV-3D, then the geometry scan unit is on the scanning head Top.

You can use the geometry scan unit to assign 3D coordinates to scan points. To do so, first of all define the scan points as described in chapter 5 and then determine the 3D coordinates of the scan points.

The geometry scan unit provides the scanning head with a second laser apart from the vibrometer laser to determine the object geometry. In contrast to the vibrometer laser, the geometry laser can not be focused. This means that in general it generates a larger spot of light than the vibrometer laser. To check whether the laser is also hitting the required points at the edges or periphery of the object under investigation, you can switch over to the geometry laser at any time. If the spot of light from the geometry laser only partially hits the object, it is not possible to make a distance measurement and you have to correct the laser position again. Apart from that, with the aid of the geometry laser you can check and see if your scanning head is still adjusted correctly. If both laser beams with the same setting do not hit the same point on the object, then the scanning head is probably misaligned.

Geometry laser To switch between the vibrometer laser and the geometry laser, select Scan > Geometry Laser.

Geometry point To make a distance measurement between the scanning head and the object, position the laser beam at any point on the object and select Scan > Geometry Point. The software will make a distance measurement to this point, calculate the x-, y- and z-coordinates of this point from the results of this measurement and the current mirror angles and will display these coordinates.

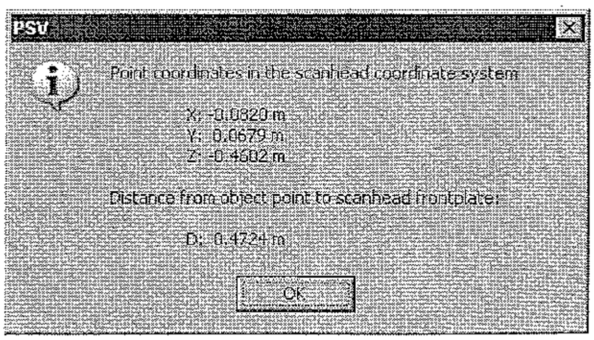


Figure 4.18: Display of the coordinates

If there is a valid 3D alignment, then the coordinates are given in the object coordinate system that you defined through the 3D alignment. Otherwise the coordinates are given in the scanning head system which you can define as described in section 4.1under Enter Coordinates of Axes.

Geometry scan

To scan an object, the 3D geometry of which is not yet known by the software, select Scan > Geometry Scan. If applicable, the software switches over to the geometry laser automatically. The geometry laser is positioned at every scan point, measures the distance from the scanning head and determines every x-, y- and z-coordinate as described above under Geometry Point. The coordinates of the scan points are displayed in the scanning head control in the element 3D Point. Once the software has determined the coordinates of all the scan points, you can start a scan. On starting, it automatically switches over to the vibrometer laser.

☞ Prerequisite for a geometry scan is a valid 3D alignment.

The geometry scan unit is equipped with a filter which you can use to weaken the intensity of the laser beam. As a general rule you initially carry out a geometry scan without this filter. If the scanning head is receiving too much light, you will be given the advice to use the filter. In this case switch the filter on. See your hardware manual on this.

☞ If the geometry scan has not been carried out correctly or you have canceled it, you will get a status report (see figure 4.19). You can decide whether to finally abort the geometry scan or whether to remeasure the remaining scan points or to have them interpolated. Refer to section 6.2 or section 9.1 and your theory manual on this. Independently of whether you have carried out the geometry scan or have aborted it, you can subsequently check the status of the scan points and if necessary take further measures. See section 5.6.1 and section 8.1 on this.

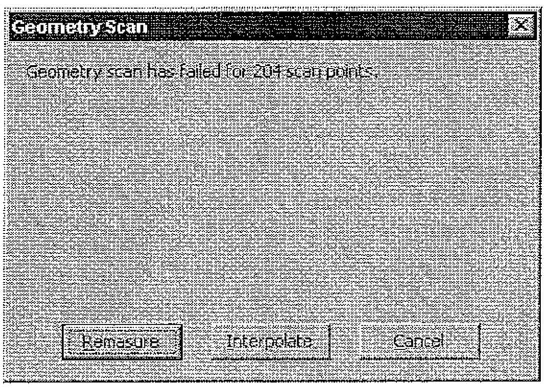


Figure 4.19: Status report if geometry scan is incomplete

The 3D coordinates of the geometry points are determined in the coordinate system of the alignment points (object system). The coordinates are displayed in the element 3D Point.

Transform 2D geometry to 3D geometry You can transform the 2D geometry of a three-dimensional object into 3D geometry. Prerequisite is that you have previously carried out a 3D alignment. To transform 2D geometry into 3D geometry, start a geometry scan. This makes the three-dimensional geometry of the object known to the software.

4.4 Automatically Focusing the Laser Beam

With the PSV 400 you can automatically focus the laser beam. There are two ways to do so:

- with the software
- with the optional PDA.

4.4.1 Focusing with the Software

PSV To focus the laser beam with the software, click in the scanning head control.

☞ Automatic focusing can take several seconds during which the software is inactive.

PSV-3D If you are making a measurement with the PSV-3D, hold the shift key pressed while clicking . This allows all three laser beams to be focused at the same time.

4.4.2 Focusing with the PSV-A-PDA (as an Option)

PSV Focus the laser beam with the PDA by touching the icon .

☞ Automatic focusing can take several seconds during which the software is inactive.

PSV-3D If you are making a measurement with the PSV-3D, you can select the scanning heads and focus them individually automatically.

4.5 Teaching-in Focus Values (as an Option)

You have the option of assigning focus values to the scan points. This makes it easier to focus if several objects are to be scanned which are at different distances from the scanning head, or if the object has three-dimensional geometry. When focusing automatically (Auto Focus) a focus value is determined. You have the possibility to save the focus values determined in this way with the object geometry. They can then be used for any number of measurements, providing the object geometry remains the same. Teaching-in the focus values is only available if you have the option APS Professional Extended.

You have different options how to allocate focus values to the scan points:

- Manually, to single scan points or figures
- Fast or Best, to all scan points

4.5.1 Assigning Focus Values Manually

You can assign focus values manually to single scan points or figures. This is particularly useful if the object under investigation is made up of one or more planes which are equidistant from the scanning head, i.e. the object is not at an angle to the scanning head.

☞ If you are using the PSV-3D and are making measurements with all three scanning heads, the command Assign Focus Manually is not available.

Assign a focus value

To assign a focus value manually, proceed as follows:

1. Select Scan > Assign Focus Manually. The software changes over to scan point definition (APS). All single scan points or figures are marked which have not yet had a focus value assigned.
2. Use the middle mouse button to position the laser beam at the point at which you want to determine the focus value and then click .

☞ If you have assigned a special function to the middle mouse button (e.g. double-click), position the laser beam using the icons Position in the scanning head control.

Or:
Click with the right mouse button and select Auto Focus in the pop-up menu.

3. Select the scan points or figures which you want to assign a focus value to, as described in section 5.5.1 and section 5.6.1.
4. Click with the right mouse button and select Set Focus in the pop-up menu. The previously determined focus value is assigned to all selected scan points or figures respectively.

5. End scan point definition.
6. You can now check the focus settings as described in section 4.6.
7. Then you can start a scan.

☞ If you have not assigned focus values to all scan points, when the scan starts you will be given the message that there not all scan points have a valid focus value. You can repeat Assign Focus Manually or start the scan anyway.

Reset focus value

To reset a manually assigned focus value, change back to scan point definition. Click the scan point with the right mouse button and select Clear Focus in the pop-up menu.

Retrospectively correct focus values

You can retrospectively correct the focus values of single scan points within a figure. To do so, undo the figure into individual points as described in section 5.3 and assign the correct focus values to the affected scan points manually.

4.5.2 Assign Focus Values Automatically

Fast

Select Scan > Assign Focus Fast to assign a focus value to all scan points quickly. While doing so, using one scanning head (PSV) or all three scanning heads (PSV-3D), scan points at different distances from the scanning head are approached and automatically focused. For the PSV, you have to enter the correct coordinates for the distance in the element 2D Point in the scanning head control before you use Assign Focus Fast (refer also to section 4.1).

☞ This method is only suitable for level surfaces which are positioned at a right angle to the laser beam.

In contrast, for the PSV-3D and for 3D geometries in the PSV which have been imported or determined by a geometry scan, the precise position of the scan points is used. The focus values for all other scan points are then calculated by the software.

Best

Select Scan > Assign Focus Best to automatically focus all scan points respectively and to assign them a focus value. This can take up to 10 seconds per scan point. For the PSV-3D focusing is done with all three scanning heads at the same time.

☞ If you cancel Assign Focus Best, the focus values determined until then are saved and used for the subsequent scan. For all scan points which have not had a focus value determined, the focus value last set is used for a scan. The function Focusing during Scan is not activated.

Assign focus values

To automatically assign focus values to all scan points, proceed as follows:

1. Select Scan > Assign Focus Fast or Scan > Assign Focus Best. The scan points are focused automatically as described above and the focus values are saved with the object geometry.
2. In the menu Scan, Focusing during Scan is activated by the software. This has the effect that during a scan, the focus values are set for every scan point using the optics.
3. You can now check the focus settings as described in section 4.6.
4. Then you can start a scan.

☞ If you have canceled Assign Best Focus, when the scan starts, you will be given the message that not all scan points have a valid focus value. You can repeat Assign Best Focus or start the scan anyway.

4.6 Checking the Focus Settings

If you click a scan point and leave the mouse cursor there, then the focus values of this scan point are displayed on a yellow background next to the cursor. The current focus position is shown as a percentage and as an absolute value. The value 0% (0) means that the optics in the scanning head has been moved right to the end in the direction close-up (N). The value 100% (3300) means that the optics in the scanning head has been moved right to the end in the direction infinity (F).

At the same time the optics is set to the focus value of this scan point.

If the focus values are not to be taken into consideration during scanning, select Scan > Focusing during Scan to deactivate focusing during a scan.

4.7 Image Settings of the Live Video Image (2D View)

You adjust the settings of the live video image in the dialog Display Properties. To open the dialog, double-click the live video image. You can also activate the video window (to do so, click it) and then select Scan > Properties.

4.7.1 General

On the page general you set up the display of the video window on the screen.

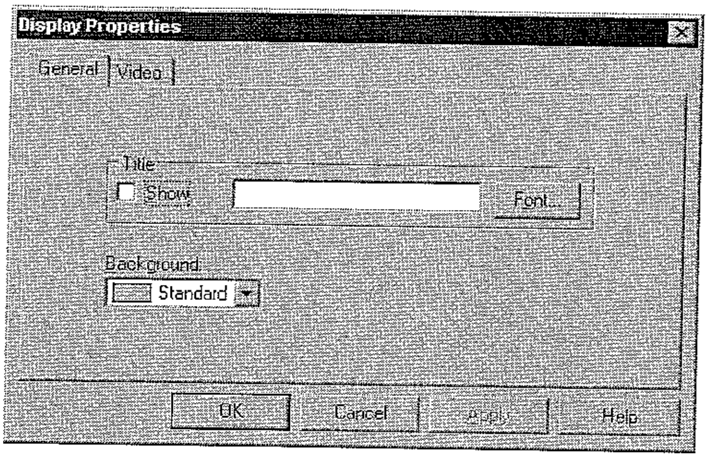


Figure 4.20: Page General

Title

Show: If you would like to display a title above the video window, tick the box. You enter the title on the right.

Font: Click here to format the title. The dialog Font appears.

Background

Here you select the background color for the video window.

4.7.2 Video

On the page Video you adjust the camera settings.

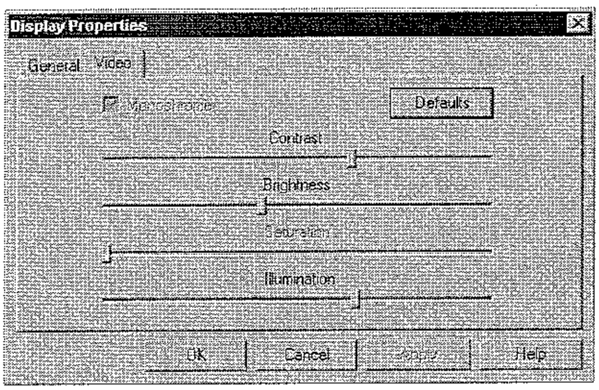


Figure 4.21: Page Video

Monochrome: Here you can change color images to black and white. This is recommended for measurements with the optional close-up unit PSV-A-410 or OFV-056-C, as it is equipped with a red filter.

Standard: Click here to load the default settings for the live video image.

Contrast: Here you set the contrast of the live video image.

Brightness: Here you set the brightness of the live video image.

Saturation: For color images you set the color saturation here.

Illumination: This slider only appears for MSA/MMA systems. If you want to use the strobe illumination in MSA / MMA operation to illuminate the sample, you can adjust its brightness here. See your hardware manual on this as well.

4.8 Image Settings of the Video Image (3D View)

You can also display the video image in the 3D view. To do so, click 3D. However, you will then no longer see a live video image but a snapshot of the video image at the time at which you changed the view.

You can adjust the image settings of the video image in 3D view in the dialog Display Properties. To open the dialog, double-click the video image. You can also activate the video window (to do so, click it) and then select Scan > Properties.

4.8.1 General

On the page general you set up the display of the video window on the screen.

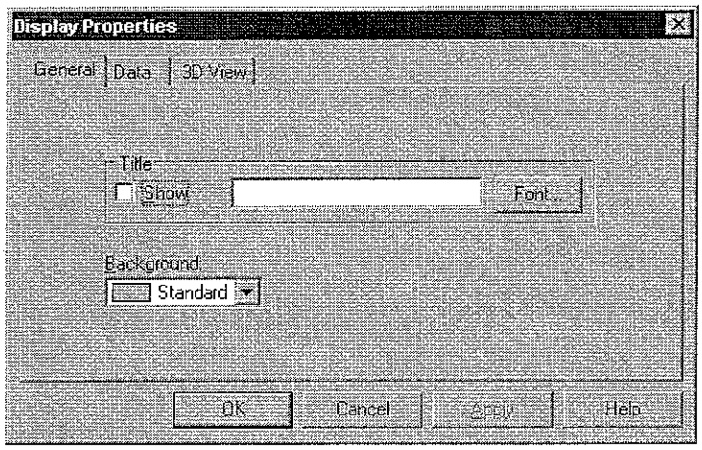


Figure 4.22: Page General

Title

Show: If you would like to display a title above the video window, tick the box. You enter the title on the right.

Font: Click here to format the title. The dialog Font appears.

Background

Here you select the background color for the video window.

4.8.2 Data

On the page Data you set up the display of the data on the screen.

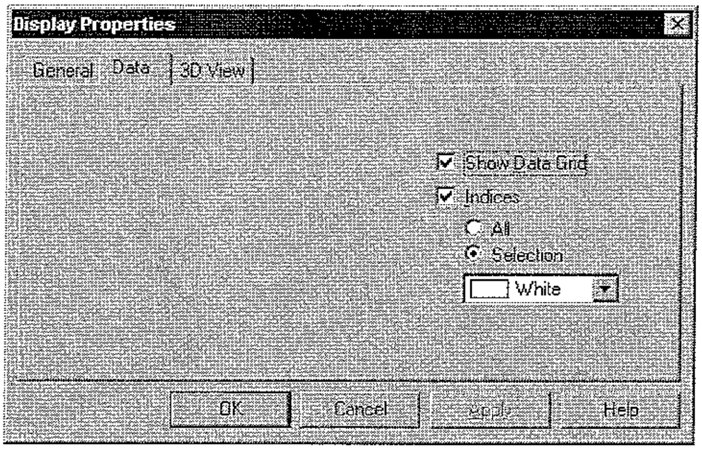


Figure 4.23: Page Data

Show Data Grid: Tick the box if you want to see the grid that the scan points are on.

Indices: Tick the box to show the index of scan points. Select whether the indices of all scan points are to be shown or only the indices of selected scan points. In the list below select the color which is to be used to show the indices.

4.8.3 3D View

On the page 3D View set up the presentation of the 3D view on the screen.

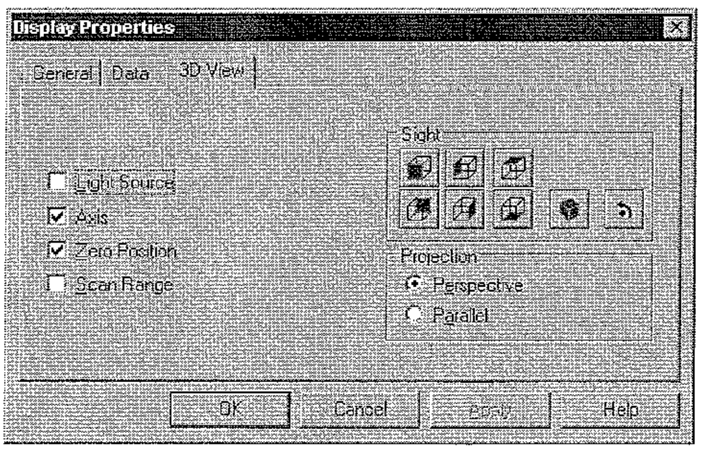


Figure 4.24: Page 3DView

Changes made to the representation or the sight are immediately effective, i.e. without clicking Apply or closing the dialog.

Light Source: Tick the box to switch on the illumination model. It simulates illuminating the object from the direction of the observer.

☞ Depending on the shape of the object, the display of light and shadow has a detrimental effect on the quality of the presentation. In this case, deactivate the box to switch off the illumination model.

Axes: Tick the box to display a coordinate system top left in the presentation window next to the object.

Zero Position: Tick the box to view the object in its original position in addition to viewing the measurement results.

Scan Range: Tick the box to show lines to help you display the position of the scanning heads in front of the object. In this way you can see whether the 3D alignment has provided a useful result.

☞ For combined files (refer to section 8.5), the box is not displayed.

Sight

The icons in the field Sight show the line of sight of the object. You can move the object more precisely by clicking these icons than by dragging with the mouse.

 Sight on the object from the front

 Sight on the object from the back

 Sight on the object from the left

 Sight on the object from the right

 Sight on the object from the above

 Sight on the object from the below

 Sight of the video camera (only for 3D geometry)

 Sight on the object at an angle from front, left and above

 Rotating the object around the line of sight

You can show (hide) a coordinate system which shows you the resulting orientation of the object (see above, Axes).

☞ You can also set the line of sight directly in the presentation window using the mouse. To do so, click the object and using the mouse drag it into the direction you require.

Projection

Here you select the type of projection of the object.

Perspective: The object is shown in perspective, i.e. parts in the front of the image become larger, parts in the background of the picture are shown smaller.

Parallel: All parts of the object are shown the same size regardless of their distance from the observer.

☞ Parallel projection makes it easier to differentiate between in-plane and out-of-plane vibrations. Particularly with out-of-plane vibrations, the perspective layout viewed from the top can give the impression that the object is being stretched and contracted again.

5 Defining Scan Points (APS)

Before a scan you first of all have to define the scan points. To do so, you draw geometrical figures on the live video image as you would in graphics software. For this purpose, the software offers a standard mode and two further modes as an option. If you want to make a measurement with 3D coordinates, you can also use 3D point mode.

Standard mode

In standard mode you can draw rectangles, ellipses and polygons. The scan points in all figures are on a global right-angled grid.

Professional mode (as an option)

In professional mode, apart from rectangles, ellipses and polygons, you can also draw lines. You can set up the grid for every figure individually and it can also be polar or hexagonal. Professional mode is only available if you have the option APS Professional.

Point mode (as an option)

In point mode you do not draw figures but define and edit single scan points and their connections. You can take over scan point definitions from the other modes and fine-tune them. Point mode is only available if you have the option APS Professional. In point mode you can define scan points with both the PSV software and also the optional PDA. Refer to section 5.3.1 or section 5.3.2.

3D point mode (PSV-3D)

In 3D point mode, in addition to the above mentioned modes, you can also import the scan points from an external file or teach-in them with the aid of the three scanning heads.

☞ With the PSV or the PSV-3D (1D)[1], 2D geometries occur in standard, professional and point mode. With a valid 3D alignment and the corresponding software option, it is possible to change to 3D point mode. However geometries which have already been generated in other modes are not taken over, they are deleted!

[1] refer also to section 3.1

With the optional geometry scan unit in contrast you can proceed as follows:

1. Define the scan points in standard, professional or point mode as described in section 5.1, section 5.2 or section 5.3 respectively.
2. Exit scan point definition and carry out a geometry scan as described in section 4.3.
3. Go to 3D point mode (refer to section 5.4). When you do so, the scan points and the measured coordinates are retained.

3D point mode (PSV, as an option)

In 3D point mode for the PSV you can import 3D geometry and then edit it. You can only define new scan points with the optional geometry scan unit.

The following table contains an overview of the geometries which you can define in the individual modes with the PSV and the PSV-3D.

System	Standard	Professional	Point	3D Point
PSV	2D	2D	2D	3D
PSV-3D (3D)	3D	3D	3D	3D
PSV-3D (1D)	2D	2D	2D	3D

Define To define scan points, proceed as follows:

1. Go to acquisition mode. To do so, click .
2. If necessary, align the coordinates of the live video image to the measurement plane. See section 4.2 on this.
3. In the toolbar of the application window, click or select Setup > Define Scan Points. The software maximizes the video window and displays a graphics toolbar. Areas of the live video image can be crosshatched. These areas are outside the range you can scan.

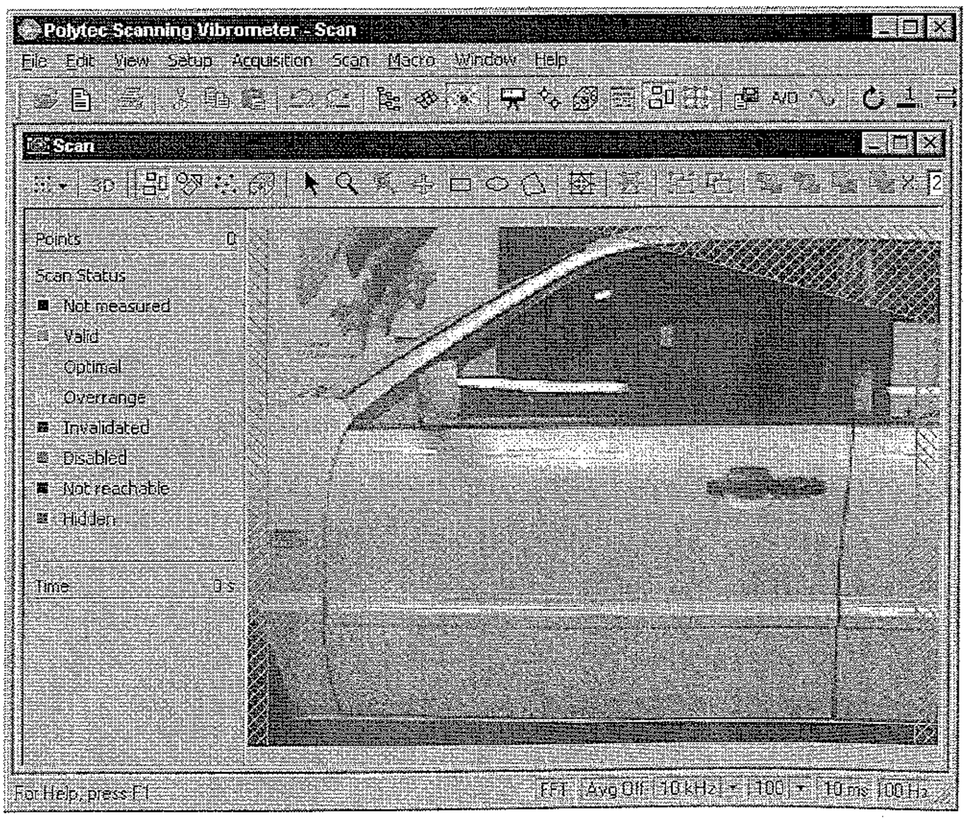


Figure 5.1: Available range for defining the scan points

☞ The possible scan area depends on the scanning head, zoom of the camera and correct alignment.

4. Go to the required mode.

   To scan a flat object, click , or in the graphics toolbar. The icons and are only active if you have the option APS Professional. To use 3D point mode, click .

5. Define scan points as described in section 5.1, section 5.2, section 5.3 and section 5.4. You can see how many scan points you have defined in the legend of the live video image. Below that you see the estimated time needed for the scan. The estimation is based on the time for data acquisition at all scan points and the settling time of the scanner mirrors.

☞ You can also define scan points in the crosshatched area of the live video image. However, when scanning, these scan points themselves are not hit, but the next attainable point respectively.

6. When you have defined all scan points, in the toolbar of the application window, click again.

Zoom

To position the scan points exactly, you can zoom in the video image. Read section 2.8 on this.

☞ If you change into one of the four scan point definition modes, the icons for the zoom function in the toolbar of the video window become inactive. Instead they appear in the toolbar for point definition.

Test

As the live video image shows a two-dimensional image of the three-dimensional object, it is possible that the laser beam does not hit some of the scan points exactly. So check the scan points as follows:

7. Point at the live video image and click a scan point. The laser beam moves to this point on the object.

   Only PSV 400 and PSV 300: You can also approach the scan points with the optional PSV-A-PDA or the hand set PSV-Z-051. Refer to section 5.3.2 and your theory manual on this.
   Only PSV 300: You can also position the laser beam on scan points using the hand set PSV-Z-051. See your hardware manual on this.

8. Check if the position of the laser beam on the object corresponds to that on the live video image.

9. Repeat steps 7 and 8 for a few more scan points.

5.1 Standard Mode

In standard mode you draw geometric figures on a global, right-angled grid. You can

- draw rectangles, ellipses and polygons
- determine the density of the grid points
- move the grid.

To go into standard mode, in the graphics toolbar, click .

☞ If you define scan points with the PSV-3D in standard mode, then these points have already have 3D coordinates assigned to them. These coordinates have been calculated from the prior 3D alignment of the three scanning heads and their mirror angles. It is not possible to make a calculation of this kind with the PSV or PSV-3D (1D). To be able to obtain 3D data with the PSV or PSV-3D (1D) despite this, you have to import the data into 3D point mode.

5.1.1 Drawing Rectangles and Squares

To draw a rectangle or a square, proceed as follows:

1. Click .
2. Point at the live video image. The cursor becomes a cross.

Rectangle

There are two ways of drawing a rectangle:

3. Point at a corner of the rectangle.
4. Press the mouse button and drag to the diagonally opposite corner.

or

5. Point at the center of the rectangle.
6. Press the control key and the mouse button simultaneously and drag across to a corner point.

Square

There are two ways of drawing a square:

7. Point at a corner of the square.
8. Press the shift key and the mouse button simultaneously and drag to the diagonally opposite corner.

or

9. Point at the center of the square.
10. Press the control key, shift key and the mouse button simultaneously and drag across to a corner point.

5.1.2 Drawing Ellipses and Circles

To draw an ellipse or a circle, proceed as follows:

1. Click .
2. Point at the live video image. The cursor becomes a cross.

Ellipse

There are two ways of drawing an ellipse:

3. Point at a corner of the rectangle enclosing the ellipse.
4. Press the mouse button and drag to the diagonally opposite corner.

or

5. Point at the center of the ellipse.
6. First press and hold the control key and then the mouse button and drag across to a corner point of the rectangle enclosing the ellipse.

Circle

There are two ways of drawing a circle:

7. Point at a corner of the square enclosing the circle.
8. First press and hold the shift key and then the mouse button and drag to the diagonally opposite corner.

or

9. Point at the center of the circle.
10. Press the control key, shift key and the mouse button simultaneously and drag across to a corner point of the square enclosing the circle.

5.1.3 Drawing Polygons

To draw a polygon, proceed as follows:

1. Click .
2. Point at the live video image. The cursor becomes a cross.
3. Click at least three corners of the polygon.
4. Double-click the last corner. The software connects it to the first corner.

5.1.4 Deleting Scan Points within a Figure

You can delete all scan points within a figure. You can use this to hide areas which you do not want to scan or which the laser beam can not reach. This could be the case for example with objects which have a complicated three-dimensional geometry. Scan points which the laser beam can not reach must be deleted before the start of the measurement. Otherwise the sensor head hits the wrong scan points on the object when trying to hit the points, giving you an incorrect result.

☞ With the PSV-3D, it is practically impossible to see on the screen which laser beams reach which scan points, or which ones they can not reach, as only one of the three scanning heads is equipped with a video camera. So in the CAD program you should already delete those parts of the object which are covered by other parts. Then import the object geometry from the CAD as UFF or ME'Scope in PSV (refer to section 5.4).

To delete the scan points, proceed as follows:

1. Select the figures as described in section 5.5.1.
2. Click .

5.1.5 Setting up the Grid

In standard mode there is a global grid over the whole live video image.

Show and hide the grid

To show (hide) the grid in the live video image, click .

Density of grid points

The density of the grid points $d_{x,y}$ determines the distance between the grid points $a_{x,y}$ on the live video image as follows:

$$a_{x,y} = \frac{h_y}{d_{x,y}} \qquad \text{Equation 5.1}$$

h_y... Height of the live video image.

You can enter the density of the grid points in the fields X: 10.5 and Y: 17. You can also enter decimals.

Another way of increasing the density of the scan points is to make the grid finer. See section 5.6.1 on this.

You can also scale the grid at the same time as all the figures. To do so, proceed as follows:

1. If you can not see the grid on the live video image, it would be useful to display it. To do so, click .

2. Click . All figures are selected.
3. Point at one of the white handles which mark the edge of the figures. The cursor becomes a double arrow.

There are now three ways of scaling:

4. Press the mouse button and drag in one of the directions the double arrow is pointing in. The anchor point is opposite the point you are dragging.

or

5. Press the control key and the mouse button and drag in one of the directions the double arrow is pointing in. The anchor point is the center of the figures.

or

6. Press the shift key and the mouse button and drag across to a corner point. The figures and the grid are scaled in proportion horizontally and vertically.

Moving the grid

You can move the grid on the live video image. To do so, proceed as follows:

1. Click .
2. Point at the live video image.

To move the grid without the figures:

3. Point at a dot outside the figures.
4. Press the mouse button and drag in the direction required.

To move the grid at the same time as all the figures:

5. Point at a dot within a figure.
6. Press the mouse button and drag in the direction required. (You can also use the arrow keys.)

5.2 Professional Mode (as an Option)

Professional mode is only available if you have the option APS Professional. In professional mode you can draw rectangles, ellipses and polygons as described in section 5.1.1, section 5.1.2 and section 5.1.3. Apart from that you can

- set up the grid for every figure individually and it can also be polar or hexagonal
- draw polylines
- rotate figures
- edit figures.

To go into professional mode, in the graphics toolbar, click . The dialog Object Properties appears.

5.2.1 Drawing Polylines

To draw a polyline, proceed as follows:

1. Click .
2. Point at the live video image. The cursor becomes a cross.
3. Click the corners of the polyline.
4. Double-click the last corner.

5.2.2 Rotating Figures

To rotate figures, proceed as follows:

1. Select the figures as described in section 5.5.1.

There are now two ways of rotating figures:

2. Enter the absolute angle of rotation in the dialog Object Properties, group Object in the field Rotation.

or

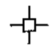
3. Click .
4. Point at one of the white handles which mark the edge of the figures. The cursor becomes a .
5. Press the mouse button and drag in the direction you want to rotate in. The anchor point is the center of the figures.

5.2.3 Changing the Shape of a Figure

You can retrospectively insert corners in figures and move corners individually. To do so, proceed as follows:

1. Select the figures as described in section 5.5.1.
2. Click .

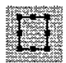
To insert a corner:

3. Point at the edge of the figure. The cursor becomes a .
4. Click the edge of the figure. The software inserts a corner at this point.

To move a corner:

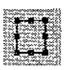
5. Point at the corner. The cursor becomes a .
6. Press the mouse button and drag in the direction required.

5.2.4 Distributing Scan Points Among Figures

Using the icons , ,  and  in the dialog Object Properties you can distribute scan points on figures. To do so, first select the figures as described in section 5.5.1. Then click

: You are defining scan points inside and on the edges of the figures (not active for polylines).

: You are defining scan points only within the figures (not active for polylines).

: You are only defining scan points on the edges of the figures.

: You are deleting the scan points inside and on the edges of the figures.

5.2.5 Setting up the Grid

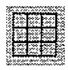
In professional mode, every figure has got its own grid. To set up the grid, first of all select the figure as described in section 5.5.1. In the dialog Object Properties you can then

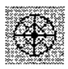
- select the type of grid
- set the density of the grid points
- rotate the grid.

You can not set up a grid for polylines and figures which only have scan points on the edge (refer to section 5.2.4).

Type of grid

To select the type of grid, click

: You select a right-angled grid.

: You select a polar grid.

: You select a hexagonal grid.

Density of grid points

You enter the density of the grid point in the dialog Object Properties in the respective field Density. You can also enter decimals. The density is independent of the dimensions of the figure, it always refers to the height of the live video image.

For a figure with a right-angled grid, in the dialog the fields Density X and Density Y appear. The density of the grid points $d_{x,y}$ determines the distance between the grid points $a_{x,y}$ as follows:

$$a_{x,y} = \frac{h_y}{d_{x,y}} \qquad \text{Equation 5.2}$$

h_y... Height of the live video image.

For a figure with a polar grid, the fields Density radial and Density tang appear. The radial density d_{radial} determines the distance between the grid points on the beams a_{radial} as follows:

$$a_{radial} = \frac{h_y}{d_{radial}} \qquad \text{Equation 5.3}$$

h_y... Height of the live video image.

The tangential density d_{tang} is equal to the number of grid points on the circles.

For a figure with a hexagonal grid, the field Density appears. The density of the grid points d determines the distance between neighboring grid points as follows:

$$a = \frac{h_y}{d} \qquad \text{Equation 5.4}$$

h_y... Height of the live video image.

Rotate grids You can rotate a grid relatively to its figure. To do so, enter the angle of rotation in the field Rotation, group Grid.

5.2.6 Vertex Points of Ellipses

The software approximates ellipses by using polygons (at least quadrangles). You can set the number of vertex points. To do so, first select the ellipse as described in section 5.5.1. In the dialog Object Properties, the field Vertex Points then appears, in which you can enter the required number of vertex points. The number of vertex points then also applies for all ellipses which you subsequently draw.

☞ If you define scan points on the edge of an ellipse (refer to section 5.2.4), every vertex point becomes a scan point.

5.2.7 Properties of Lines

Polylines and figures which only have scan points on the edge (refer to section 5.2.4) do not have a grid. However, you can set the density of the scan points on the lines. To do so, first select the figure as described in section 5.5.1.

Resolution In the dialog Object Properties, the field Resolution appears. The resolution is inversely proportional to the distance between the scan points on the line.

Width For polylines, the field Width also appears. The width determines the size of a shadow around the polyline. Within the shadow, the scan points which are behind the polyline are hidden. This means, for example, you can delete scan points on cables which obscure the view of the object.

5.3 Point Mode (as an Option)

Point mode is only available if you have the option APS Professional. In point mode you do not draw figures but edit single scan points and their connections. You can take over scan point definitions from the other modes and fine-tune them. To do so, proceed as follows:

1. Draw figures in standard or professional mode as described in section 5.1and section 5.2.

2. Go to point mode. To do so, in the graphics toolbar, click . A message window appears. To separately save the scan points which have already been defined and to then define new ones, click Save. To add more to those which already exist, click Continue.

☞ If you have displayed the project browser (refer to section 2.7.4), you will then automatically be shown the directory marked there as saving location.

3. Click Continue. The software groups all scan points which have already been defined and selects the group.

4. Undo grouping. To do so, click . The software selects all scan points.

5. Undo the selection. To do so, click the live video image outside the scan points.

6. You can now edit scan points as described in section 5.3.7. Apart from that, you can define single scan points as described in section 5.3.1 and section 5.3.2.

   Only PSV 400 and PSV 300: You can also approach the scan points with the optional PSV-A-PDA or the hand set PSV-Z-051. Refer to section 5.3.2 and your theory manual on this.
   Only PSV 300: You can also position the laser beam on scan points using the hand set PSV-Z-051. See your hardware manual on this.

7. You can edit connections of scan points as described in section 5.3.3 and section 5.3.4.

5.3.1 Defining Single Scan Points Using the Software

There are two ways of defining a scan point:

1. Click .
2. Point at the live video image and click. A scan point is defined at this point.

Or:

1. Move the laser beam on the object to the point at which you want to define a scan point. See section 4.1 on this.
2. Click .

5.3.2 Defining Individual Scan Points with the PSV-A-PDA (as an Option)

You can use the optional PDA to help you define individual scan points. To do so, proceed as follows:

1. Go to point mode as described in section 5.3.
2. Start the PDA as described in section 2.4. The user interface of the PDA software appears.

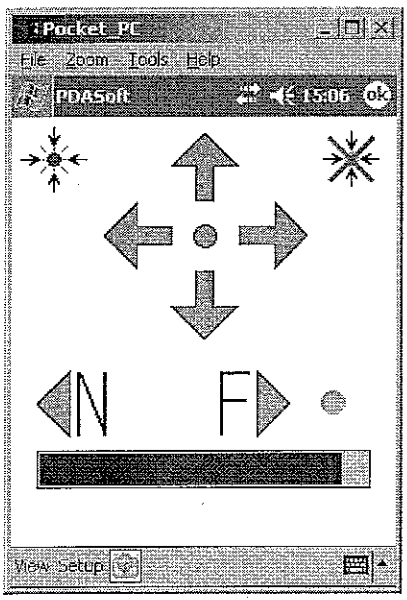


Figure 5.2: User interface of the PDA software

Position the laser beam

3. Center the laser beam by touching the icon ◉ with the pen.

4. Position the laser beam by touching the icons ⇧, ⇩, ⇦ or ⇨.

☞ If you touch an arrow icon for more than approx. one second, the PDA switches to fast forward. For fine adjustment you can always briefly touch the icon again.

Define scan points

5. You define a scan point by touching the icon ✛.

Delete scan points

6. You can delete a scan point by positioning the laser beam on a scan point and touching the icon ✳.

Head for scan points directly

You can use the optional PDA to directly head for the defined scan points with the laser beam. To do so, proceed as follows:

1. Select View > Toggle Points in the PDA menu bar.

2. Touch the icons ⇦ or ⇨. The laser will directly head for the defined alignment points backwards or forwards.

5.3.3 Defining Connections

There are several ways of connecting scan points.

- connect two scan points and thus define a line,
- connect three scan points and thus define a triangle,
- automatically connected selected scan points to each other.

☞ In point mode it is useful to select the view (refer also to section 5.5.1). You can then see which areas are enclosed by scan points.

Connect two scan points

To connect two scan points, proceed as follows:

1. Click .

2. Point at the first scan point. The cursor becomes a cross.

3. Click the scan point.

4. Point at the second scan point.

5. Double-click.

Connect three scan points

To connect three scan points, proceed as follows:

1. Click .
2. Point at the first scan point. The cursor becomes a cross.
3. Click the scan point.
4. Point at the second scan point and click.
5. Point at the third scan point and click. The software connects this scan point to the first one.

Connect selected scan points

To automatically connect scan points, proceed as follows:

1. Select the points you want to connect as described in section 5.6.1.
2. Click . The software will connect all the selected points with each other.

5.3.4 Deleting Connections

To delete connections, proceed as follows:

1. Click .
2. Point at a connection. The cursor becomes a .
3. Select the connection. To do so, click it.
4. To select further connections, click them while holding the shift key pressed.
5. To remove a connection from the selection, click the connection while holding the shift key pressed.
6. To select all connections, press the key combination Ctrl+A or select Edit > Select All.
7. To delete the selected connections, press the Delete key or select Edit > Delete.

☞ To delete a triangle, you only have to delete one of the connections. The software automatically deletes the other connections.

5.3.5 Refining the Grid

If you have defined individual scan points and connections in point mode, you can then refine the resulting grid. This means you increase the number of scan points in the grid and thus their density. To do so, proceed as follows:

1. Select several connected scan points as described in section 5.6.1.
2. Click or select Scan > Refine Grid. The software will insert more scan points between the selected scan points.

5.3.6 Merging Scan Points in the Grid

If you have defined individual scan points and connections in point mode, you can then merge neighboring scan points. This means you decrease the number of scan points in the grid and thus reduce their density. In doing so, the software first calculates the distances between the selected scan points. Then, starting from the minimum distance found, it merges two points into one point if their distance is less than the minimum distance + 50%. In doing so, the positions of the scan points in the video image and, if existing, the 3D coordinates of the scan points are being calculated by averaging the values of the two points that have been merged.

To merge scan points, proceed as follows:

1. Select several connected scan points as described in section 5.6.1.
2. Click or select Scan > Merge Points. The software will merge neighboring scan points as described above.

5.3.7 Editing Scan Points

If you have defined individual scan points in point mode, you can select scan points and modify them.

Select scan points You can select points as also described in section 5.6.1 and modify the selected points as described in the following.

Disable If the selected scan points are not to be measured, you can disable them. To do so, select Disable. The scan points are then disabled for measurements, geometry scans and for the function Assign Focus Best.

Enable To undo disabling, select Enable.

Modify 3D Coordinates

You can modify the 3D coordinates of individual scan points. See section 5.6.2 on this.

With the PSV you can only modify the 3D coordinates of individual scan points if there is 3D geometry, i.e. after importing geometry or after a geometry scan. Refer to section 5.4 or section 4.3.

Triangulate 3D Coordinates (only PSV-3D)

To triangulate the 3D coordinates of the selected scan points, select Triangulate 3D Coordinates. Using the standard and 3D alignment of all three scanning heads, the software calculates the 3D coordinates of the scan points. You will find more information on this in your theory manual.

Interpolate 3D Coordinates

To interpolate the 3D coordinates of the selected scan points, select Interpolate 3D Coordinates. To do so, the software calculates the average distance of the neighboring points to the scanning head Top. From this distance and taking into consideration the position of the selected scan points on the video image, the 3D coordinates are determined.

With the PSV you can only interpolate the 3D coordinates of individual scan points if there is 3D geometry, i.e. after importing geometry or after a geometry scan. Refer to section 5.4 or section 4.3.

5.4 3D Point Mode

3D point mode ( ) is only available if you previously carried out a 3D alignment (refer to section 4.2.3, section 4.2.4 and section 4.2.6 or section 4.2.7 respectively). In 3D point mode, there are the following ways of defining the scan points:

- Importing scan points (only PSV-3D or as an option for the PSV)
  If you know the geometry of the object and it is saved in an external program, you can simply import the required scan points as a Universal File. You can also import Vibrant ME'Scope structural data. For this purpose, an additional file filter is available in the dialog Open.
- Teaching-in scan points with the geometry scan unit PSV-A-420 (only PSV-3D or as an option for the PSV)
  If there is no data available on the object, you can define the points yourself.

☞ If you are using the PSV-3D and change from standard, professional or point mode into 3D point mode, scan points which have already been defined are retained. However, with the PSV or PSV-3D (1D) respectively, the scan points are only retained if you have previously carried out a geometry scan!

- Defining scan points with auto-alignment

5.4.1 Importing Scan Points

The icon and the command for geometry import are only available for the

- PSV with the option Data Import: Geometry
- PSV-3D.

To import scan points, proceed as follows:

1. Click or in the menu select Scan > Import Geometry. The dialog Open appears.

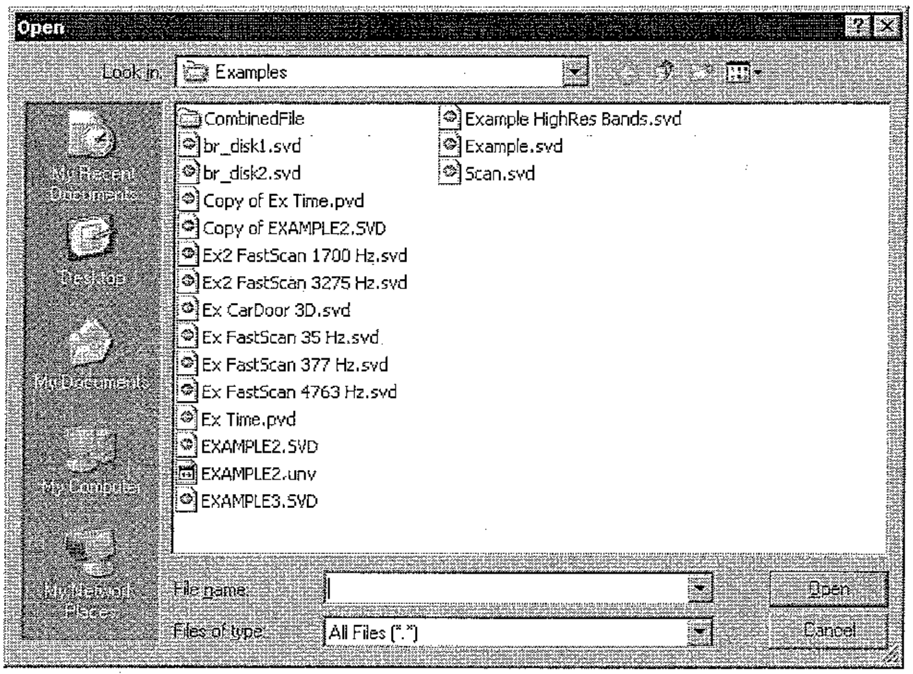


Figure 5.3: Dialog Open

2. Select the required file type.
3. Navigate to the saving location and select the required file.
4. Click Open. The scan points from the selected file are taken over in the video image. The indices of the scan points are also taken over.

☞ If you are importing geometry from a file in Universal File format which does not contain data set 164 with the units of the coordinates, you have to enter a scaling factor in the dialog Scaling of Imported Coordinates, refer to figure 5.4. The factor 1 stands for the unit m, the factor 0.01 for the unit cm etc.

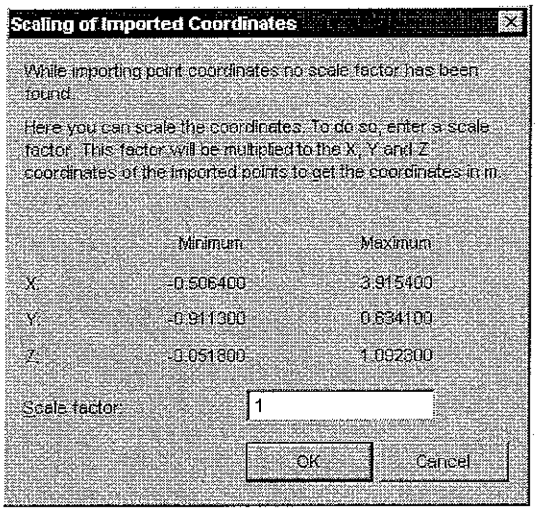


Figure 5.4: Dialog Scaling of Imported Coordinates

☞ If the object is deep, the imported points are not precisely on the object in the display on the screen. However despite this, during scanning, the laser beams hit the scan points precisely. If you want to correct the display on the screen, you can move the individual points in the video image to the right position. This, however, does not have any effect on the measurement result.

Work with geometries which are too large

If the imported geometry is larger than the image section of the object in the video window, the video window is reduced correspondingly and the geometry is shown completely in both the 2D view as well as the 3D view.

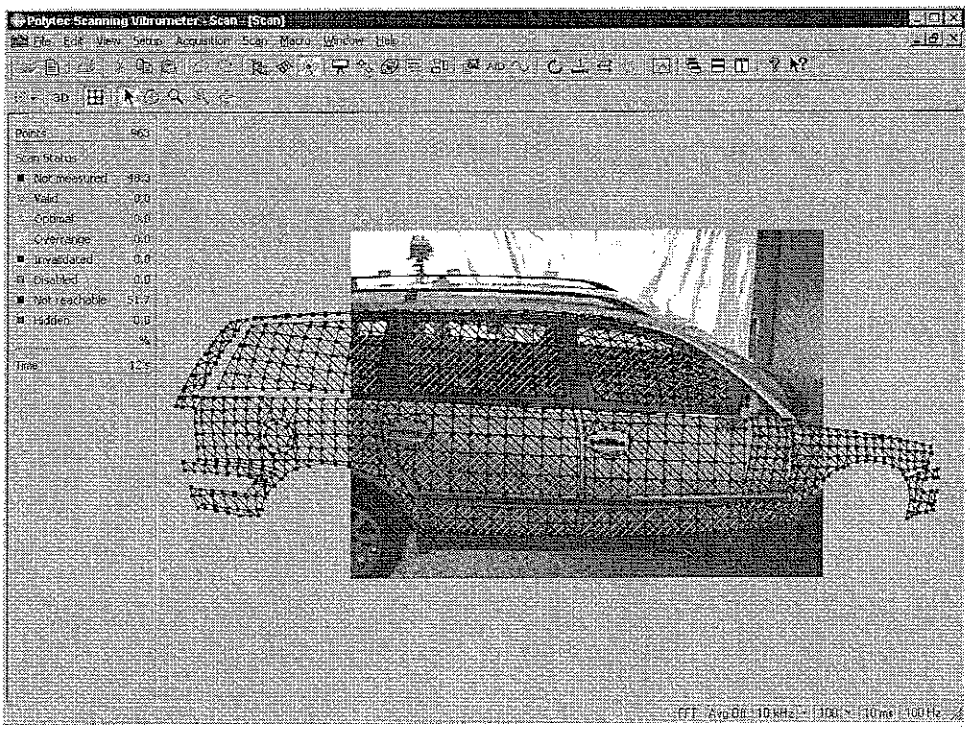


Figure 5.5: Example of geometry which is too large

Generally several scan points will then be given the status Not reachable or Hidden (refer to section 8.1). These points are not measured during a scan.

To acquire the entire geometry of the object, proceed as follows:

1. Select the scan points which are not to be measured with the current measurement setup. See section 5.6.1 on this.
2. Assign the status Disabled to these scan points. See section 5.6.2 on this.
3. Start a scan as described in section 6.2.
4. Change the position of the measurement setup so that you can scan another part of the object. To do so, carry out a new alignment as described in section 4.2 and disable the scan points which are not to be measured.
5. Start another scan.
6. Repeat the steps 4 and 5 until you have acquired the whole geometry.

☞ If you are using PSV-3D, you can then group the individual measurements to a combined file as described in section 8.5.

Import scan points with auto-alignment

If you are using one of the graphics cards ATI Radeon® 9000 Pro, 9600 Pro or 9600 XT, then after the geometry import you can have the position of the scan points on the video image corrected. To do so, click the video image with the right mouse button and select Auto Align from the pop-up menu. Then import the scan points as described above.

As soon as the import is finished, a message window is displayed with the query whether the scan points in the video image are to be repositioned. Click Yes. The software moves the laser beam of the scanning head Top to the points, determines the position of the laser beam on the screen and positions the scan point precisely at this point.

☞ This process can take quite some time!

5.4.2 Teaching-in Scan Points with the Geometry Scan Unit

If the object you are making measurements on does not have a continuous surface on which you can define a grid of scan points (e.g. a sheet of glass which has only been covered with reflective film in certain places), you can define single scan points with the aid of the optional geometry scan unit.

PSV, PSV-3D (1D)

1. Only PSV-3D: Select the scanning head Top.
2. Position the laser beam at the point at which you want to define a scan point.

☞ You can also use the hand set PSV-Z-051 for this or the optional PDA. Position the laser beam with the arrow keys on the hand set. Once the laser beam has reached the correct position on the object, press the button TEACH on the hand set. See your hardware manual on this as well.
You can read section 5.3.2 to find out how to define scan points with the PDA.

3. Click . If the geometry laser is not active yet, the software will now switch over to it. The software makes a distance measurement. At the same time, the coordinates of the point on the object are automatically determined, as is the position of the point on the video image.

☞ You can accelerate the speed at which new points are taught-in by switching over to the geometry laser first. To do so, click Scan > Geometry Laser. In this case the software does not keep on switching back and forwards between the vibrometer and the geometry laser for every individual point.

Once you have taught-in all the scan points, you can link them together to become a surface as described in section 5.3.3.

PSV-3D (3D)

If the positions of the scanning heads are known, you can acquire the geometry of the object by manually teaching-in the scan points.

1. Point all three laser beams at a point which you want to define as the scan point.

☞ The more precisely you define the scan points, the better the measurement result will be. **So please take your time defining the scan points!**

2. Click . This then automatically determines the coordinates of the point on the object and the position of the point on the video image. You can use the mouse to move this blue point. However this does not have any effect on the calculated 3D coordinates; it only affects the display in the video image.

☞ In the scanning head control, additional information is displayed in the element 3D Point. X, Y and Z describe the coordinates of the selected scan point. D is information on the plausibility control. This value shows the distance between the scan point and the front panel of the scanning head Top.

3. Once you have defined all scan points, you can connect them with each other. See section 5.3.3 on this.

4. Click to finish scan point definition. You can now start scanning.

5.4.3 Defining Scan Points with Auto-alignment, only PSV-3D (3D)

If you are using one of the graphics cards ATI Radeon® 9000 Pro, 9600 Pro or 9600 XT, you can also define individual scan points. To do so, proceed as follows:

1. Click in the video image with the right mouse button and select Auto Align in the pop-up menu.

2. Hold the control key pressed and in the video image click the place on the object at which you want to define the scan point. Depending on the lighting conditions, the surface of the object etc., the software positions the three laser beams precisely at this point and defines a scan point.

Correct 3D coordinates If the three laser beams jump to other positions after clicking , then you have not carried out the 2D alignment precisely enough. The 3D-coordinates were only determined approximately via the video image. If the three laser beams do not meet at one point, then you could change the distance between the coordinates and the sensor heads. You can use this to minimize the distances of the laser points. The minimal attainable distance is limited by the accuracy of the 3D alignment. To correct the coordinates, proceed as described in section 5.6.2 under Modify 3D Coordinates.

5.4.4 Editing Scan Points

If you have defined individual scan points in 3D point mode, you can select scan points and modify them.

Select scan points You can select points as also described in section 5.6.1 and modify the selected points as described in the following.

Disable If the selected scan points are not to be measured, you can disable them. To do so, select Disable. The scan points are then blocked for measurements, geometry scans and for the function Assign Focus Best.

Remove block To undo disabling, select Enable.

Modify 3D Coordinates If 3D geometry data is available, you can modify the 3D coordinates of individual scan points. Refer also to section 5.6.2 under Modify 3D coordinates.

Triangulate 3D Coordinates (only PSV-3D) To triangulate the 3D coordinates of the selected scan points, select Triangulate 3D Coordinates. Using the standard and 3D alignment of all three scanning heads, the software calculates the 3D coordinates of the scan points. You will find more information on this in your theory manual.

Interpolate 3D Coordinates

If 3D geometry is available for the selected scan points, you can interpolate the 3D coordinates of the selected scan points. To do so, select Interpolate 3D Coordinates. The software will then calculate the average distance of the neighboring points to the scanning head (Top with PSV-3D). From this distance and taking into consideration the position of the selected scan points on the video image, the 3D coordinates are determined.

5.5 Common Functions in All Modes

Several functions are available to you in all modes. They are described in the following sections. Show and Hide Scan Points

To show and hide the scan points in the live video image, in the toolbar of the application window, click or select View > Scan Points. You see the scan points as blue squares. You see the connections between the scan points as lines.

5.5.1 Editing Figures

Present figures

Using the icons , , and , you can present figures in different ways. To do so, first select the figures as described below. Then click

: You can see the scan points and their connections.

: You can see the scan points, their connections and cross-hatching of the areas enclosed by the scan points. As a general rule, these areas are different from the geometric figures you have drawn.

☞ In presentation mode, areas which are enclosed by scan points are shown as enclosed areas.

: You see the connections between the scan points.

: You see cross-hatching of the areas enclosed by scan points.

Select figures

To edit figures, you have to select them first. To do so, proceed as follows:

1. Click .
2. Point at a figure. At the right below the cursor, a cross ✥ appears.
3. Click. The software marks the edge of the figure with white handles.
4. To select further figures, click them while holding the control key pressed. The software marks every selected figure with white handles.
5. To select all figures, press the key combination Ctrl+A or select Edit > Select All.
6. To remove a figure from the selection, click the figure holding the control key pressed. The white handles disappear.

Move figures

To move figures, select them as described above and then use the mouse to drag them in the direction required. You can also use the arrow keys.

Scan points which you have defined in point mode or 3D point mode can be moved individually or in groups. You move individual scan points, whether connected or freestanding, in exactly the same way as you move figures (see above). If you want to move several scan points at the same time, then you first have to select them. To do so, you have the following possibilities:

- Hold the control key pressed and click the individual points. Then release the control key.
- Mark the scan points you would like to move. To do so, use the mouse to draw a rectangle which encloses these scan points.

☞ If you want to add even more scan points to this selection, hold the shift key pressed and draw another rectangle.

Move the scan points with the mouse.

Scale figures

To scale figures, proceed as follows:

1. Select the figures as described above. If you want to scale scan points which you defined in point mode or in 3D point mode, then first of all select them as described above under Move figures. Then click to group the selected scan points.
2. Point at one of the white handles which mark the edge of the figures. The cursor becomes a double arrow.

There are now different ways to scale:

3. Press the mouse button and drag in one of the directions the double arrow is pointing in. The anchor point is opposite the scan point you are dragging.

or

Press the control key and the mouse button and drag in one of the directions the double arrow is pointing in. The anchor point is the center of the figures.

or

Press the shift key and the mouse button and drag across to a corner point. The figures are resized in proportion horizontally and vertically.

Duplicate figures

To duplicate figures, proceed as follows:

1. Select the figures as described above.
2. Click or select Edit > Copy. The figures are copied onto the clipboard.
3. Click or select Edit > Paste.

Delete figures

To delete figures, proceed as follows:

1. Select the figures as described above.
2. Press the Delete key or select Edit > Delete.

Group figures

To group figures, proceed as follows:

1. Select the figures as described above.
2. Click .
3. To undo grouping, click .

Arrange figures

Using the four icons , , and , you can arrange figures behind each other (not in point mode and 3D point mode). To do so, first of all, select one of the figures as described above. Then click

or : The figure moves into the foreground or background.

or : The figure moves one layer forwards or backwards.

Undo and Redo

You can undo up to 20 operations and then redo them. To do so, click and or select Edit > Undo and Edit > Redo.

5.6 Editing Scan Points

You can also edit scan points if you have already finished scan point definition.

To do so, you have to start by selecting the scan points. See section 5.6.1 on this.

You can see how to modify the scan points in section 5.6.2.

5.6.1 Selecting Scan Points

Select scan points with the mouse

To select scan points with the mouse you have the following options:

1. To select several scan points adjacent to each other, hold the shift key and the left mouse button pressed and draw one or more rectangles across the required scan points.

   Or:

   To select several scan points that are not adjacent to each other, hold the control key pressed and click the required scan points.

Select all scan points

2. To select all scan points, press the key combination Ctrl+A.

   Or:

   Select Edit > Select All.

   Or:

   Click the object with the right mouse button and select Select Points from the pop-up menu. The dialog Select Scan Points appears.

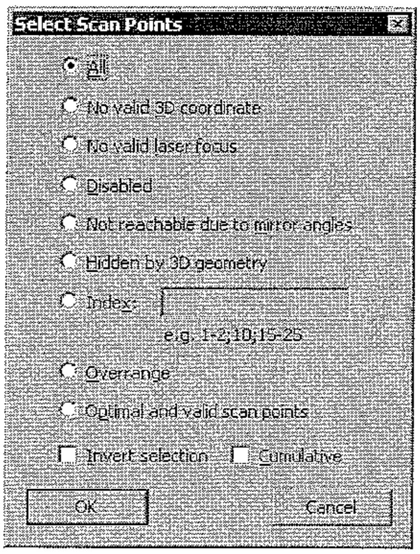


Figure 5.6: Dialog Select Scan Points

Select All and click OK.

Select scan points with certain properties

To select scan points which have certain properties, proceed as follows:

1. Click or select Edit > Select Points.
2. Click the object with the right mouse button and select Select Points from the pop-up menu. The dialog Select Scan Points appears (refer to figure 5.6).
3. Here you select the criteria according to which you want to select the points and click OK.

☞ If you want to select the scan points on the basis of their index, you can display the indices. See section 4.8.2 on this.

4. If you want to select points with different properties, then also tick the box Cumulative and repeat steps 2 and 3 as often as necessary.
5. To undo the selection, click again.

5.6.2 Modifying Scan Points

To retrospectively modify the selected scan points, select Edit > Modify Selected Points or click one of the selected scan points with the right mouse button and select Modify Selected Points and then the required command in the pop-up menu.

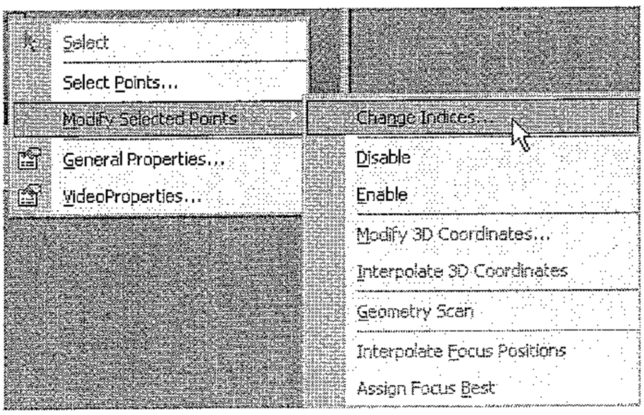


Figure 5.7: Command selection to modify scan points

You have the option of the following functions:

- Change Indices
- Disable/Enable
- Modify 3D Coordinates (only with 3D geometries)
- Triangulate 3D Coordinates (only for PSV-3D)
- Interpolate 3D Coordinates (only with 3D geometries)
- Geometry Scan
- Interpolate Focus Positions (only with option PSV-S-APS Ex)
- Assign Focus Best (only with option PSV-S-APS Ex)

Display indices You set up the display of scan point indices in the dialog Display Properties in the 3D view. To open the dialog, display the 3D view. To do so, click 3D. Double-click the video image and display the page Data or click the video image with the right mouse button and select Data Properties in the pop-up menu. You will also find a detailed description of the dialog in section 4.8.

Change Indices To change the indices of selected scan points, select Change Indices. The dialog Change Indices appears.

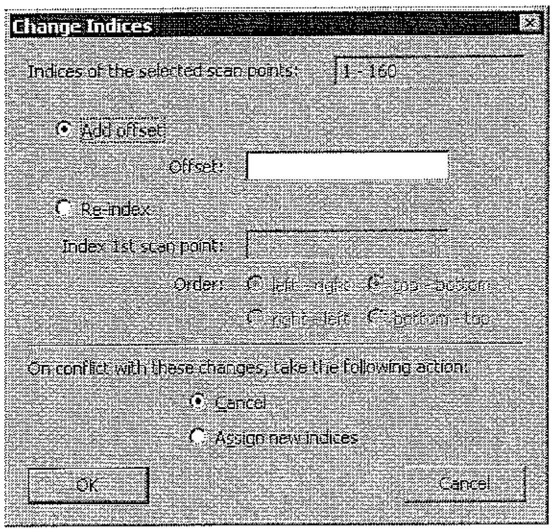


Figure 5.8: Dialog Change Indices

At the top you are shown the indices for selected scan points.

Add offset: Click here if you want to add a certain amount to the indices of the selected scan points or want to subtract it from them. In the field Offset enter the required value. For a negative offset you have to enter an additional minus sign (–).

Example:
The selected scan points have the indices 1 - 21.
Offset: 10
The new indices will be 11 - 31.

Re-index: Click here if you want to renumber the selected scan points. In the field Index 1st scan point enter the value at which the new numbering is to start.

In addition to that, select the direction of the numbering, starting with the first scan point.

Example:
The selected scan points have the indices 27 - 52.
Index 1st scan point: 30
Direction: left - right, top - bottom
The new indices will be 30, 31, 32, ... They are assigned to the selected scan points from left to right and from top to bottom.

☞ The numbering of the indices only affects the display on the screen. It has no influence on the order in which the points are scanned.

On conflict with these changes, take the following action: Here you select how the software is to react if there is a conflict after changing the indices, i.e. numbers are assigned twice. If you select Assign new indices, then the selected scan points are assigned the required indices. Indices for other scan points which already exist are then counted up, starting with the highest index +1.

Example:
You have defined 2500 scan points and want to newly assign the indices 1 - 200 to the scan points 200 - 400.
Index 1st point: 1
On conflict with these changes, take the following action: Assign new indices
The selected scan points are given the indices 1 - 200. The scan points which originally had the indices 1 - 200 will be given the indices 2501 - 2701.

☞ Independently of whether you abort assignment of new indices or carry it out anyway, you will see a message as to whether a conflict occurred.

Disable

If the selected scan points are not to be measured, you can disable them. To do so, select Disable. The scan points are then disabled for measurements, geometry scans and for the function Assign Focus Best.

Enable

To undo disabling, select Enable.

Modify 3D Coordinates

You can modify the 3D coordinates of individual scan points. To do so, for the respective selected scan point, select Modify 3D Coordinates. The dialog Modify 3D Coordinates appears.

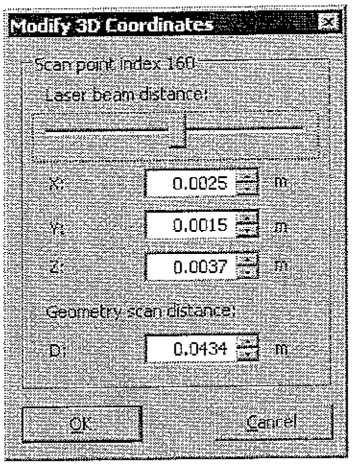


Figure 5.9: Dialog Modify 3D Coordinates

Here you can correct the values of the X, Y and Z coordinates and also the distance determined by the geometry scan unit. If you move the laser beams with the aid of the slider Laser beam distance, the values in the fields are automatically updated. If however you correct the values in the fields, the slider remains in the set position.

You can also modify the 3D coordinates of several scan points at the same time. To do so, proceed as follows:

1. Select several scan points as described in section 5.6.1.
2. Click one of the scan points with the right mouse button and select Modify 3D Coordinates in the pop-up menu.
3. Modify the 3D coordinates as described above and click OK. The change to the 3D coordinates of that scan point is added to the 3D coordinates of all selected scan points. This allows you to move the position of several scan points in the same direction.

Triangulate 3D Coordinates (only PSV-3D)

To triangulate the 3D coordinates of the selected scan points, select Triangulate 3D Coordinates. Using the standard and 3D alignment of all three scanning heads, the software calculates the 3D coordinates of the scan points. You will find more information on this in your theory manual.

Interpolate 3D Coordinates

If 3D geometry data is available for the selected scan points, you can interpolate the 3D coordinates of the selected scan points. To do so, select Interpolate 3D Coordinates. The software will then calculate the average distance of the neighboring points to the scanning head (Top with PSV-3D). From this distance and taking into consideration the position of the selected scan points on the video image, the 3D coordinates are determined.

Geometry Scan

If you want to correct the 3D coordinates of the selected scan points with the aid of the geometry scan unit, select Geometry Scan. The software will carry out a geometry scan as described in section 4.3.

Interpolate Focus Positions

To interpolate the focus positions of the selected scan points, select Interpolate Focus Positions. The focus positions of the selected scan points are interpolated linearly from the focus positions of the adjacent points.

Assign Focus Best

Select Assign Focus Best to automatically focus the selected scan points respectively and to assign them a focus value. See also section 4.5.2 on this.

6 Making Measurements

You can make single point measurements and scan using the software. In section 6.1 and section 6.2 the different measurements are described. There you will also find an explanation of the respective procedure.

When a measurement is running, the status bar can display messages on it. See section 6.4 on this.

In section 6.5 you will find information on what you have to pay attention to if you stop a measurement.

Only with option VDD: You must run the test mode at regular intervals before making measurements. See section 6.6 on this.

In section 6.7 you will find a few example applications which give you detailed instructions on various measurement tasks.

6.1 Single Point Measurement

You can make single point measurements as single shots or as a continuous measurement.

Single shot

With a single shot, the software makes a single measurement and then ends data acquisition. You can also stop single shots manually.

Continuous measurement

With a continuous measurement, the software repeats single shots until you manually stop data acquisition. You can only save the last single shot.

To make a single point measurement, proceed as follows:

Preparation

1. Go to acquisition mode. To do so, click or select View > Acquisition.
2. Set the software up for data acquisition as described in chapter 3.
3. Set the optics and position the laser beam to point at the place where you want to make a measurement. See chapter 4 on this.
4. Focus the laser beam (manually or automatically in the scanning head control). See section 4.1 and section 4.4 on this.
5. Only with option VDD: You must run the test mode at regular intervals before making measurements. See section 6.6 on this.
6. Set the parameters for data acquisition. See chapter 7 on this.

Start

7. Start a single shot or a continuous measurement. To do so, click or . You can also select Acquisition > Single Shot or Acquisition > Continuous.

☞ If you have selected the 3D view in acquisition mode, the software will change over to the 2D view on starting the scan. Thus you can follow the movement of the laser beam on the object in the live video image.

Follow the measurement

8. During the measurement, you can display data in analyzers as described in section 8.2 and section 8.4.

9. During the measurement, the status bar and scanning head control can display messages on data acquisition. See section 6.4 on this.

Stop

10. To stop the measurement, click or select Acquisition > Stop. Please see section 6.5 on this as well.

6.2 Scanning

A scan is a sequence of single point measurements. The order in which the software approaches the scan points is determined by an internal algorithm. For every scan point, the software carries out the following steps:

- position the laser beam at the scan point,
- set the optics of the scanning head to the focus value of the scan point (only with option APS Extended, refer to section 4.5),
- wait for the end of the settling time of the scanner mirrors,
- make a single shot,
- assign scan point status,
- save measurement data.

After a scan, the software can automatically remeasure certain scan points or you can start remeasuring manually. You can also mark single scan points in presentation mode to be remeasured and then remeasure this file in acquisition mode.

To scan, proceed as follows:

Preparation

1. Go to acquisition mode. To do so, click or select View > Acquisition.

2. Set the software up for data acquisition as described in chapter 3.

3. Set the optics. See chapter 4 on this.

4. Define the scan points as described in chapter 5.

5. Set the parameters for data acquisition. See chapter 7 on this.

Start

6. Start the scan. To do so, click or select Acquisition > Scan. If the function generator is active (refer to section 7.2.9), signal output starts. The software creates a file for the scan. The dialog Save As appears.

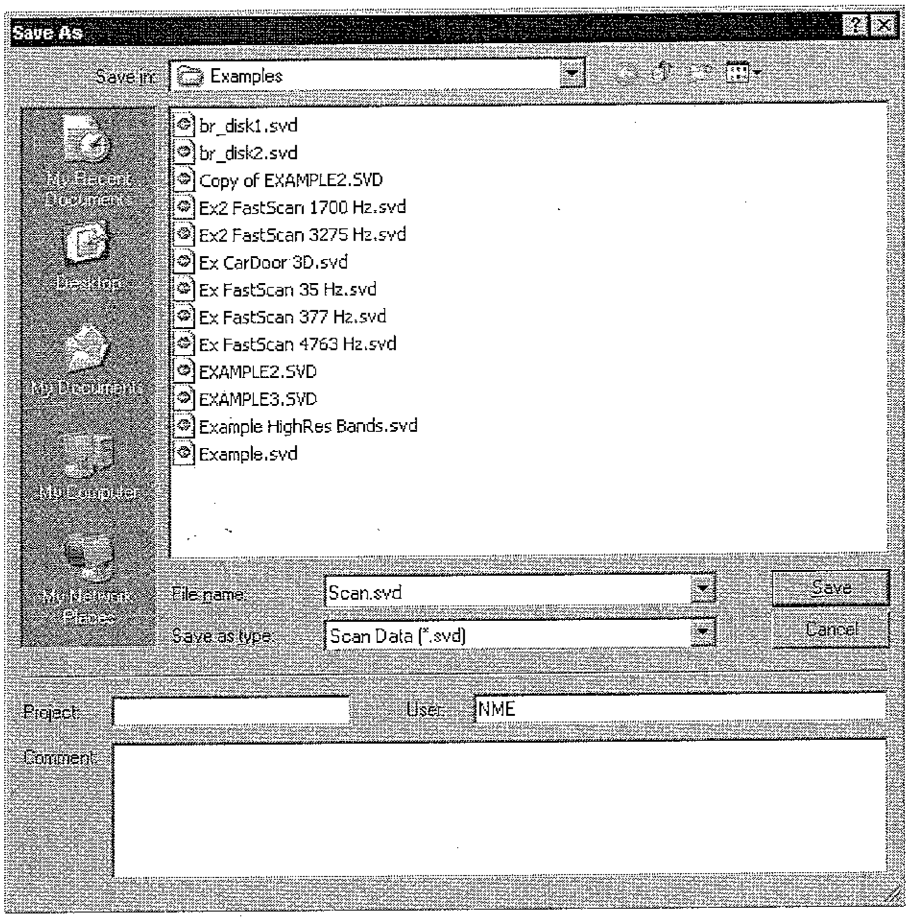


Figure 6.1: Dialog Save As

Save

7. Navigate to the saving location and enter the file name.

☞ If you have displayed the project browser (refer to section 2.7.4), you will then automatically be shown the directory marked there as saving location.

8. At the bottom in the dialog you can enter additional information to give the file more precise properties. This information is part of the file properties which you can also view and edit in the Explorer. It will be displayed to you when you open a file in presentation and also in the dialog File Information. (refer to section 2.7.4 on this as well).

9. Click Save. The scan starts. The software immediately saves every scan point measured.

☞ In measurement mode Time, a high number of samples can mean that very large files are generated which can only be saved and read using Windows® 2000 or Windows® XP! See also section 7.2.12 on this.

Follow the scan

10. You can follow the progress of the scan in the video window as described in section 8.1. During the scan, you can display data in analyzers as described in section 8.2 and section 8.4.

11. During the scan, the status bar and scanning head control can display messages on the data acquisition. See section 6.4 on this.

Stop the scan and continue

12. Once the total sample time has expired, the software ends data acquisition and displays a message. However, you can also stop the scan manually. You will find more details on this in section 6.5.

13. You can continue a stopped scan. To do so, select Acquisition > Continue.

Remeasure

14. After the scan you can remeasure the scan points with the status Overrange, Invalidated and Not Measured at a slightly different position. To do so, select Acquisition > Remeasure. If Signal Enhancement is active for at least one channel (refer to section 7.2.7), then other scan points with the status Valid are also remeasured.

Remeasure File

15. If you have marked individual scan points in presentation mode to be remeasured (refer to section 9.1), you can remeasure them. To do so, select Acquisition > Remeasure File. The dialog Open appears. Navigate to the saving location, select the file and click Open.

☞ In addition to that, the software can also remeasure the points automatically, see section 7.2.1 on this.

6.3 Using the PSV-3D for Making 1D Measurements

If you are using the PSV-3D with just one scanning head, then you have to activate it first. section 3.1) and then change the settings as follows:

1. Click A/D or select Acquisition > Settings.

2. Go to the page Channels and deactivate Vibrometer Left and Vibrometer Right. In this case only the scanning head Top makes a measurement. So you only have to carry out the alignment for this scanning head as described in section 4.2.1.

   You can ignore any error messages about the other two scanning heads not having been aligned.

☞ You can also use Vibrometer Left and Vibrometer Right as a reference. To do so, activate the corresponding vibrometer on the page Channels and mark it as reference.

6.4 Messages while Measuring

During a measurement, the status bar and scanning head control can display messages on data acquisition. A list of messages, their causes and information on prevention can be found in table 6.1.

Table 6.1: Messages on data acquisition

<table>
<tr><th>Message</th><th>Cause</th><th>If the message appears permanently:</th><th>See</th></tr>
<tr><td>OVERRANGE VIB (status bar)</td><td>The voltage on the vibrometer channel exceeds the input range set.</td><td>Click A/D, display the page Channels and set to the next highest input range of the vibrometer channel. Increase the input range on the page Channels step by step up to 10V. Then display the page Vibrometer and increase the measurement range for the velocity step by step.</td><td>section 7.2.2</td></tr>
<tr><td colspan="4">☞ The message OVERRANGE VIB can also appear briefly which is caused by noise peaks due to dropouts. In this case, do not reset the input range.</td></tr>
<tr><td>OVERRANGE REF (status bar)</td><td>The voltage on the reference channel exceeds the input range set.</td><td>Click A/D, display the page Channels and set the next highest input range of this reference channel.</td><td>section 7.2.2</td></tr>
<tr><td>NO TRIGGER (status bar)</td><td>Triggering is set but the software can not detect a trigger signal.</td><td>Click A/D, display the page Trigger and check the trigger settings. Also check the cabling.</td><td>section 7.2.6, hardware manual</td></tr>
<tr><td>Display OVER is red (scanning head control)</td><td>The measurement range for the velocity has been exceeded.</td><td>Click A/D, display the page Vibrometer and set the next highest measurement range for the velocity.</td><td>section 7.2.8</td></tr>
<tr><td colspan="4">☞ Even if you are only measuring and evaluating the displacement signal, the measurement range for the velocity must not be exceeded.</td></tr>
</table>

6.5 Stopping a Measurement

With single shots and with scanning, the software ends data acquisition once the total sample time has expired. You can also stop measurements manually. Continuous measurements have to be stopped manually.

To stop a measurement, click or select Acquisition > Stop.

Single point measurement

If you stop a single point measurement, the following applies:

- If there are less than three seconds to the end of the sample time, the software carries out the measurement completely and then ends data acquisition.
- If there are more than three seconds to the end of the sample time, the software aborts the measurement. In the measurement modes FFT and Zoom-FFT, you can always display and save the time signal for aborted measurements, but may not be able to save a spectrum. For long sample times, single shot is recommended if you want to evaluate and save spectra.

Scan

If you stop a scan, the following applies:

All completely measured scan points are already saved. You can evaluate the scan the same as you can a completed one.

6.6 Test Mode (as an Option)

In the test mode, the software calculates the errors which are caused by the analog components during signal processing. Prior to demodulation, the software corrects these errors using special algorithms. To do this, you need the option VDD.

You have to run test mode after having installed both the option VDD and the hardware, and having set up the software, and then repeat it regularly. In doing so, the following applies:

- If you only want to measure to 10 nanometers accuracy or less, you should run the test mode again every three months.
- If you want to measure more accurately than 10 nanometers or if the ambient temperature has changed by ±5°C or more, repeat the test mode every day.

☞ Test mode can be carried out automatically for the controller OFV-5000 if the controller is controlled remotely via the RS-232-interface. Test mode is then run every time the software is started.

To run the test mode, you will need

- a test object which is vibrating – for example, a loudspeaker. The displacement amplitude should be at least 1 µm.
- a piece of reflective film.

To run test mode, proceed as follows:

1. Switch the PSV or MSV on and wait for 30 minutes. The components are then in thermal equilibrium.
2. **Only PSV:** Attach a piece of reflective film to the test object and point the scanning head at it.
3. Let the test object vibrate.
4. **Only PSV:** Open the beam shutter on the scanning head, fine-position and focus the laser beam on the reflective film. The signal level display should light up completely.

   Only MSV: Open the beam shutter on the scanning head, fine-position and focus the laser beam on the test object. The signal level display should light up completely.
5. In the software, select Setup > VDD Test.

☞ If the command is not active, select Setup > Preferences, display the page Devices and in the list Junction Box select the junction box VDD-Z-01x, or MSA-E-400 (VDD), refer also to section 3.1.

The software records the vibration and calculates the correction factors for the errors caused by analog components.

Should test mode fail, then first of all check the cabling and the test assembly. If cabling and the test assembly are correct, then it is possible that the displacement amplitude of the test object is too small.

If test mode is successful, you can now start a measurement as described in section 6.1 or section 6.2.

6.7 Example Measurements

Here you will find a few example applications which give you detailed instructions on various measurement tasks.

6.7.1 Optimizing Input Signals with Signal Enhancement and Speckle Tracking

When scanning with Signal Enhancement and Speckle Tracking, you get an approximately even noise level for all scan points.

☞ Speckles occur when laser light is scattered back from optically rough surfaces. The light scattered back from a certain point can cause constructive or destructive interference. Correspondingly, the detector sees a bright or a dark speckle. Dark speckles lead to dropouts in the vibrometer signal. Dropouts increase the noise level significantly.

With Signal Enhancement and Speckle Tracking, you suppress dropouts in averaged spectra. In addition, the software evaluates the noise level of the single scan points. You will find more information on this in your theory manual.

To activate Signal Enhancement and Speckle Tracking, proceed as follows:

1. Click A/D or select Acquisition > Settings. The dialog Acquisition Settings appears.
2. Display the page SE.
3. On the left you mark the channels which Signal Enhancement is to be active for. You will find information on this in section 7.2.7.
4. If Signal Enhancement is active for the vibrometer channel, then you can activate Speckle Tracking for this channel on the right.
5. Set the parameters on all other pages of the dialog. You will find information on this in section 7.2.
6. Click OK.

You can now start a measurement as described in section 6.1 or section 6.2.

6.7.2 Controlling an External Function Generator (as an Option)

Using the software you can control certain function generators via an IEEE-488/GPIB interface. To do this, you need the option External Signal Generator.

☞ You can set which generator you are using via Setup > Preferences on the dialog page Devices.

The software supports the following function generators:

- HP 33120A
- Agilent 33120A
- Agilent 33250A
- PREMA ARB1000.

To control an external function generator, proceed as follows:

Make a connection

1. Connect your PC to the function generator via an IEEE 488/GPIB or RS-232 interface.
2. Switch the function generator on.
3. Only 33120A: Configure the interface of the function generator as described in its manual. Set HPIB/488 or RS-232 as the interface and as HPIB address 10.
4. Start the software or go into acquisition mode.
5. Select Setup > Preferences and open the page Devices. Here you set the correct connection to the generator (refer also to section 3.1).
6. Click OK. The generator is initialized.

Set the parameters

7. Click  or select Acquisition > Settings. The dialog Acquisition Settings appears.
8. Display the page Generator.
9. At the top left, tick the box Active to activate the function generator.
10. Set the parameters for the signal you want to emit. You will find information on this in section 7.2.9.
11. Set the parameters on all other pages of the dialog. You will find information on this in section 7.2.
12. Click OK.

Signal output

13. Start (stop) the signal output of the function generator. To do so, click  or select Acquisition > Generator.

☞ When scanning, the signal output starts automatically.

You can now start a measurement as described in section 6.1 or section 6.2.

6.7.3 Controlling the Internal Function Generator (as an Option)

Using the software you can control the internal function generator of the PSV 400, PSV 300 or MSV 300. To do this, you need the option Internal Signal Generator. The output signal of the internal function generator is available at a BNC jack on the junction box (refer to hardware manual).

☞ You can set which generator you are using via Setup > Preferences on the dialog page Devices.

To control the internal function generator, proceed as follows:

Set the parameters

1. Click [A/D] or select Acquisition > Settings. The dialog Acquisition Settings appears.
2. Display the page Generator.
3. At the top left, tick the box Active to activate the function generator.
4. Set the parameters for the signal you want to emit. You will find information on this in section 7.2.9.
5. Set the parameters on all other pages of the dialog. You will find information on this in section 7.2.
6. Click OK.

Signal output

7. Start (stop) the signal output of the function generator. To do so, click [~] or select Acquisition > Generator.

☞ When scanning, the signal output starts automatically.

You can now start a measurement as described in section 6.1 or section 6.2.

6.7.4 FastScan (as an Option)

You can fast scan at individual frequencies. To do this, you need the option FastScan. The principle of FastScan is a regression in the time domain.

To carry out a FastScan, proceed as follows:

Set the parameters

1. Click  or select Acquisition > Settings. The dialog Acquisition Settings appears.
2. Display the page General and select the measurement mode FastScan. In the dialog a page with parameters for FastScan appears. The pages Frequency, Window and Trigger disappear.
3. Display the page FastScan and set the parameters. You will find information on this in section 7.2.11.
4. Set the parameters on all other pages of the dialog. You will find information on this in section 7.2.
5. Click OK.

Measure

6. You start and stop FastScans the same way as normal scans. See section 6.2, section 6.4 and section 6.5 on this.

☞ With a FastScan there is no leakage. Triggers are not active. If you are controlling a function generator with the software, then a sinusoidal signal with the frequency of the FastScan is used for excitation.

Display data

7. You can display data for FastScans as described in chapter 8, but no spectra.

Evaluate

8. You can evaluate FastScans as described in chapter 9, but only at the frequency of the FastScan. You can not define any other frequency bands.

6.7.5 MultiFrame Measurement (as an Option)

Using the software you can divide measurements on combustion engines into frames and analyze the frames individually. To do this, you need the option MultiFrame and a trigger signal (TTL) which determines the start of an engine cycle. For the frame cycle you will need a second trigger signal which determines the end of a frame. You connect this second trigger signal to the channel with the highest number (REF3 or REF24). In the software, this channel will be named MultiFrame.

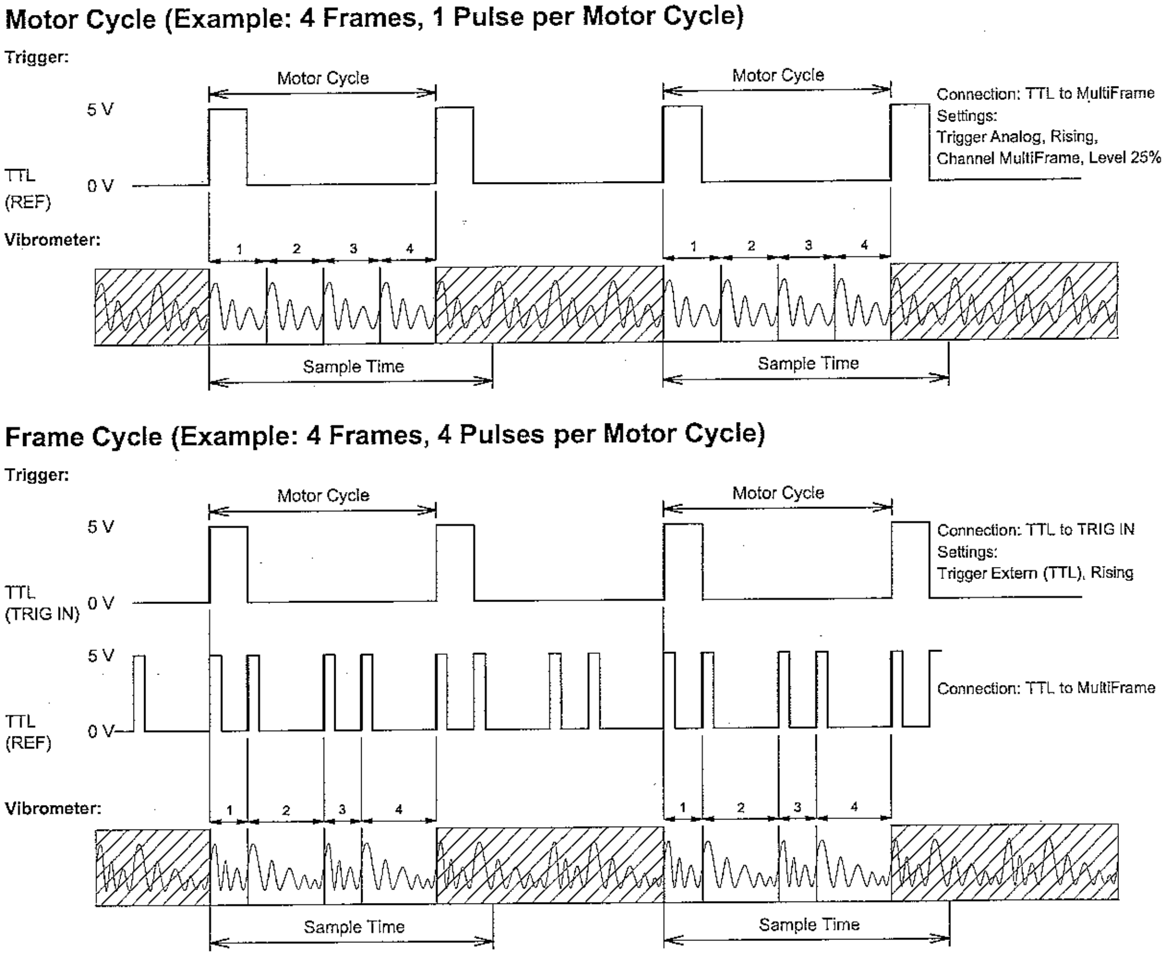


Figure 6.2: Schematic representation of setting frame boundaries

There are three ways of setting the frame boundaries (refer also to section 7.2.13):

- manually
- automatically with the aid of the engine cycle
- automatically with the aid of the frame cycle

Manually

If you manually set the frame boundaries in the analyzer, the start of the engine cycle is determined by a trigger signal at TRIG IN (TTL).

Engine cycle If the frame boundaries are set automatically by the engine cycle, the start and the end of the engine cycle are determined by a trigger signal (TTL, rising edge) at MultiFrame. All frames are the same length.

Frame cycle If the frame boundaries are set automatically by the frame cycle, the start of the engine cycle is determined by a trigger signal (TTL, rising edge) at TRIG IN. A second trigger signal (TTL, rising edge) at MultiFrame ends the frame.

To make a MultiFrame measurement, proceed as follows:

Cabling One way of cabling the system and the necessary settings in the software for this is shown in table 6.2. In principle other versions of cabling would be possible.

Table 6.2: Example of connecting up the trigger signals for MultiFrame measurements

Determining the frame boundaries	Cabling	Setting in the software
Manual	Trigger signal for the start of the engine cycle: TRIG IN	Source: External (TTL), Rising Pre-trigger: 0%
Engine cycle	Trigger signal for the start and the end of the engine cycle: MultiFrame	Source: Analog Pre-trigger: 0% Channel: MultiFrame, Rising Source: 25% Pulses per engine cycle: 1
Frame cycle	Trigger signal for the start of the engine cycle: TRIG IN Trigger signal for the end of a frame: MultiFrame	Source: External (TTL), Rising Pre-trigger: 0%

Set the parameters

1. Click A/D or select Acquisition > Settings. The dialog Acquisition Settings appears.
2. Display the page General and select the measurement mode MultiFrame. A page with parameters for the MultiFrame measurement appears in the dialog.
3. Set all other parameters on the page General. You will find information on this in section 7.2.1.
4. Display the page MultiFrame and set the parameters. You will find information on this in section 7.2.13.
5. Display the page Frequency. Set the parameters as described in steps 6 and 7.
6. At the top left, set the bandwidth.
7. At the bottom right, set the number of samples. Above that, the software shows the lower RPM limit RPM_{min} which it can acquire with the bandwidth and number of samples set. Set the number of samples so that the lower RPM limit is 5 to 40% below the RPM the engine is running at.

8. Display the page Window and set the window functions. As a general rule, the window function Tapered Hanning with a parameter of 10 is suitable for MultiFrame measurements. You will find more information on windowing in section 7.2.5 and in your theory manual.

9. Display the page Trigger and set the parameters according to table 6.2.

10. Set 0% pre-trigger.

11. Set the parameters on all other pages of the dialog. You will find information on this in section 7.2.

12. Click OK.

If you set the boundaries of the frames manually, then now follow steps 13 to 18. If you set the boundaries automatically, you can jump these steps and continue with step 19.

Set frame boundaries manually

13. Start a single point measurement. To do so, click .

14. In the analyzer you will see a MultiFrame toolbar and in the diagram, the boundaries of the frames. In the MultiFrame toolbar, click .

15. Point at a boundary in the diagram. The cursor becomes a ↔.

There are two ways of moving the boundaries:

16. To move a boundary, use the mouse to drag it to the right or left into the required position. You can only move each boundary in a certain range which depends on the neighboring boundaries.

17. To move all boundaries at the same time, press the shift key and drag to the right or left into the required position. All boundaries move at the same time and retain the same respective distances to each other.

18. When you have adjusted all boundaries, click  again. Initially the boundaries jump back into their old positions in the analyzer. The new boundaries are not shown until you start a new measurement.

Measure

19. You start and stop MultiFrame measurements as described in section 6.1, section 6.2, section 6.4 and section 6.5.

Display data

20. You can display data for MultiFrame measurements as described in chapter 8.

21. In analyzers you can also display the spectra of the individual frames and the average of all frames. To (de)activate the display of a spectrum, click the corresponding icon in the MultiFrame toolbar.

22. In presentation windows, you can either only display an individual frame or the average respectively. Select the data set you want to display in the list Frame [Frame 4] in the legend for the object.

Exporting Universal File or ME'Scope

23. If you export a MultiFrame measurement as a Universal File or in ME'Scope format (refer to section 10.2.3), the software will create an own file for every single frame and for the average.

6.7.6 Controlling a Second Vibrometer

Apart from the PSV, MSA or MSV, you can control a second Polytec vibrometer at the same time. To do this, you need an IEEE488 /GPIB board or a free RS232 interface in your PC.

Supported controllers

You will find an overview of the controllers and interfaces supported as well as information on cabling in table 6.3.

Table 6.3: Supported controllers and interfaces

Vibrometer	IEEE-488/GPIB	RS-232	RS-232 cable
CLV-1000/2000/3000	-	x	Null modem (cross-wired)
HLV-1000	-	x	Null modem (cross-wired)
NLV-1232	-	x	Null modem (cross-wired)
OFV-3000/3001/3001S	x	x	1:1
OFV-3020/3020S	x	x	1:1
OFV-3300-1/3300-2	x	x	1:1
OFV-3310/3320	x	x	1:1
OFV-4000	x	x	1:1
OFV-5000	-	x	Null modem (cross-wired)
OFV-5000-S	-	x	Null modem (cross-wired)

Supported commands

The connection supports the following commands:

- set the parameters of the controller for data acquisition

Only Vibrometer Controller 1 (refer to section 2.3):

- query overranging
- query the optical signal level
- OFV-5000 with scanning head PSV-I-400: focus the laser beam automatically (Auto Focus)
- OFV-5000 with sensor head OFV-505: focus the laser beam automatically (Autofocus)
- OFV-5000 with sensor head OFV-551/-552: control the beam shutter, dim the laser beam (as an option)
- OFV-3001S with scanning head OFV-056: focus the laser beam
- OFV-3001S and OFV-3001 with the sensor head OFV-303: focus the laser beam

To control a vibrometer, proceed as follows:

Make a connection

1. Connect the PC to the controller via an IEEE-488/GPIB or RS-232 interface, refer also to table 6.3.

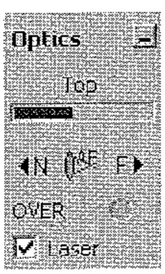
☞ If you are using an RS-232 interface, then set 9600 Baud on the controller, on the OFV-5000 controller 115200 Baud.

2. Switch the controller on.
3. Only OFV-3300-1, OFV-3310 and OFV-4000: Use the key ↑ on the front panel of the controller to switch its display to the menu SETTINGS. Then you can monitor the current settings on the display.
4. Start the software or go into acquisition mode.
5. Select Setup > Preferences. The dialog Preferences appears.
6. Display the page Devices. Make the necessary settings here (refer also to section 3.1).
7. Display the page Channels.
8. In the column Vibrometer, connect the controller to the digital channel it is providing the signal for. You will find information on this in section 3.2.
9. Click OK. The controller is initialized.

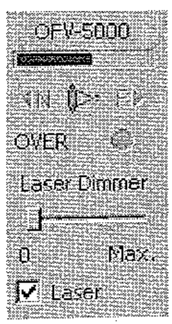
Set the optics

10. If you can not see the scanning head control in the application window, select View > Scanning Head to display it. At the top you can see the optical signal level as a bar.

☞ If you are using the sensor head OFV-551/-552, you can control the beam shutter and use it to turn the laser on and off. To do so, click the box Laser. Apart from that, as an option, the slider Laser Dimmer is displayed. By moving this slider with the mouse in the direction Max. you can reduce the light intensity of the laser beam.



OFV-505



OFV-551/-552

Figure 6.3: Elements of beam control

11. OFV-5000 with scanning head PSV-I-400 or sensor head OFV-505: You can focus the laser beam automatically with the icon .

12. OFV-3001S with scanning head OFV-056: You focus the laser beam using the icons (close-up) and (infinity).

Set the parameters

13. Click or select Acquisition > Settings. The dialog Acquisition Settings appears.

14. Display the page Vibrometer.

15. Set the parameters of the controller for data acquisition. You will find information on this in section 7.2.8 and in your vibrometer manual.

16. Set the parameters on all other pages of the dialog. You will find information on this in section 7.2.

17. Click OK.

You can now start a measurement as described in section 6.1 or section 6.2.

7 Parameters for Data Acquisition

There are three ways for you to set the parameters for data acquisition. See section 7.1 on this.

You will find a description of all parameters in section 7.2.

7.1 Setting the Parameters

You can set the parameters for data acquisition as follows:

- in the status bar
- in the dialog Acquisition Settings
- by loading the settings from a file.

Status bar

You can set some parameters on the right in the status bar. The parameters which are shown there depend on the measurement mode set. To see which parameters they are, point at a setting and leave the cursor there for a moment. The parameter is then shown on a yellow background next to the cursor and also on the left in the status bar. To set a parameter, click the arrow on the right of it and select the required setting in the pop-up menu.

Dialog

You can set all parameters in the dialog Acquisition Settings. To do this, proceed as follows:

1. Click  or select Acquisition > Settings. The dialog appears. It consists of several pages each with a group of parameters respectively. To display a certain page, click the name of the group.
2. Display the page General and set the parameters. You will find information on this in section 7.2.1. The pages in the dialog can change with the measurement mode selected.
3. Set the parameters on all other pages of the dialog. You will find information on this in section 7.2.
4. When you have set all parameters, click OK.

File

You can load settings from setting files and measurements. See section 10.1.3 on this. You can save the current settings as described in section 10.2.7.

7.2 Description of the Parameters

7.2.1 General

On the page General, you set the measurement mode, averaging and automatic remeasuring.

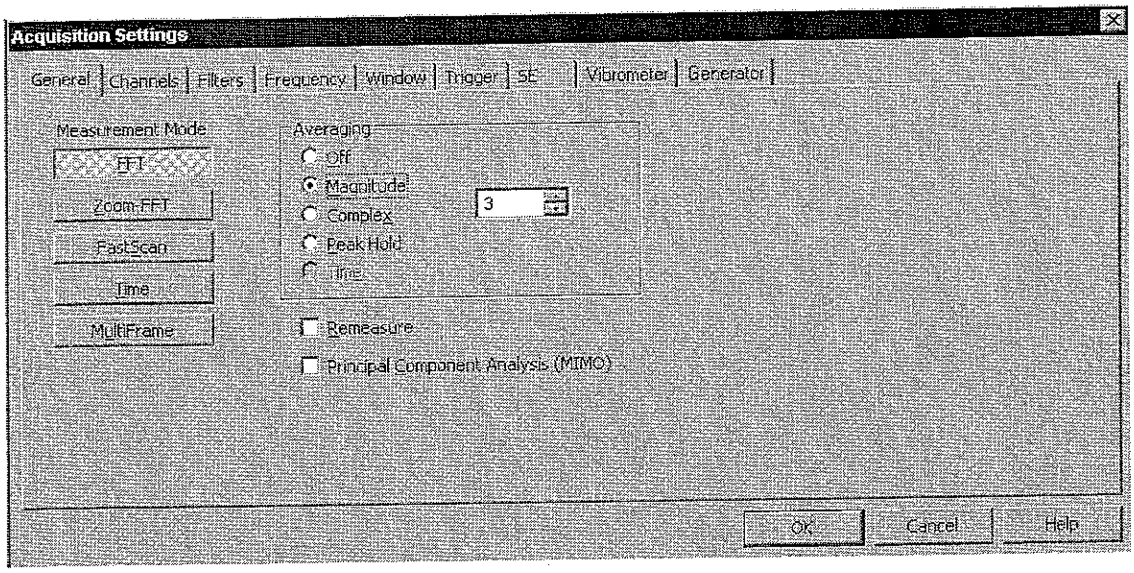


Figure 7.1: Page General

Measurement mode On the left you select the measurement mode. The measurement mode FFT is available as standard, all others are optional. The pages in the dialog can change with the measurement mode selected. If, for example, you select the measurement mode FastScan, then a page appears with parameters for FastScan. Other pages disappear.

Averaging On the right you set the averaging. In measurement mode FastScan you can not average. By averaging you can improve the signal-to-noise ratio of spectra. You will find detailed information on averaging in your theory manual.

Off: You do not average.

Amplitude: Select magnitude averaging if you

- are neither using a reference signal nor a trigger

or

- are using stochastic excitation – for example, in a wind tunnel.

Complex: Select complex averaging if you

- are using a reference signal or a trigger

and

- are using deterministic excitation.

On the right you enter the number of averages. The time needed for a measurement will increase by this factor.

Peak Hold: Select Peak Hold for averaging if you want to calculate and display the respective maximum of the spectra over the set number of averages.

☞ Peak Hold is not available in the measurement mode Time.
If you select Peak Hold averaging, you can not make any further quality adjustment for Signal Enhancement (Fast ... Best, refer to section 7.2.7).

You will find more information on the measurement mode Peak Hold in your theory manual.

Time: In the measurement mode Time you can only select Time averaging. A prerequisite of this is that you trigger the measurements.

Remeasure

At the bottom you can activate automatic remeasuring. After a scan all the scan points with the status Overrange, Invalidated and Not Measured are then remeasured at a slightly different position. If Signal Enhancement is active for at least one channel (refer to section 7.2.7), then other scan points with the status Valid are also remeasured.

☞ You can also start remeasuring manually. See section 6.2 on this.
After changing from acquisition to presentation mode you can also identify single scan points to be remeasured. See section 9.1 on this.

Principal Component Analysis (MIMO)

With the option PCA (Principal Component Analysis) you can run a MIMO data acquisition. To do this, mark the box Principal Component Analysis (MIMO) in the lower part of the dialog.

☞ So that you can start MIMO data acquisition, you have to have selected Magnitude or Complex as averaging. On the page Channels specify at least two reference channels and on the page Generator tick the box Multiple Channel (refer also to section 7.2.2 and section 7.2.9).

Principal Component Analysis is also available to you if you are also using the optional junction box PSV-E-408 and are measuring 8 channels (refer to section 3.2). You will find more information on MIMO data acquisition in your theory manual.

7.2.2 Channels

On the page Channels you activate the required measurement channels and set their parameters for digital data acquisition. For certain hardware configurations and measurement modes, parameters on the page are not available or are set permanently.

Work in the table

To accelerate adjustment of the settings, you can use the icons (Copy) and (Insert) above the table. To do so, tick the required cell(s), line(s) or column(s) as described in the following. Then click , mark the cell(s), line(s) or column(s) which you want to transfer the settings to and click .

Or:

Click with the right mouse button and select Copy or Insert in the pop-up menu.

- To mark a cell, click it.
- To mark a line, click the first cell of this line.
- To mark a column, click the head of this column.
- To mark several consecutive cells, lines or columns, hold the shift key pressed and mark the first and last cell/start of line/column head with the mouse.
- To mark several cells, lines or columns which are not consecutive, hold the control key pressed and mark the respective cells/starts of line/column heads with the mouse.
- If you want to mark the whole table, click the cell Channel.

In the same way you can copy settings into and out of other applications such as Microsoft® Excel.

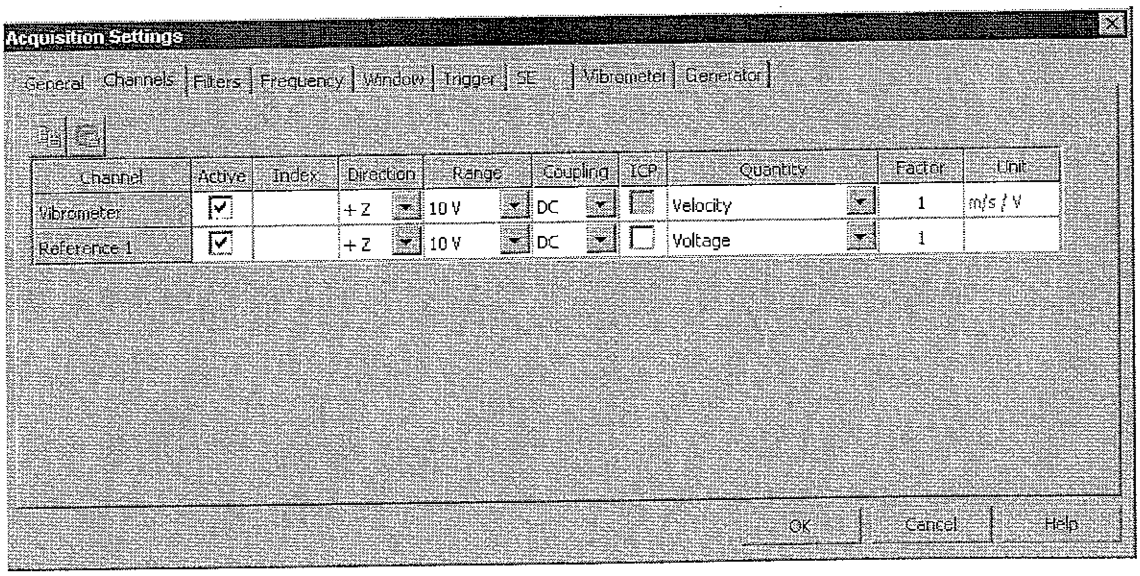


Figure 7.2: Page Channels

Active: Here you mark the channels you want to make measurements on.

Ref: This column only appears if there are more than two input channels available in the software. A channel is either an answer channel or a reference channel. The channel Vibrometer is always an answer channel.

For systems with two channels the channel Reference 1 is always a reference channel. For systems with more than two channels you can select which channel is the reference channel (apart from Vibrometer). To do so, mark it in the column Ref. If the column Ref is not marked for one channel, it is used as the answer channel, even if it is called Reference.

The channel Reference 1 is given special treatment. It serves as a phase reference for the other channels if you

- average magnitudes (refer to section 7.2.1) or
- do not use a trigger (refer to section 7.2.6).

When calculating the frequency response function, all possible combinations of type answer channel/reference channel are formed.

Example:

Vibrometer & Reference 1: answer channels
Reference 2 & Reference 3: reference channels

The following signals are available as frequency response function:

Vibrometer/Reference 2
Vibrometer/Reference 3
Reference 1/Reference 2
Reference 1/Reference 3

When using more than one reference channel, frequencies are respectively formed as a total answer signal/reference signal. This is correct with an excitation signal and several reference signals (e.g. self-excited system, vibrometer and microphone as reference).

☞ When using the measured frequency responses for Experimental Modal Analysis, please note that these can not easily be fed in to a multi-reference procedure in the modal analysis software package. To do this, it is also necessary to determine the transmission function. For these calculations the total answer signal of every individual sample point must be divided up into the individual references (Principal Component Analysis, only with option PCA). This is only possible if the reference signals are uncorrelated (refer also to section 7.2.9). If you are running a principal component analysis, you have to select at least two reference channels. You will find detailed information on this in your theory manual.

Index: Here you enter the index of the scan point at which you are measuring the reference. You can read this index under 2D Point or 3D Point in the scanning head control if you click the scan point with the mouse. Then click the pertinent line in the column Index and enter the displayed value there.

☞ The default setting in the column Index is 0. A reference point index of 0 is however ignored when calculating the reference. In principle the number of scan points is the highest possible value which you can enter in the field Index. However, the software allows you to enter higher values so that you can make several measurements with the same index and then can reunite them in an external program.

Direction: Here you can enter the direction of the vibration. The default setting is +Z. However you can also select another direction (±X/Y/Z) for all channels apart from Vibrometer 3D. With the direction of the vibrometer channel you set the orientation of the scanning head system. Refer to section 4.2.6 and your theory manual on this.

☞ In the presentation window you can also retrospectively change the direction of vibration, refer to section 9.1 on this.

☞ The values from the columns Index and Direction are used when exporting in UFF and ME'Scope. You can change the settings for export again (refer to section 10.2.3 and section 10.2.4).

Range: Here you select the input range of the data acquisition board for every channel.

Coupling: Here you select the input coupling for every channel. For vibrometer channels you have to set DC-coupling, for other sensors DC-coupling is recommended. Only PSV 200-1: For certain hardware configurations, select the input coupling via the cabling of the data acquisition board. See your PSV 200 hardware manual on this.

Impedance: This column is only shown if the Spectrum data acquisition board MI-3025 is installed. In this case you can set the input resistance of the board here (50 Ω or 1 MΩ).

ICP: If you are using one of the junction boxes VIB-Z-012, VIB-Z-016, PSV-E-400 or PSV-E-400-3D and in the list Junction Box on the page Devices you have set it accordingly, you can switch ICP® on and off for the channel REF1 and if applicable, for REF2 and REF3.

☞ If you are using such a junction box and have activated ICP®, then you should select AC coupling. Pay attention to the cutoff frequency when doing so (refer to hardware manual).

Quantity: Here you select the physical quantity which you want to measure on the respective channel.

☞ Using a digital filter, the software can integrate or differentiate the time signal of some measured quantities. See section 7.2.3 on this.
If the quantity Displacement, Velocity or Acceleration is selected, then the spectra of both the others are calculated by integration or differentiation. This also applies to the quantities Angle, Angular Velocity and Angular Acceleration.

Factor: Here you enter the calibration factor for every channel, i.e. the measurement value which corresponds to an analog input signal of one volt. If a vibrometer is connected up (refer to section 3.2), the software will enter the calibration factor for this channel corresponding to the measurement range set on the page Vibrometer (refer to section 7.2.8).

Unit: Here, the software enters the SI unit of the set quantity.

Differential Input: If you are using one of the junction boxes VIB-Z-012, VIB-Z-016, PSV-E-400 or PSV-E-400-3D, then here you can activate the differential input for all selected channels. You can thus avoid ground loops and generally improve reliability. All activated channels are switched to ungrounded by the differential input so that distortions through harmonics of the mains frequency (humming) can no longer appear in the spectrum.

7.2.3 Filters

On the page Filters you set digital filters for the input signals

- to limit the bandwidth

and

- for differentiation or integration.

The page Filters is divided into two parts. In the first part you select the filter type to limit the bandwidth – high pass, low pass etc. – and select the integration or differentiation filter. In the second part you set the filter parameters to limit the bandwidth, i.e. cutoff frequency and quality. You can also see the frequency response there.

Work in the table

To accelerate adjustment of the settings, you can use the icons (Copy) and (Insert) above the table. Tick the required cell(s), line(s) or column(s) as described in the following. Then click , mark the cell(s), line(s) or column(s) which you want to transfer the settings to and click .

Or:

Click with the right mouse button and select Copy or Insert in the pop-up menu.

- To mark a cell, click it.
- To mark a line, click the first cell of this line.
- To mark a column, click the head of the column.
- To mark several consecutive cells, lines or columns, hold the shift key pressed and mark the first and last cell/start of line/column head with the mouse.
- To mark several cells, lines or columns which are not consecutive, hold the control key pressed and mark the respective cells/starts of line/column heads with the mouse.
- If you want to mark the whole table, click the cell Channel.

In the same way you can copy settings to and from Microsoft® Excel.

Select

In the first part of the page Filters you select the filter types you want for each channel.

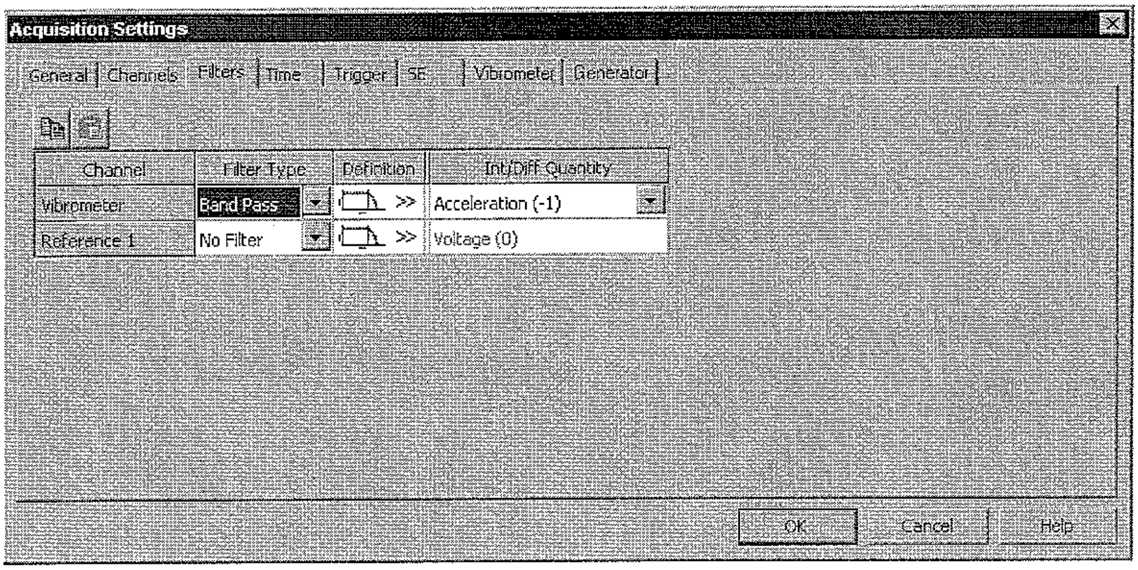


Figure 7.3: Page Filters

Filter Type: Here you select the type of filter to limit the bandwidth.

Definition: You click here to set the filter parameters to limit the bandwidth. The second part of the page Filters appears (see below).

Int/Diff Quantity: Using digital filters, the software can integrate or differentiate the time signal of some measured quantities. Here you select the physical quantity the software is to calculate. The number on the right next to the quantity tells you which arithmetic operation is being carried out, refer to table 7.1.

Table 7.1: Filters for integration/differentiation

Number	Arithmetic operation
1	Integrate once
0	No filter
-1	Differentiate once
-2	Differentiate twice

Set the parameters

In the second part of the page Filters you set the filter parameters to limit the bandwidth. There you can define the filters for several channels one after the other.

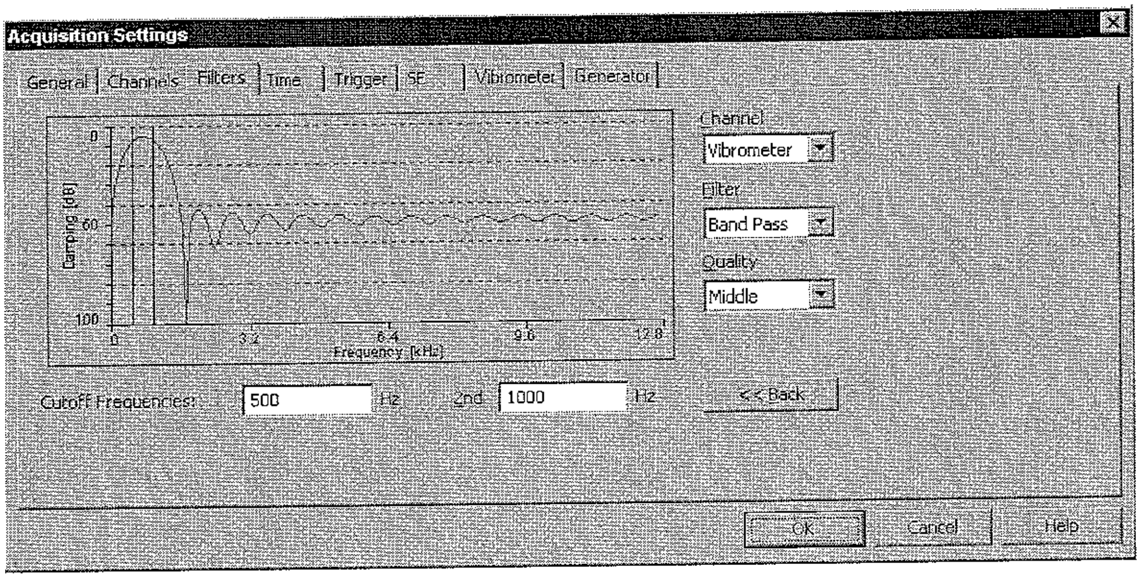


Figure 7.4: Page Filters, part 2 to set the parameters

Channel: Here you select the channel you want to set the filter for.

Filter: Select the type of filter here.

Quality: Here you select the quality of the filter.

Cutoff Frequencies: Enter the cutoff frequency(/ies) of the filter here in Hertz.

The software uses the parameters set to calculate the frequency response and displays it.

To apply all settings, at the bottom right, click Back. The software returns to the first part of the page Filters (see above).

7.2.4 Frequency

You set the parameters for calculating the frequency spectra on the pages Frequency and Window. In the measurement mode Zoom-FFT, the page Frequency is adapted to the Zoom-FFT. See section 7.2.10 on this. In measurement mode MultiFrame, additional parameters appear on the page for the MultiFrame measurement. See section 7.2.14 on this.

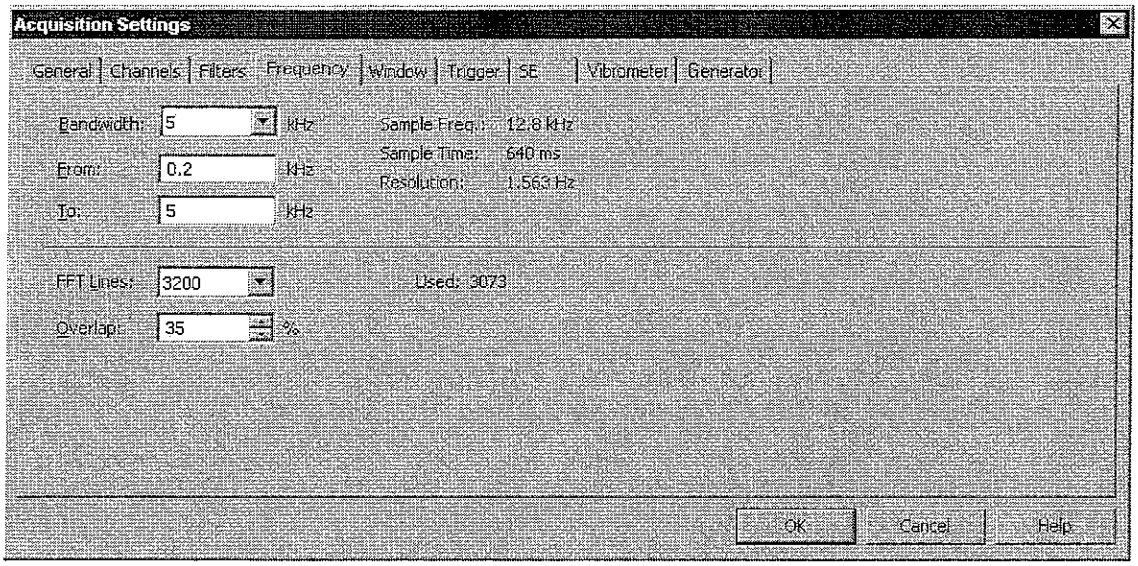


Figure 7.5: Page Frequency in the measurement mode FFT

Frequency range

At the top left you set the frequency range to be measured.

Bandwidth: Here you select the bandwidth in kilohertz.

From and **To:** Here you can limit the frequency range which is displayed and evaluated. If you control a function generator using the software, then with Periodic Chirp and Pseudo Random, excitation only takes place in this frequency range.

FFT

At the bottom you set the parameters for the Fast Fourier Transformation (FFT).

FFT Lines: Here you select the number of FFT lines that you want to analyze.

Used: The number of FFT lines shown here corresponds to the frequency range between From and To (see above).

Overlap: This parameter only appears for certain hardware configurations in the measurement modes FFT and Zoom-FFT. The software only takes the parameter into account for measurements with averaging and without trigger. With overlap you can significantly reduce the time for a measurement, in particular for narrow bandwidths. As a rule of thumb, for a two-channel measurement, the following applies:

- up to 2.5 kHz bandwidth: 75% overlap
- from 2.5 to 5 kHz: 50%
- over 5 kHz: 0%.

You will find more information on overlap in your theory manual.

Sample frequency and resolution

The software calculates the following parameters and shows them at the top right.

Sample Frequency: $$f_{Sample} = 2.56 \cdot BW \qquad \text{Equation 7.1}$$

BW... Bandwidth

Sample Time: $$t_{Sample} = \frac{n_{FFT}}{BW} \qquad \text{Equation 7.2}$$

n_{FFT}... Number of FFT lines
BW... Bandwidth

Resolution: $$\Delta f = \frac{1}{t_{Sample}} \qquad \text{Equation 7.3}$$

t_{Sample}... Sample time

Max. Velocity: This parameter only appears with the option VDD. Due to the processing power of the PC, when using the option VDD only signals up to this maximum vibrational velocity can be acquired. The value depends on the bandwidth and the number of FFT lines (see above).

7.2.5 Window

You set the parameters for calculating the frequency spectra on the pages Frequency and Window. You set windowing of the input signals on the page Window. With suitable windowing you can prevent leakage. You will find information on this in your theory manual.

Work in the table

To accelerate adjustment of the settings, you can use the icons (Copy) and (Insert) above the table. Tick the required cell(s), line(s) or column(s) as described in the following. Then click , mark the cell(s), line(s) or column(s) which you want to transfer the settings to and click .

Or:

Click the analyzer with the right mouse button and select Copy or Insert in the pop-up menu.

- To mark a cell, click it.
- To mark a line, click the first cell of this line.
- To mark a column, click the head of the column.
- To mark several consecutive cells, lines or columns, hold the shift key pressed and mark the first and last cell/start of line/column head with the mouse.
- To mark several cells, lines or columns which are not consecutive, hold the control key pressed and mark the respective cells/starts of line/column heads with the mouse.
- If you want to mark the whole table, click the cell Channel.

In the same way you can copy settings to and from Microsoft® Excel.

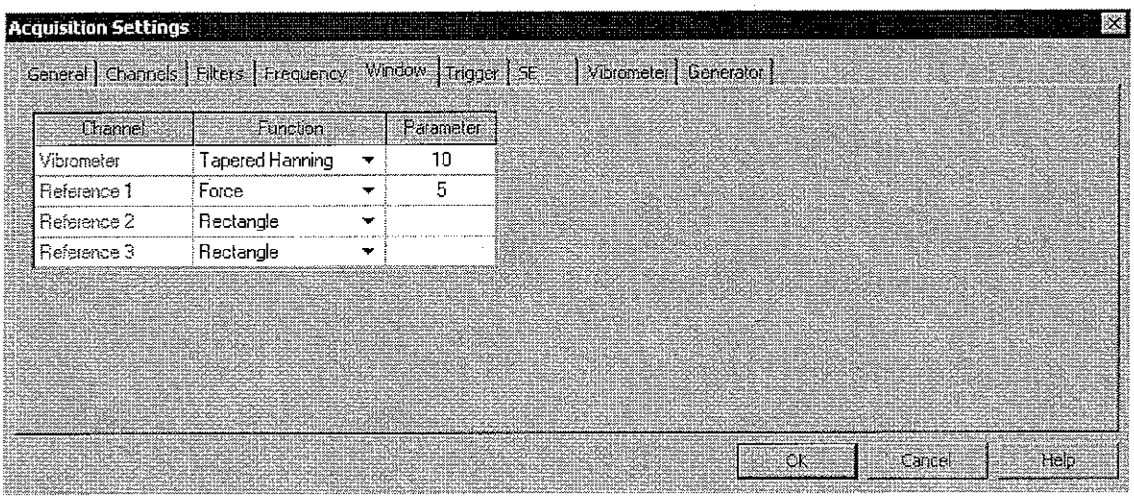


Figure 7.6: Page Windows

Function: Here you select a window function which is suitable for your application. See your theory manual on this.

Parameter: The window functions Tapered Hanning, Force and Exponential can be fine-tuned with a parameter. In table 7.2, the parameters are described.

Table 7.2: Parameters for window functions

Window function	Description of the parameter	Default
Tapered Hanning	Rise and decay time in percent of the sample time	10
Force	Length of the window in percent of the sample time	5
Exponential	Quotient from window length and decay constant	4

7.2.6 Trigger

You set the parameters for triggering on the page Trigger. You will find information on the influence of the trigger in your theory manual.

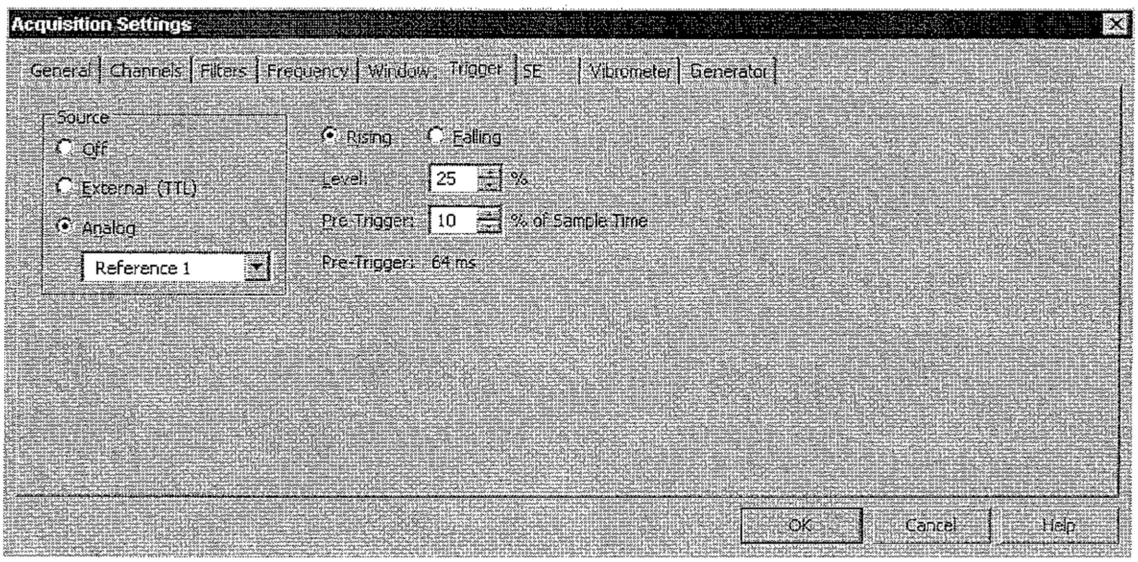


Figure 7.7: Page Trigger

Source On the left you select the trigger source.

Off: You measure without a trigger.

☞ To measure phases you need a trigger or a reference signal.

External (TTL): You trigger using an external trigger signal.

> **Caution!**
>
> Only connect voltages in the range of 0 to 5V to the input for the external trigger! Otherwise you could damage the data acquisition board.

Analog: You trigger using one of the analog input signals. Select the channel the trigger signal is connected to below.

☞ When scanning, do not trigger on the vibrometer signal.

Conditions

On the right you set the trigger conditions.

Rising or **Falling:** Here you select which edge is used to trigger.

Level: If you trigger using one of the analog input signals, you set the trigger threshold here. 100% threshold corresponds to the input range of the channel (refer to section 7.2.2).

Pre-trigger: Here you set the trigger time. If the data acquisition is to start **before** the trigger time, enter a positive value. If data acquisition is to start **after** the trigger time (Post-trigger), enter a negative value. Only PSV 400-M2, PSV 400-M4 and PSV 300-F: You can not set a pre-trigger for an external trigger signal. Only MSV 300-M: with bandwidths $\leq 2\,\text{MHz}$ you can not set a pre-trigger for an external trigger signal.

Gate signal (as an option)

As an option, you can control data acquisition with an external gate signal. You will find information on this in your hardware manual. You do not have to set special parameters for this.

7.2.7 Signal Enhancement (SE)

On the page SE you set the parameters for Signal Enhancement (SE) and Speckle Tracking. When scanning, with Signal Enhancement and Speckle Tracking, you get an approximately even noise level for all scan points. You will find information on measuring with Signal Enhancement in section 6.7.1 and in your theory manual.

☞ If you want to mark the whole table, click the cell Channel.

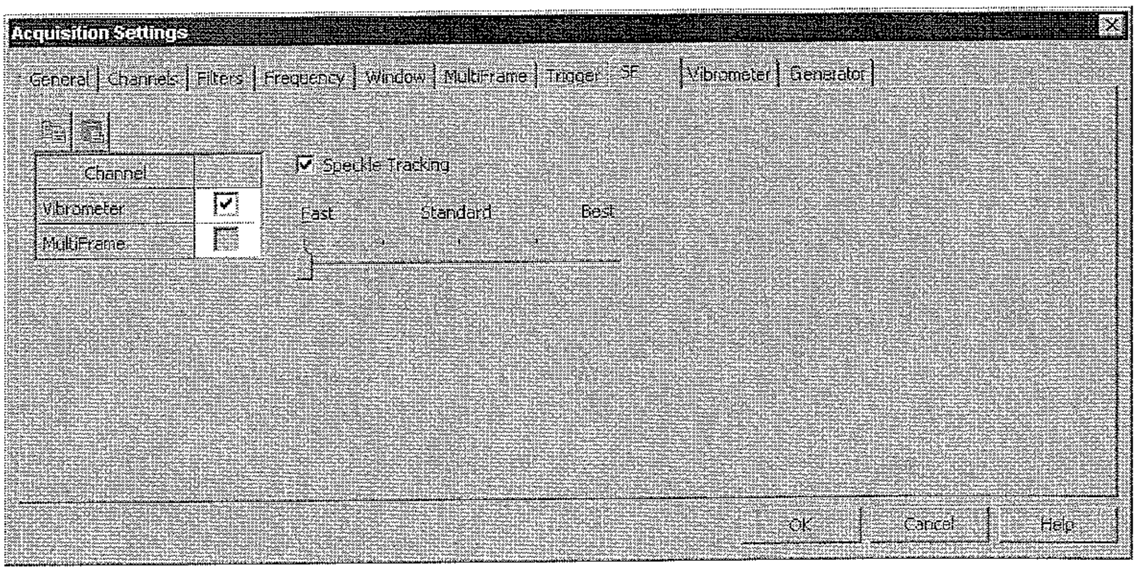


Figure 7.8: Page SE

The measurement mode Time is an exception. The dialog page SE only appears if on the page General you have set Time for Averaging.

Activate

On the left you can activate Signal Enhancement.

Measurement mode Time: With active SE, a median algorithm is used for averaging. This makes higher demands on your PC with regards to memory and calculation speed.

Channel: Here you mark the channels which Signal Enhancement is to be active for.

☞ Activate Signal Enhancement for all channels which may have dropouts. This is generally the case for the vibrometer channel. For reference channels, the following applies: If a vibrometer is connected, measure on treated surfaces if possible and switch Signal Enhancement off. To treat surfaces, stick reflective film on them or apply metallic paint. If you are measuring with the vibrometer, but not on treated surfaces, activate Signal Enhancement.

Speckle Tracking: If Signal Enhancement is active for the vibrometer channel, then you can activate Speckle Tracking for this channel on the right. Without Speckle Tracking, every scan point is measured at the same position when averaging. So it is possible that you will always measure a dark speckle. With Speckle Tracking, the position of every scan point is slightly changed on averaging - at a 1 meter stand-off distance by about 50 μm. You are then also quite likely to measure some bright speckles.

Averaging

At the right you set how often additional averaging is carried out with Signal Enhancement.

Fast: Averaging is only carried out as often as set on the page General (refer to section 7.2.1).

Standard: Depending on the optical signal level, averaging is carried out up to three times as often as set.

Best: Averaging is carried out up to five times as often as set.

In the measurement mode Time, the number of times averaging is carried out always correspond to the figure given on the page General.

7.2.8 Vibrometer

You set the parameters of the controller for data acquisition on the page Vibrometer. You will find information on suitable settings in your hardware manual. If you are controlling a second vibrometer, then you set the parameters for both controllers on the page Vibrometer. You will find information on controlling a second vibrometer in section 6.7.6.

The parameters displayed on the page Vibrometer depend on which controllers are connected (refer to section 3.2). The parameters for the controllers OFV-5000 and also OFV-3001 and OFV-3001S are described below. If you would like any information on other controllers, refer to your vibrometer manual. There you will also find information on suitable settings.

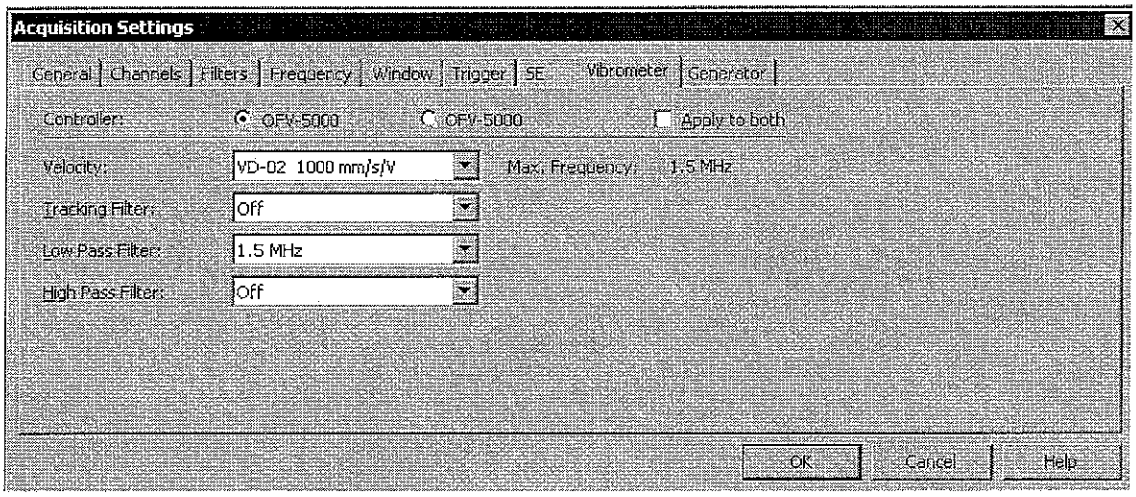


Figure 7.9: Page Vibrometer for the controller OFV-5000S

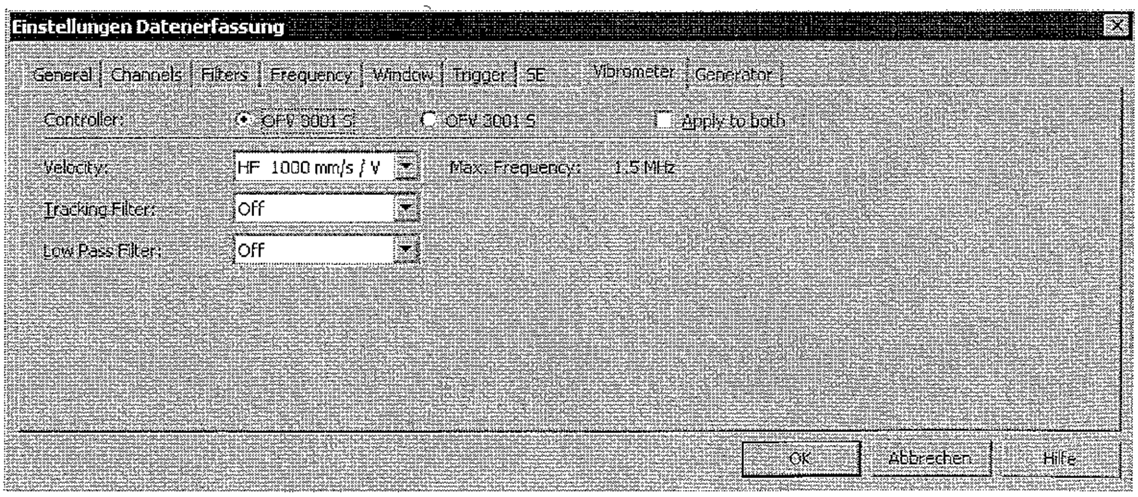


Figure 7.10: Page Vibrometer for the controller OFV-3001S

Controller: Here you can select the controller which the settings are to apply to. If there are two controllers installed, you can switch between the two of them and define the settings for each of them individually.

☞ Only OFV-5000 as of firmware version 2.0:
The software queries the time delay of the measurement range set on the vibrometer controller. The time delay is used to correct the phase of the spectra. The high and low pass filter should be left switched off as their delay times are not being corrected.
The correction can only be made approximately. The remaining phase error in the acoustic area is up to 3° and increases for frequencies above 20kHz with increasing frequency up to 35°.
In the time domain this correction is not active!

Apply to both: If both controllers are identical, i.e. the same type and equipped with identical decoders, then the settings for one can be transferred directly to the other. To do so, mark the box.

Velocity: Here you select the measurement range for the velocity. For the controller OFV-5000, the decoder descriptions are shown in plain text. OFV-3001 and OFV-3001S: If a measurement range is available in several velocity decoders, then to the left of the measurement range you can see an abbreviation for the active velocity decoder. The abbreviations are explained in table 7.3.

Table 7.3: Abbreviations for velocity decoders

Abbreviation	Velocity decoder
HF	OVD-02 OVD-04
LF	OVD-06
DC	PLL-DC
PLL	OVD-01

Displacement: This line only appears if the controller is equipped with an optional displacement decoder. Here you select the measurement range for the displacement.

☞ Even if you are only measuring and evaluating the displacement signal, the measurement range for the velocity must not be exceeded (see above).

Tracking Filter: Here you set the tracking filter.

Low Pass Filter: Here you set the low pass filter. Only PSV 300-H and PSV 200-1: If you select the setting User Defined, then the field Cutoff Frequency appears at the bottom. There you can enter multiples of 0.4 kHz, up to a maximum of 102.4 kHz.

High Pass Filter: Here you set the high pass filter.

☞ If you are using the vibrometer to scan, switch the high pass filter off.

Max. Frequency: Here the respective maximum frequency is shown for the selected measurement range.

7.2.9 Generator (as an Option)

As an option, you can control certain function generators using the software. You will find information on this in section 6.7.2 and section 6.7.3. You set the parameters for signal output on the page Generator.

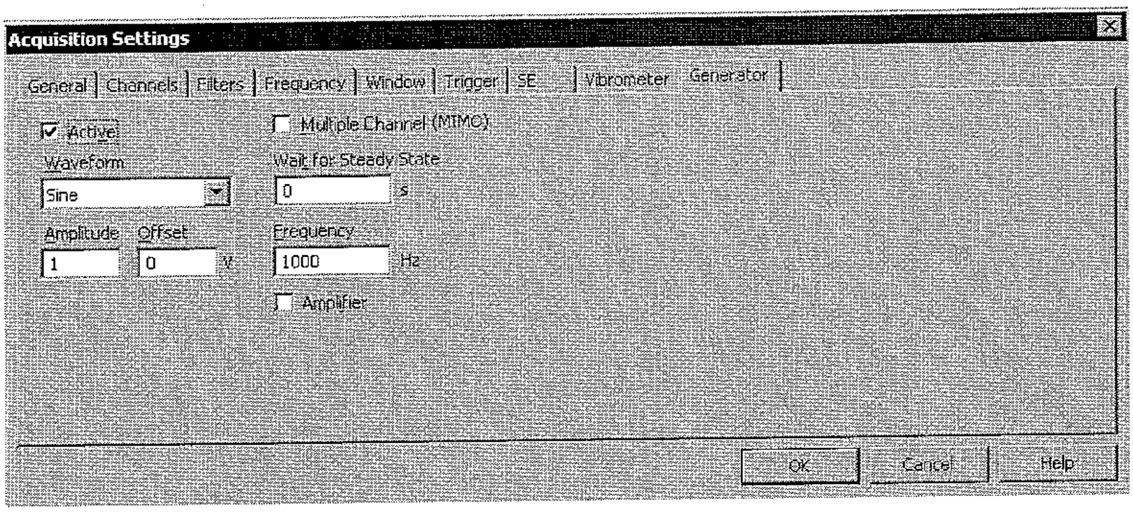


Figure 7.11: Page Generator

General parameters

Active: If sometimes you are not working with the function generator, you can switch it off here for the software. Otherwise signal output starts automatically when scanning. Apart from that, you will suppress corresponding warnings and error messages.

Multiple Channel: Only PSV 400-H4 and PSV300-H: Activate three generator channels here. For signals with randomly generated numbers (Pseudo Random, White Noise, Burst Random), different signals are generated using various random number sequences, otherwise identical signals on all three channels. You will find more information on this in section 7.2.2.

☞ If you want to carry out a principal component analysis, you have to mark the box Multichannel (MIMO) (only with option PCA, refer also to section 7.2.1) and select White Noise or Burst Random. Uncorrelated signals are only emitted with these waveforms.

Waveform: Here you select the waveform you want to emit. Some parameters on the page Generator change with the waveform selected. You will find an explanation of these parameters and information on some of the waveforms in the following. In the measurement mode FastScan, a sinusoidal signal with the frequency of the FastScan is always used for excitation.

Wait for Steady State: Here you enter the time in seconds which the excited object needs to attain steady-state condition. The software delays data acquisition by this time after you have

- started signal output or
- closed the dialog Acquisition Settings with OK.

Amplitude and **Offset:** Here you enter the peak amplitude and DC offset of the signal in volts for high-impedance termination of the function generator. The following conditions must be fulfilled:

$$\text{Amplitude} + |\text{Offset}| \leq 10\,\text{V} \qquad \text{Equation 7.4}$$

Only 33120A and 33250A:

$$|\text{Offset}| \leq \text{Amplitude} \qquad \text{Equation 7.5}$$

If one of the conditions is not fulfilled, the software changes the offset.

☞ Many function generators such as the HP or the internal function generator have an output impedance of 50 Ω. If you terminate such a function generator with 50 Ω, then the output voltages are only half the size set.
This is of particular importance for spectrum generators which have an output impedance of < 1 Ω. The data acquisition board of Spectrum is preset to be terminated with 50 Ω (default setting). To change the setting to 1 MΩ, open the page Channels in the dialog Acquisition Settings (refer to section 7.1).
Only for external function generators: The display of the generator shows peak-to-peak amplitude and offset for the termination with 50 Ω. With high-impedance termination the display shows twice the voltage applied at the output.

Amplifier: This box only appears for PSV/MSV/MSA/MMA-M2-20 systems with the generator board MI.6030 by Spectrum. Mark the box to increase the voltage of the generator output from ±3V to ±10V.

Sine, Rectangle, Triangle, Ramp, User Defined

Frequency: For the waveforms Sine, Rectangle, Triangle, Ramp and User Defined, you enter the repeat frequency of the signal in hertz here.

Sweep

Start Frequency, End Frequency and **Sweep Time:** For a Sweep, you enter the start and end frequency in hertz here. The start frequency can be higher than the end frequency. You also enter the duration of the sweep in seconds.

Periodic Chirp, Pseudo Random

For the waveforms Periodic Chirp and Pseudo Random, sinusoidal signals are emitted to all FFT lines at the same time, but only in the frequency range between From and To on the page Frequency (refer to section 7.2.4).
Only 33250A: The waveforms are not available in the measurement mode Zoom-FFT.
Only 33120A: The waveforms are not available in the measurement mode Zoom-FFT or if 12800 FFT lines are set.

With Periodic Chirp, the phases of the sinusoidal signals are adapted so that the energy of the resulting signal is maximized. With Pseudo Random, the phase of the sinusoidal signals is random.

Amplitude Correction File: As standard, with Periodic Chirp and Pseudo Random all sinusoidal signals have the same amplitude. If you need other amplitudes or frequencies, you can generate a correction file and list it here. To do this, tick the box and then click Browse. The dialog Open appears, in which you can navigate to correction files. You will find a short description of the format required in the file AmplitudeCorrectionSample.txt in the software's installation directory. You can also use this file as a template for your own correction files.

Burst Chirp, Burst Random

The waveforms Burst Chirp and Burst Random are only available for certain hardware configurations. The number of samples for Burst Random is limited to 524288 (1/2 Megasample).

Burst Start and **Burst End:** Here you enter when the burst is to start and when it is to end (input in percent of the sample time).

User Defined

If you need other waveforms, you can generate them yourself. You will find a short description of the format required in the file UserDefSample.txt in the software's installation directory. You can also use this file as a template for waveforms you want to generate. To load a waveform you have generated, select the waveform User Defined and then click Browse. The dialog Open appears, in which you can navigate to files you have generated.

7.2.10 Frequency in the Measurement Mode Zoom-FFT (as an Option)

In the measurement mode Zoom-FFT you can also make high-resolution FFT measurements. To do this, you need the option Zoom-FFT. The page Frequency is then adapted to the Zoom-FFT.

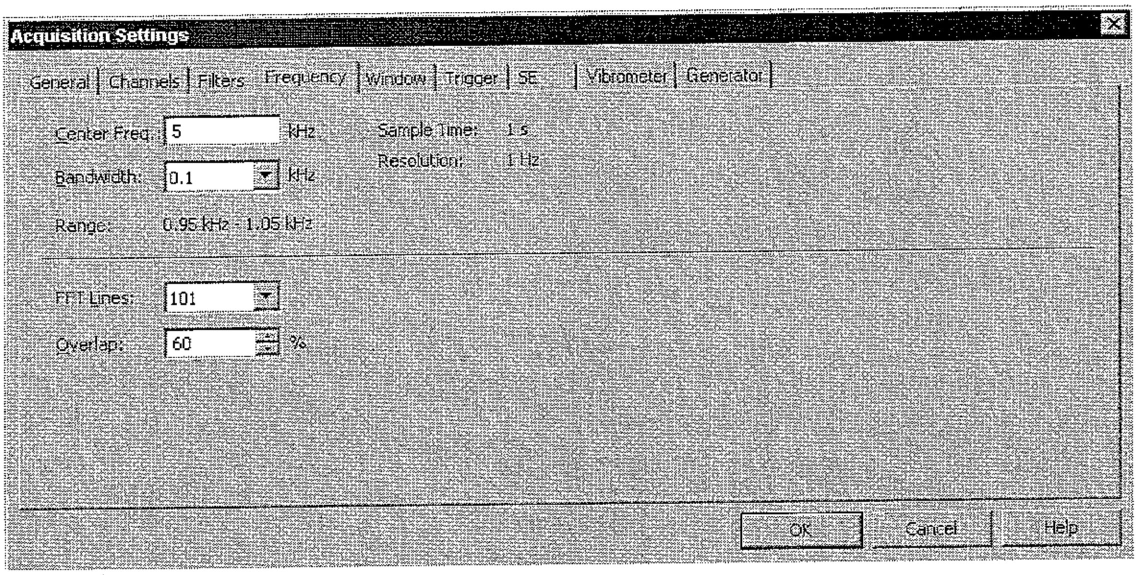


Figure 7.12: Page Frequency in the measurement mode Zoom-FFT

Frequency range

At the top left you set the frequency range to be measured.

Center Freq. Here you enter the center frequency in kilohertz.

Bandwidth: Here you select the bandwidth in kilohertz.

☞ For PSV/MSV/MSA/MMA 400-M2-20 and MSV 300-M bandwidths are only available up to 2MHz.

Range: The software calculates the frequency range to be measured and shows it here.

FFT

At the bottom you set the parameters for the Fast Fourier Transformation (FFT).

FFT Lines: Here you select the number of FFT lines that you want to analyze. The number is odd because the frequency range measured is symmetrical about the center frequency.

Overlap: This parameter only appears for certain hardware configurations. You will find information on this in section 7.2.4 and in your theory manual.

Resolution

The software calculates the following parameters and shows them at the top right.

Sample Time:

$$t_{Sample} = \frac{n_{FFT} - 1}{BW} \qquad \text{Equation 7.6}$$

n_{FFT}... Number of FFT lines
BW... Bandwidth

Resolution: $$\Delta f = \frac{1}{t_{Sample}}$$ Equation 7.7

t_{Sample} ... Sample time

☞ The highest attainable resolution depends on the frequency range measured (see above).

Max. Velocity: This parameter only appears with the option VDD. Due to the processing power of the PC, when using the option VDD only signals up to this maximum vibrational velocity can be acquired. The value depends on the bandwidth and the number of FFT lines (see above).

7.2.11 FastScan (as an Option)

In the measurement mode FastScan you can scan individual frequencies quickly. You will find information on this in section 6.7.4. You set the parameters for this on the page FastScan.

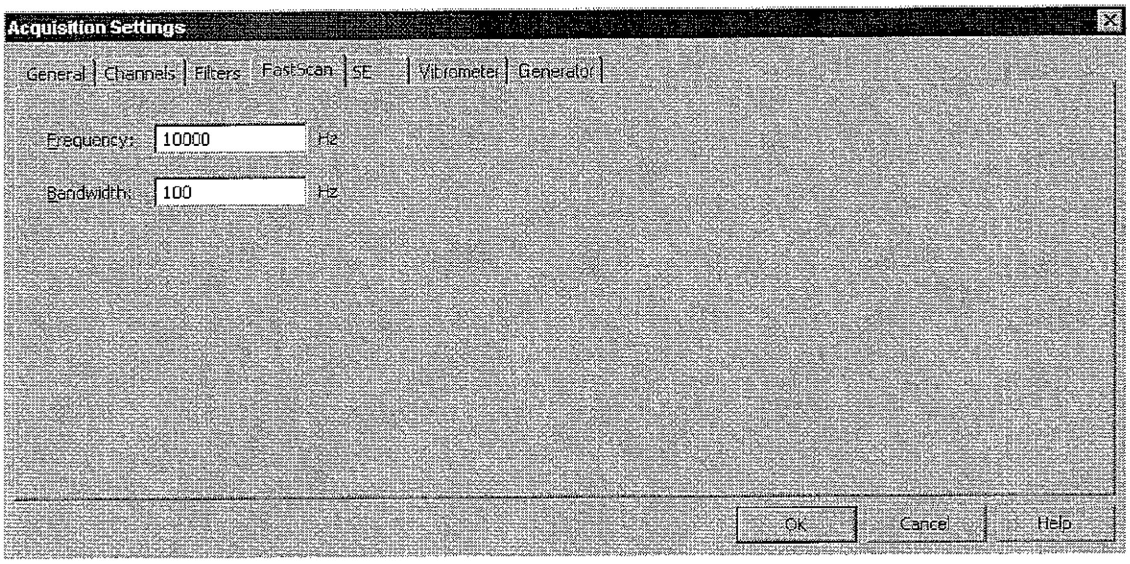


Figure 7.13: Page FastScan

Frequency: Here you enter the frequency in hertz at which you want to fast scan.

☞ If you control a function generator using the software, then in the measurement mode FastScan, a sinusoidal signal at the FastScan frequency is always used for excitation.

Bandwidth: Here you enter the bandwidth in hertz. As a general rule it can be said: The smaller the bandwidth, the better the signal-to-noise ratio, but the slower the scan.

Max. Velocity: This parameter only appears with the option VDD. Due to the processing power of the PC, when using the option VDD only signals up to this maximum vibrational velocity can be acquired. The value depends on the bandwidth and the number of FFT lines (see above).

7.2.12 Time (as an Option)

In the measurement mode Time you can save time signals instead of spectra for scans. To do this, you need the option Time Domain Data. You can select up to 64 Megasamples (67108864 samples). However, please note that the amount of memory required increases with the number of samples. The minimum amount of memory a measurement requires can be approximated using the following formula:

$$\text{File size in bytes} > \text{Active channels} \cdot \text{Number of samples} \cdot 4$$

Depending on the number of samples and the hardware configuration, there are limitations on the generator signals Burst Chirp, Burst Random and White Noise. In this case the software will give you corresponding messages. Either reduce the number of samples or select a different excitation signal (see also section 7.2.9 on this).

For PSV/MSV/MSA/MMA 400 M2-20, the maximum number of samples from a sample frequency of 10.24MHz upwards is limited by the memory on the data acquisition board. The higher the sample frequency you select, the more samples are possible.

If you are working in Windows® 2000, the software will try to use the main memory during data acquisition to buffer the acquired data.

☞ Windows® NT does not support this intermediate storage. If you are working in Windows® NT, you should not use data acquisition with a high number of samples.

While the contents of the buffer are being transferred to the hard disk, so-called buffer overruns can occur which lead to the data acquisition being aborted. All data which had been acquired before this point in time however will be saved. So make sure that your PC has got a large enough main memory (RAM). In an ideal case this is 64MB more than the file size calculated above. If the size of the RAM used should not be sufficient, the software will issue you with a warning. If possible, close all other applications during data acquisition.

Data acquisition in the measurement mode Time generates extremely large files with numerous samples. Once the file size has reached 2GB, the software will give you a warning. Files which are larger than 2GB can only be processed by operating systems from Windows® 2000 onwards.

☞ With Windows® 98 or NT you can not process or open files of this size!

You set the parameters for the measurement mode Time on the page Time.

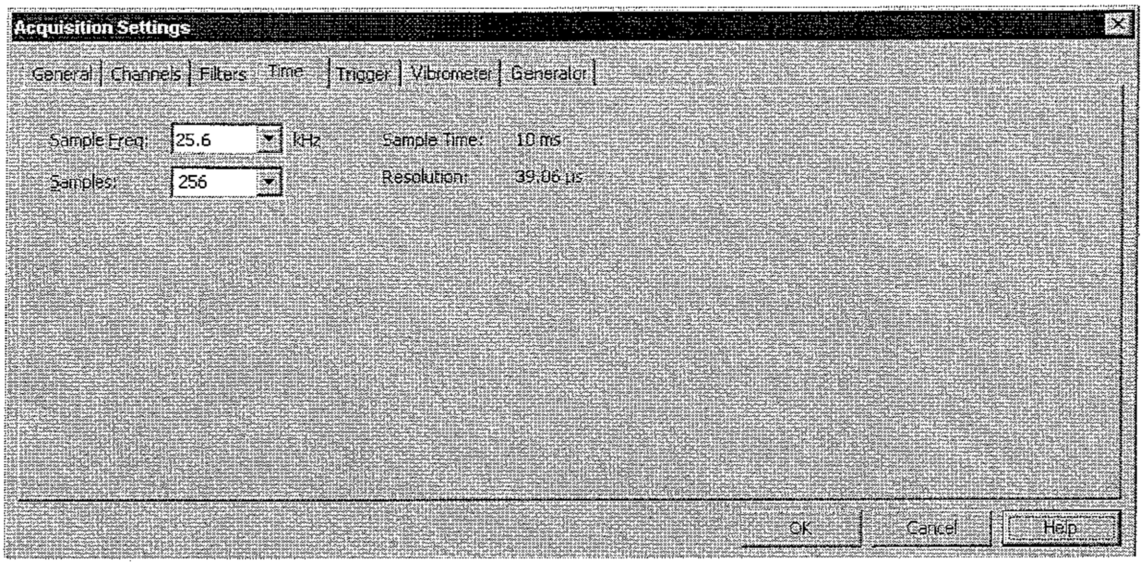


Figure 7.14: Page Time

Sample Freq. Here you select the sample frequency in kilohertz.

Samples: Here you select the number of samples. You can select in the list or enter any number.

The software calculates the following parameters and shows them on the right.

Sample Time:

$$t_{Sample} = \frac{n_{Sample}}{f_{Sample}} \qquad \text{Equation 7.8}$$

n_{Sample} ... Number of samples
f_{Sample} ... Sample frequency

Resolution:

$$\Delta t = \frac{1}{f_{Sample}} \qquad \text{Equation 7.9}$$

f_{Sample} ... Sample frequency

Max. Velocity: This parameter only appears with the option VDD. Due to the processing power of the PC, when using the option VDD only signals up to this maximum vibrational velocity can be acquired. The value depends on the sample frequency and the number of samples (see above).

7.2.13 MultiFrame (as an Option)

In the measurement mode MultiFrame you can divide measurements on combustion engines into frames and analyze the frames individually. You will find information on this in section 6.7.5. You set the parameters for this on the pages MultiFrame and Frequency.

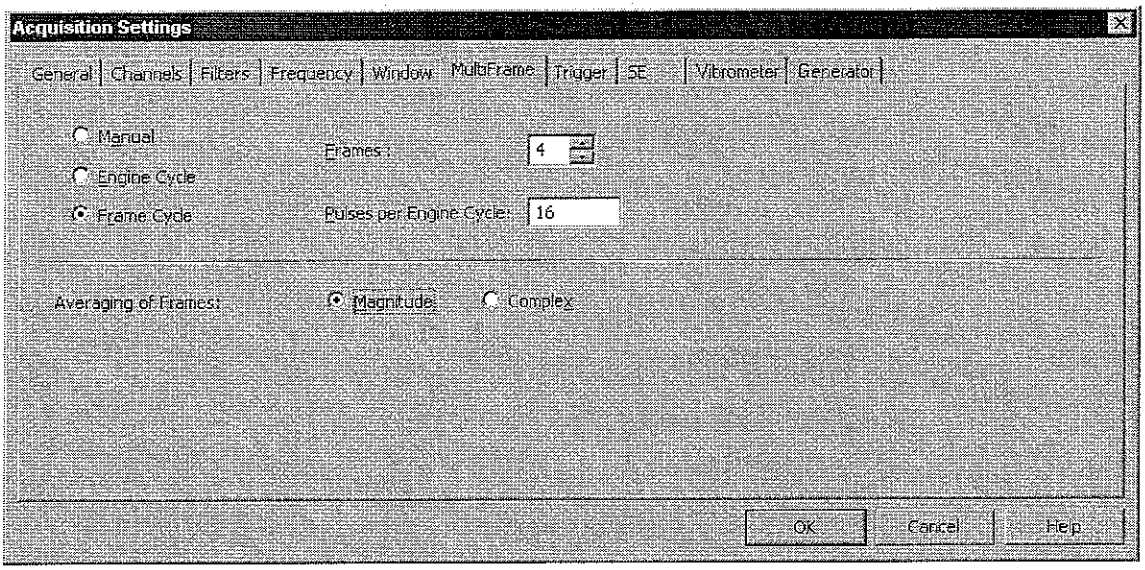


Figure 7.15: Page MultiFrame

Frame boundaries

At the top left you set how you determine the frame boundaries.

Manual: If you want to set the frame boundaries manually in the analyzer, select Manual. The start of the engine cycle is determined by a trigger signal at TRIG IN.

Engine Cycle: If the frame boundaries are to be set automatically by the engine cycle, select Engine Cycle. Start and end of the engine cycle are determined by a trigger signal (TTL, rising edge) at MultiFrame. All frames are the same length.

Frame Cycle: If the frame boundaries are to be set automatically by the frame cycle, select Frame Cycle. The start of the engine cycle is determined by a trigger signal (TTL, rising edge) at TRIG IN. A second trigger signal (TTL, rising edge) at MultiFrame ends the frame.

Number of frames

At the top right set the number of frames and the pulses per cycle.

Frames: Here you enter how many frames an engine cycle has.

Pulses per Engine Cycle: Here you enter how many trigger pulses are emitted per engine cycle. If Frame Cycle (see above), the number of pulses per cycle must be an integer multiple of the number of frames.

Averaging frames

You can analyze the spectra of the individual frames and the average of all frames. At the bottom you set how the software averages.

Magnitude or **Complex:** Here you select how the software averages over the frames. Averaging over the frames is independent of the averaging on the page General (refer to section 7.2.1).

7.2.14 Frequency in the Measurement Mode MultiFrame (as an Option)

In the measurement mode MultiFrame you can divide measurements on combustion engines into frames and analyze the frames individually. You will find information on this in section 6.7.5 and section 7.2.13. On the page Frequency additional parameters then appear for MultiFrame measurements.

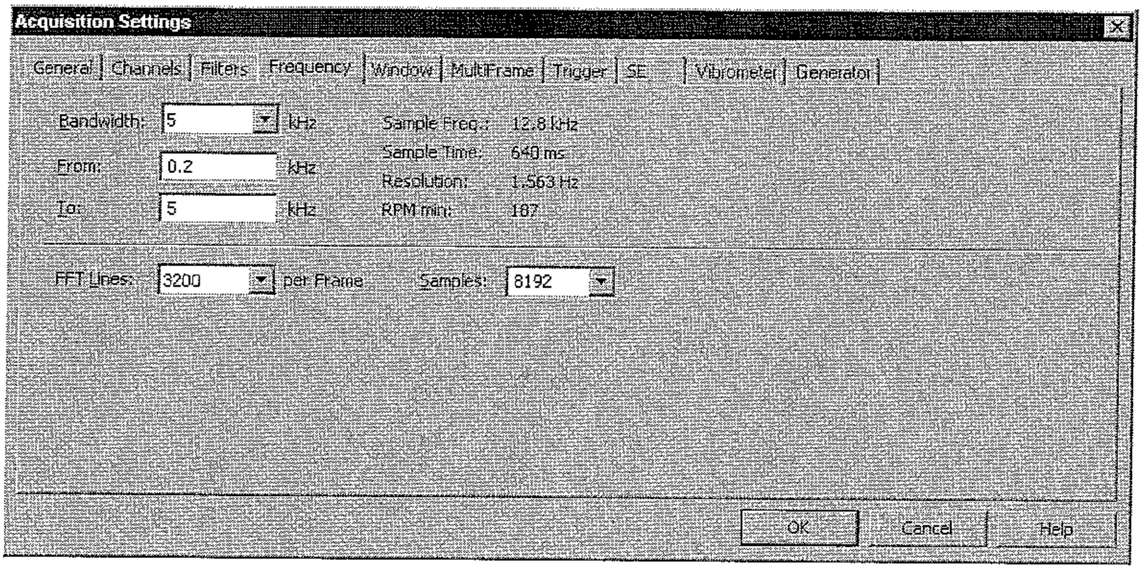


Figure 7.16: Page Frequency in the measurement mode MultiFrame

At the bottom right, set the number of samples.

Samples: Here you select the number of samples.

The software calculates the sample time and the lower RPM limit RPM_{min} which it can acquire with the parameters set and shows them on the right.

Sample Time: $$t_{Sample} = \frac{n_{Sample}}{2.56 \cdot BW} \qquad \text{Equation 7.10}$$

n_{Sample}... Number of samples
BW... Bandwidth

RPM min: $$RPM_{min} = \frac{120}{t_{Sample}} \qquad \text{Equation 7.11}$$

t_{Sample}... Sample time

You will find information on the other parameters on the page Frequency in section 7.2.4.

8 Displaying Data

In the software you work with the following windows to display data:

- in acquisition mode: a **video window**, any number of **analyzers**
- in presentation mode: any number of **presentation windows**, **analyzers** and **signal processors**.

In the video window you can follow the progress of a scan. Read section 8.1 on this.

You can work in analyzers as described in section 8.2.

To evaluate the scan, open a presentation window and then set up the window and the view of the measurement object. See section 8.3 on this.

You select the data set to be displayed in the analyzer as described in section 8.4.

If you are using PSV-3D, you can group several individual measurement files to a combined file (stitching). See section 8.5 on this.

Afterwards you can use your measurement data as the basis for further calculations. See section 8.6 on this.

8.1 Following Scans in the Video Window

In the video window you follow the progress of scans. While scanning, you can see what status the scan points get. You will find a description of the video window in section 2.7.2.

Show and hide scan points

To show and hide the scan points in the video window, click or select View > Scan Points. To the left of the live video image you can see a legend for the status. There are different views here to select from:

- Scan
- Geometry
- Laser Focus

To change the views, click .

Scan Status

Before a scan, all scan points have got the status Not Measured.

If you do not want to scan individual scan points, you can assign them the status Disabled. See section 5.6.2 on this.

If you define the scan points, then scan points which are outside the scan area of at least one scanning head are given the status Not reachable.

When scanning, the software gives every scan point the status Valid, Optimal or Overrange.

The status Optimal can only occur if Signal Enhancement is active for at least one channel (refer to section 7.2.7). At these scan points, the signal-to-noise ratio is relatively high.

At scan points with the status Overrange the input range of the data acquisition board was exceeded on at least one channel.

If Signal Enhancement is active, scan points can change their status between Valid and Optimal.

After the scan, you can manually give the scan points the status Invalid. You will find details on this in section 9.1.

If parts of the object cover scan points in such a way that they can not be reached by at least one laser beam, they are marked as being Hidden.

Geometry Status

If there are no 3D coordinates available, the scan points are given the status No 3D coord.. If you are working with a 3D geometry or the distance sensor, you can see whether scan points were measured with the geometry scan unit (status Measured) or were calculated with the aid of triangulation of the three laser beams (status Triangulation, only PSV-3D).

Other possibilities are Imported (from Universal File or ME'Scope files with the aid of the optional geometry import, refer to section 5.4), Interpolated (3D coordinates not calculated or incorrectly calculated have been interpolated from the neighboring scan points) and Modified (the coordinates of the scan points were retrospectively changed).

If the distance measurement has failed, the affected scan points are given the status Failed. In all cases this means that these scan points do not have any valid 3D coordinates. If the signal strength of the geometry scan unit being too high or too low is the reason for the measurement failing, then you will see this from the status Too much light or respectively Too little light.

Laser Focus Status

If no focus value has been assigned, the scan points are given the status No laser focus. If you have assigned a focus value (refer to section 4.5.1 and section 4.5.2), you will see here whether you assigned the focus value manually (Assigned man.), quickly (Assigned fast) or optimally (Assigned best).

If the software has interpolated the focus value of individual scan points from those of the neighboring points, these are given the status Interpolated. Scan points for which no focus value could be determined using the method Assign Focus Best are labeled as Failed.

8.2 Working in Analyzers

Analyzers show measurement data and evaluated data in x-y diagrams. You will find a description of the analyzer in section 2.7.3.

You select the data set to be displayed in the analyzer as described in section 8.4.

Analyzers offer user-friendly functions to present data quickly and usefully. In analyzers, you can zoom, set cursors, read data and autoscale the y-axis directly. You will find more functions in the dialog Analyzer Properties. There you can set the line style and color of the graphs, scale and set up the look of the diagrams. To do so, click the corresponding icon in the toolbar of the analyzer. Alternatively, click in the analyzer with the right mouse button and select the required function from the pop-up menu.

The analyzer simultaneously shows up to 0.5 mega-samples for time series as standard. If the measurement file contains more data, then this is reloaded during scrolling. If you want to see several time values at once, then to do so you can increase the number of time values shown simultaneously as described in section 9.4.2

☞ The maximum number of time values shown simultaneously can only be increased in presentation mode. In data acquisition the analyzer only shows a maximum of 0.5 mega-samples.

8.2.1 Zooming in Analyzers

You can zoom on sections of the diagrams.

Zoom the x- or y-axis

To zoom the x- or y-axis individually, proceed as follows:

1. Point at an edge point of the section required on the axis. The cursor becomes a magnifying glass.
2. Press the mouse button and drag horizontally or vertically to the other edge point.

Scroll the x-axis

The scroll bar below the diagram shows the position of the zoomed section on the whole x-axis range. You can scroll along the x-axis with the current zoom factor. To do so, move the bar in the scroll bar to the right or to the left. You can also click the arrows to the right and left of the scroll bar.

Zoom both x- and y-axis

To zoom both x- and y-axis simultaneously, proceed as follows:

1. Click or select Analyzer > Zoom In.
2. In the diagram, point at a corner of the section required.
3. Press the mouse button and drag to the diagonally opposite corner.

Pan the zoomed section

You can pan the zoomed diagram section. To do so, you have the following possibilities:

1. Using the middle mouse button (mouse wheel), click in the zoomed diagram. Hold the mouse button pressed and pan the diagram section. If you have given the middle button a special function (e.g. double-click), then you will have to proceed as described in step 2.

2. Click or select Analyzer > Pan. You can now pan the section of the diagram while pressing the left mouse button.

Zoom out

To undo the last zoom action or autoscaling, click or select Analyzer > Zoom Out.

To undo all previous zoom actions, click while holding the shift key pressed. You can also select Analyzer > Zoom Out holding the shift key pressed.

8.2.2 Scaling the Axes

You can scale the y-axis automatically or scale the x- and y-axis manually.

Autoscale the y-axis

When you have started a measurement or are displaying another data set, then the y-axis range is often unsuitable. You can then autoscale, i.e. the software selects the y-axis range displayed corresponding to the y-range of the data. To do so, click or select Analyzer > Auto Scale. Even if the x-axis is zoomed, the whole y-range is autoscaled, not just the zoomed section.

Scale manually

In the dialog Analyzer Properties you can scale manually and set further scaling properties. To open the dialog, point at an axis (the cursor becomes a magnifying glass) and double-click. You can also activate the analyzer (to do so, click it), select Analyzer > Properties and then display the page Ranges.

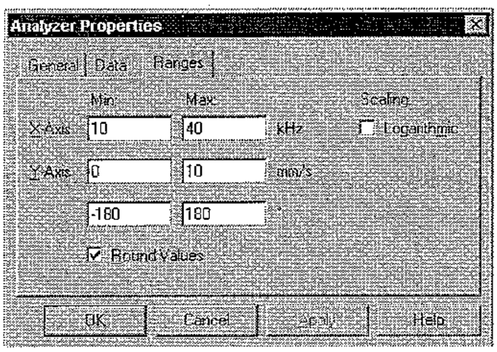


Figure 8.1: Page Ranges

Max and **Min:** Here you enter the x- and y-axis ranges you want to display.

Scale: This box only appears if the active analyzer is displaying a spectrum. Here you select logarithmic or linear scaling of the x-axis.

Round Values: Here you select whether the axis values displayed should be round. The software then rounds the values in Min and Max to be suitable. Round Values is also active when zooming. The zoomed section is then usually slightly larger than selected.

8.2.3 Setting Cursors and Reading Data

In the analyzer you can set cursors to read individual data points. Cursors are represented by thin vertical lines. In display type Nyquist you can not set any cursors. You will find details on how to animate time data in section 9.4.2.

Single cursor

To set a single cursor, proceed as follows:

1. Click  or select Analyzer > Cursor.
2. Click in a diagram.

Read data

You can see the cursor's coordinates in the legend. If the legend is not visible on the right in the analyzer, select Analyzer > Legend to display it.

Differential cursor

You can set two cursors and read the difference between coordinates. To do so, proceed as follows:

1. Click  or select Analyzer > Differential Cursor.
2. In the diagram, point at the first point you require.
3. Press the mouse button and then drag to the right or left to the second point. The difference between the coordinates also appears in the legend.

Move the cursor

You can move a cursor to the right or left. To do so, proceed as follows:

1. Point at the cursor. The mouse cursor becomes a ↔.
2. Press the mouse button and then drag to the right or left to the required point. The data in the legend is updated simultaneously.

You can also move a single cursor using the keys → and ←.

Delete the cursor

To delete cursors you have set, click  or  again.

8.2.4 Setting up the Presentation of Graphs

You set up the presentation of the graphs in the dialog Analyzer Properties. To open the dialog, point at a diagram and double-click. You can also activate the analyzer (to do so, click it), select Analyzer > Properties and then display the page Data.

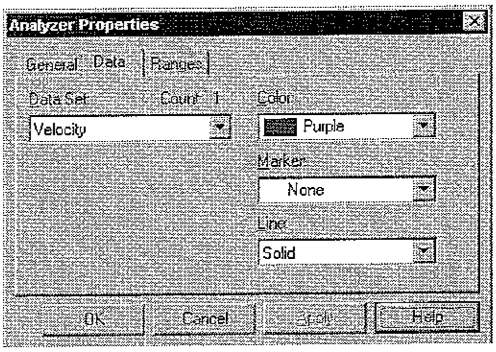


Figure 8.2: Page Data

Data Set: If the analyzer is displaying several diagrams – for example, magnitude and phase – then this is where you select the data set for which you want to set up the presentation.

Color: Here you select the color of the graph.

Marker and **line:** Here you select the view style of the graph and, if applicable, the marker. In the view styles Marker, Histogram, Thin bars and Thick bars, only measured y-values are displayed. In the other view styles, the software interpolates between the measured values.

8.2.5 Setting up Diagrams

You set up the look of the diagrams in the dialog Analyzer Properties. The current settings in the dialog are also valid for all analyzers you now open.To open the dialog, double-click an axis name. You can also activate the analyzer (to do so, click it), select Analyzer > Properties and then display the page General.

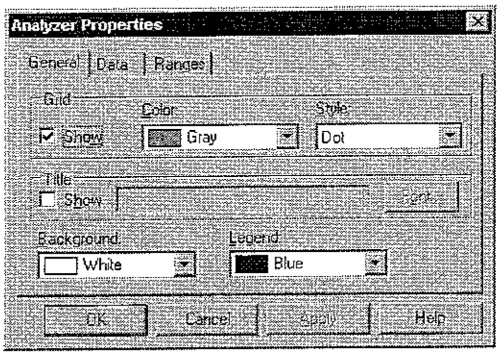


Figure 8.3: Page General

Grid

At the top you set up the grid.

Display: Tick the box to display a grid in the diagram.

Color and **Style:** Here you select the color and line style of the grid.

Title

In the middle you set up the diagram title.

Show: If you would like to display a title over the diagram, tick the box. You enter the title on the right.

Font: Click here to format the title. The dialog Font appears.

Colors

At the bottom you set up the background color of the diagram and the color of the data in the legend.

Background: Here you select the background color of the diagram.

Legend: Here you select the color of the data read in the legend.

8.3 Working in Presentation Windows

You analyze scans in presentation windows. You will find a description of the presentation window in section 2.7.5.

Depending on which functions you are working with in the presentation window, you display it in different views: See section 8.3.1 and section 8.3.2 on this. You will find more presentation options in the dialog Display Properties. You can scale there and set up the appearance of different views.

You select the data set to be displayed in the presentation window as described in section 8.4.

Apart from the display functions, in the presentation window you also have the possibility to evaluate the measurement data. See chapter 9 on this.

8.3.1 Setting up the View of the Presentation Window

Depending on which functions you are working with in the presentation window, you display it in one of four different views:

- Object
- Single Scan Point
- Average Spectrum
- Profile.

To set the view of the presentation window, click and select the view required in the pop-up menu. You can also select Presentation > View. In the Object view you will see the data superimposed on the video image, refer also to section 8.3.2. In the other three views you see the presentation window divided horizontally: at the top the Object view and at the bottom an analyzer. You work in the analyzer as described in section 8.2.

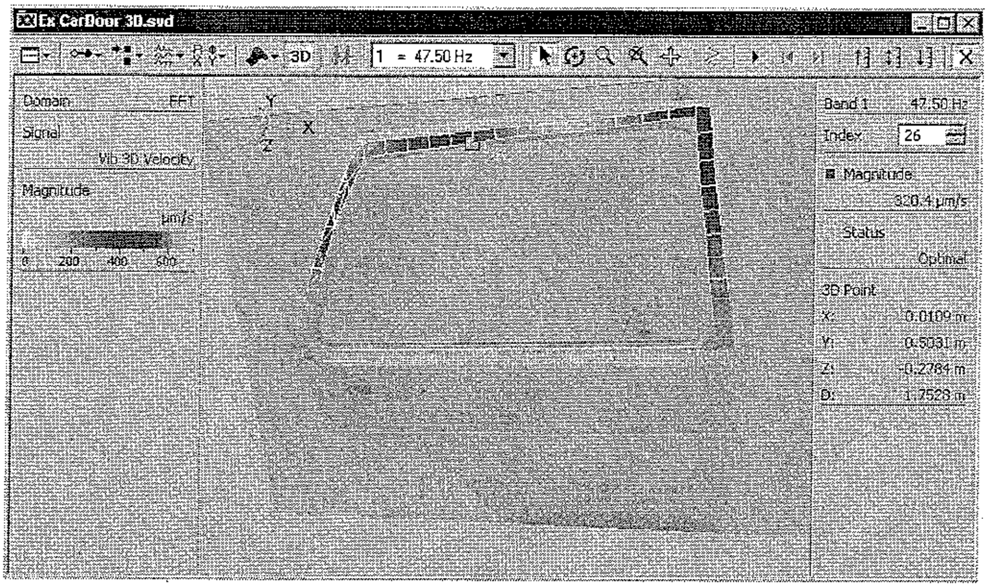


Figure 8.4: Presentation window in the view Object (3D)

Object You will see the data superimposed on the video image. You can present the data itself in different ways, see section 8.3.2 on this. You can set up the look of the object and the video image (background color, title, transparency etc.) as described in section 8.3.5.

Single Scan Point In the upper part of the presentation window you see the object. At the bottom you see an analyzer. The analyzer displays the spectrum at the single scan points. You select the scan point for which the spectrum is shown at the top. To do so, set a cursor at this scan point as described in section 8.3.4.

Average Spectrum At the top you see the object. At the bottom the analyzer displays the average spectrum of all scan points. The Average Spectrum is calculated from the amplitude spectra of the valid scan points. See also section 9.1 on this.

Profile At the top you see the object. You can draw profile sections on the object as described in section 9.3. You will see the profiles at the bottom in the analyzer.

☞ You can not draw any profile sections in the 3D view.

8.3.2 Selecting the View Style of the Data

In the presentation window you see the data superimposed on the video image. You can present the data in different ways:

- Surface
- Wireframe
- Isolines
- Scan Points
- Status Points

In all view styles you can change between the 2D and the 3D view. To do so, click . In all view styles apart from Status you will see the data color-coded. You can select the color palette for this as described in section 8.3.8. To the left of the object you can show (hide) a gauge for color-coding. To do so, select Presentation > Gauge.

To select the view style of the data, click and select the view style required in the pop-up menu. You can also select Presentation > View Style.

You can display the live video image outside the scan points.

Surface The software interpolates between the scan points.

Wireframe You see the connecting lines between the scan points as color-coded grid.

Isolines You will see equal data values connected with color-coded isolines. You can set up the presentation of the isolines (number, thickness) as described in section 8.3.6.

Scan Points You see each scan point as a color-coded square which corresponds to its data. In addition to that, you can display the index of each scan point. See section 8.3.6 on this.

Status Points You see the scan points as squares in different colors. The color shows the status of the scan point. See also section 8.1 on this.

3D View You can set up the 3D view style (projection, colors, size) as described in section 8.3.7. You can set the line of sight directly in the presentation window using the mouse. To do so, click . The mouse cursor becomes a . Drag in the direction you require.

3D Geometry You will find detailed information on the presentation of 3D geometries in your theory manual.

Read section 4.2.6 to see how to convert 2D geometry into 3D geometry.

8.3.3 Zooming in Presentation Windows

To zoom in a presentation window, proceed as described in section 2.8.

8.3.4 Setting Cursors and Reading Data

If you would like to read data at single scan points, you can set a cursor on the object. The cursor is shown as a blue square. In the view Profile you can not set a cursor.

Set a cursor

To set a cursor, proceed as follows:

1. Display the Object or Single Scan Point view. To do so, click ▤ and select Object or Single Scan Point.

2. Display any view style. To do so, click and select the view style in the pop-up menu. You can select scan points in both the surface view and also the 3D view.

Select scan points

3. Point at a scan point and click. The scan point is shown as a blue square.

Read data

In the legend you can see the data of the scan point which the cursor is at. If the legend is not visible on the right of the object, select Presentation > Legend to display it.

In the Single Scan Point view at the bottom in the analyzer you can see the spectrum at this scan point.

Move the cursor

You can move the cursor to other scan points using the mouse. The data in the legend is updated simultaneously.
In the Object view you can move the cursor within a joined area using the arrow keys as well.

☞ You can zoom on the view to be able to see details more clearly. Read section 2.8 on this.

Delete the cursor

To delete the cursor or to clear selection, in the toolbar of the presentation window, click .

8.3.5 Setting up the Object

You set up the look of the object in the dialog Display Properties. To open the dialog, double-click the object. You can also activate the presentation window (to do so, click it) and select Presentation > Properties. Then display the page General.

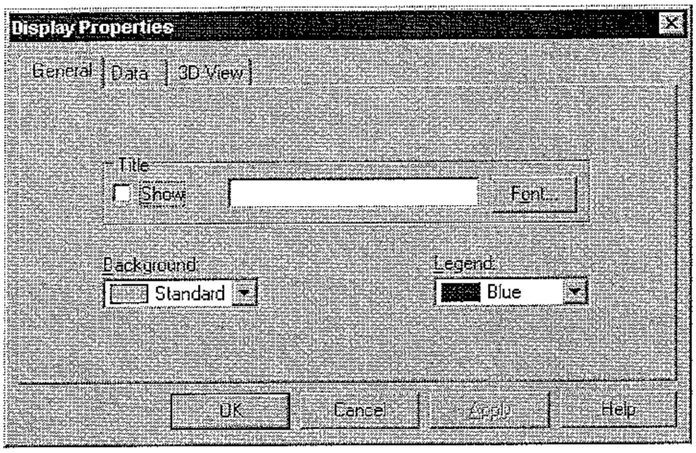


Figure 8.5: Page General

Title

At the top you set up the title of the object.

Display: If you would like to display a title over the object, mark the box. You enter the title on the right.

Font: Click here to format the title. The dialog Font appears.

Colors

At the bottom you set up the background color of the object and the color of the data in the legend.

Background: Here you select the background color of the object.

Legend: Here you select the color of the data read in the legend.

8.3.6 Setting Up Isolines and View Styles of Measurement Data and Scaling the Z-axis

To set up the view style of the measurement data and the isolines and to scale the z-axis, open the dialog Display Properties. To do so, double-click the object. You can also activate the presentation window (to do so, click it) and select Presentation > Properties.Then display the page Data. New settings on this page are immediately effective – i.e. without clicking Apply or closing the dialog.

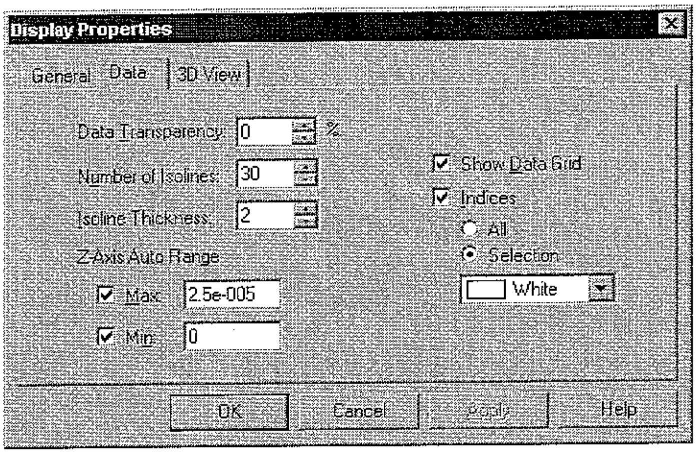


Figure 8.6: Page Data

View style of the measurement data

Data Transparency: Here you enter how transparently the superimposed is to be shown on the video image.

Show Data Grid: Tick the box if in addition to the superimposed measurement data the grid which the scan points are on is to be shown.

☞ In the Wireframe view, this box is not active.

Indices: Tick the box to show the indices of the scan points. Select whether the indices of all scan points are to be shown or only the indices of selected scan points. In the list below select the color which is to be used to show the indices.

Setting up the isolines

Number of Isolines: Here you select how close the isolines are to each other.

Isoline Thickness: Here you select the thickness of the isolines.

Automatically scale the z-axis

Z-Axis Auto Range: The software can autoscale maximum and minimum of the z-range individually. Tick the corresponding box to do so.

☞ Data which you have collected in time mode can also be autoscaled in the presentation window by clicking .

Scale the axis manually

Through entries in the fields Max: and Min: you can scale manually. As soon as you enter a value here, autoscaling is cleared correspondingly.

Max and **Min:** Enter the z-axis range here you want to display.

8.3.7 Setting up the 3D View

You set up the 3D view in the dialog Display Properties. To open the dialog, double-click the object or click it with the right mouse button and select 3D View Properties in the pop-up menu. You can also activate the presentation window (to do so, click it) and select Presentation > Properties. Then display the page 3D View.

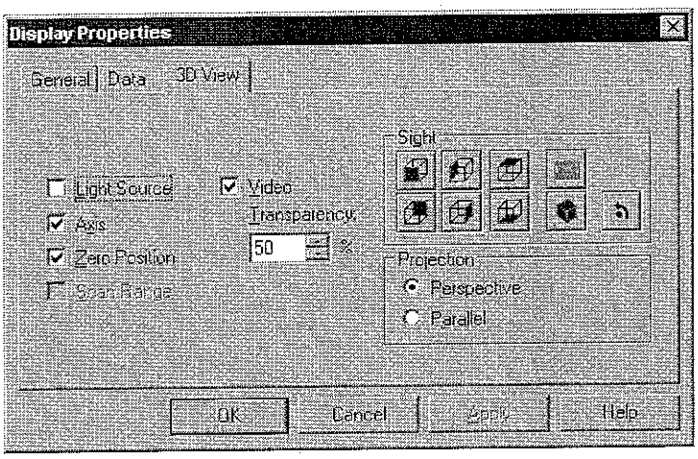


Figure 8.7: Page 3D View

Changes made to the representation or the sight are immediately effective, i.e. without clicking Apply or closing the dialog.

Light Source: Tick the box to switch on the illumination model. It simulates illuminating the object from the direction of the observer.

☞ Depending on the shape of the object, the display of light and shadow has a detrimental effect on the quality of the presentation. In this case, deactivate the box to switch off the illumination model.

Axis: Tick the box to display a coordinate system top left in the presentation window next to the object.

Zero Position: Tick the box to view the object in its original position in addition to viewing the measurement results.

Scan Range: Tick the box to show lines to help you display the position of the scanning heads in front of the object. In this way you can see whether the 3D alignment has provided a useful result.

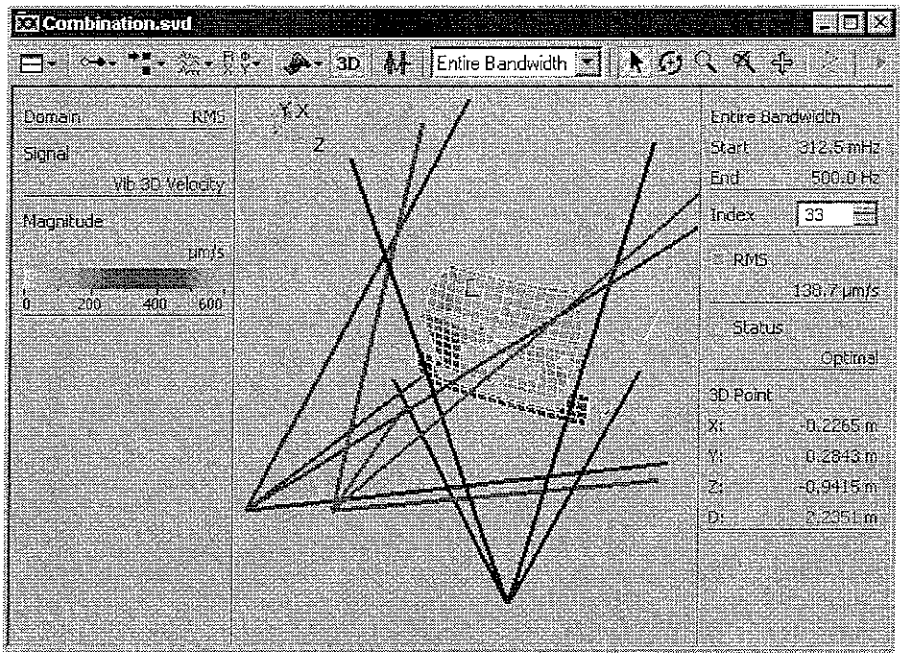


Figure 8.8: Layout of the three scanning heads

Video: Tick the box to show the video image.

Transparency: Here you enter how transparently the video image is to be displayed.

Line of sight

The icons in the field Sight show the line of sight of the object. You can move the object more precisely by clicking these icons than by dragging with the mouse.

 Sight on the object from the front

 Sight on the object from the back

 Sight on the object from the left

 Sight on the object from the right

 Sight on the object from the above

 Sight on the object from the below

 Sight of the video camera (only for 3D geometry)

 Sight on the object at an angle from front, left and above

 Rotating the object around the line of sight

You can show (hide) a coordinate system which shows you the resulting orientation of the object (see above, Axis).

☞ You can also set the line of sight directly in the presentation window using the mouse. To do so, click the object and using the mouse drag it into the direction you require.

Projection

Here you select the type of projection of the object.

Perspective: The object is shown in perspective, i.e. parts in the front of the image become larger, parts in the background of the picture are shown smaller.

Parallel: All parts of the object are shown the same size regardless of their distance from the observer.

☞ Parallel projection makes it easier to differentiate between in-plane and out-of-plane vibrations. Particularly with out-of-plane vibrations, the perspective layout viewed from the top can give the impression that the object is being stretched and contracted again.

8.3.8 Selecting the Color Palette

You can choose between different color palettes for color-coding in the presentation window. To do so, proceed as follows:

1. Click or select Setup > Color Palette. The dialog Color Palette Selection appears.

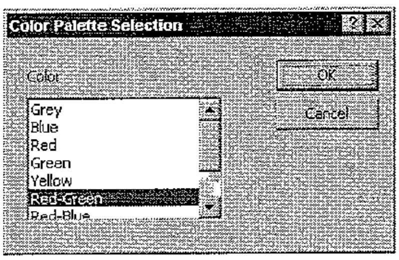


Figure 8.9: Dialog Color Palette Selection

2. Click the color palette required. Default is the color palette red-green.
3. Click OK.

   Or:

   With the right mouse button, click the gauge on the left in the presentation window and select the required color palette from the list.

8.4 Selecting the Data Set Displayed

To display a certain data set, select in the following order:

1. Time signal or type of spectrum
2. Channel or combination of channels
3. Signal or function
4. Display type in which the signal or function is shown
5. 0 dB reference
6. Only in presentation windows of data you have captured in FFT mode: Frequency band.

The selection depends on

- the measurement mode
- averaging, trigger and reference signal; see your theory manual on this as well,
- which displays have already been selected – for example, you can only display a frequency response for frequency spectra and a combination of channels.

☞ With the PSV-3D you can also select the channels Vib X, Vib Y, Vib Z and Ref1 and also combinations of channels such as Vib X & Ref1.

You first have to define frequency bands as described in section 9.2.

If an analyzer is part of a presentation window (refer to section 8.3.1), select the displayed data set in the presentation window. If possible, the analyzer displays the same data set.

To display a certain data set, proceed as follows:

Domain

1. Click [icon] or select Analyzer > Domain or Presentation > Domain.
2. Select the time signal, a spectrum or the RMS signal in the pop-up menu.

☞ Measurement modes FFT, Zoom-FFT and MultiFrame: To calculate and display a frequency spectrum, the software needs to acquire a complete sampling period. Therefore, during a continuous measurement, the **spectrum** of the **last complete measurement** is displayed at the same time as the **time signal** of the **current measurement**.

Channel

3. Click or select Analyzer > Channel or Presentation > Channel.
4. Select a channel or a combination of channels in the pop-up menu. If you want to use data sets which are user defined and have been generated using Polytec File Access, select the channel Usr. You will find more information on this in the manual on Polytec File Access.

Signal

5. Click or select Analyzer > Signal or Presentation > Signal.
6. Select a signal or a function in the pop-up menu. The abbreviations used are explained in table 8.1.

Table 8.1: Abbreviations for functions

Abbreviation	Function
AP	Autopower
CP	Crosspower
FRF	Frequency Response Function
H1	Frequency Response Function
H2	Frequency Response Function

Display type

7. Click or select Analyzer > Display Type or Presentation > Display Type.
8. Select the way in which the vibration is shown in the pop-up menu.

☞ In the display type Magnitude [dB(A)], the magnitude measured is frequency-weighted according to the standard EN 60651 (IEC 651) (A-weighting). The A-weighting approximately describes the acoustic sensitivity of a human at low magnitudes. The following figure shows the frequency-weighting curve. Outside the range shown, the software frequency-weights as follows: Below 10.0 Hz at -70.4 dB and above 20000 Hz at -9.3 dB.

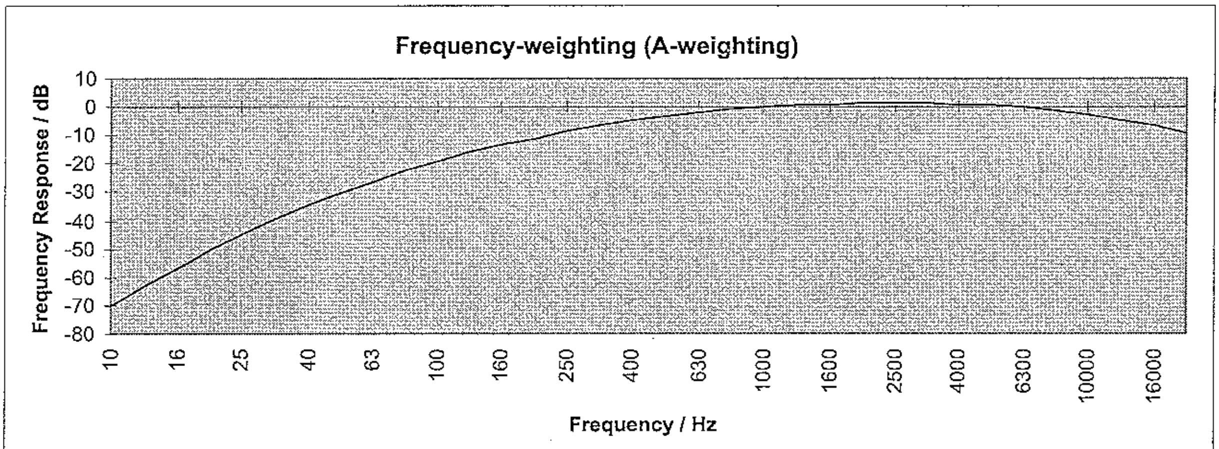


Figure 8.10: Frequency-weighting curve for the display type Magnitude [dB(A)]

☞ In the display type Nyquist, the real part of the magnitude is plotted over the x-axis and the imaginary part over the y-axis.

0 dB Reference

9. Select Setup > Preferences and if applicable open the page dB Reference.

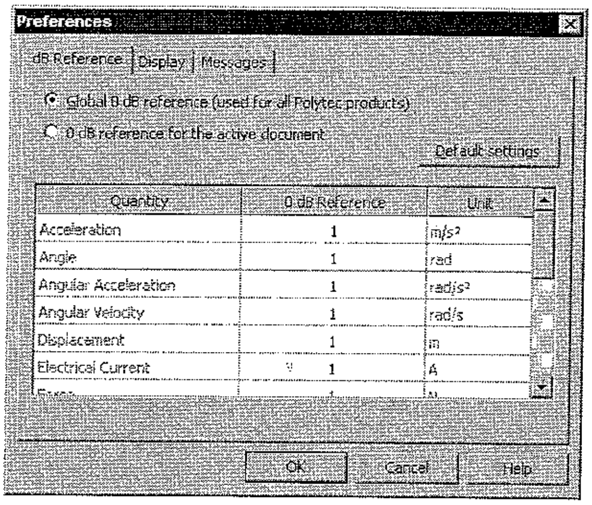


Figure 8.11: Page dB Reference

10. If the settings are to apply to all the Polytec software installed in the PC, mark Global 0 dB reference (used for all Polytec products).

    If the settings are only to apply to the file which is currently open, mark 0 dB reference for the active document.

The column Quantity shows the available physical quantities, the column Unit the respective applicable unit (ISO).

11. In the column 0 dB Reference you define the factor for the respective unit.

☞ Depending on the size of the opened file, it can take quite a while for the new value to be applied!

Example:

Quantity	**0 dB Reference**	**Unit**
Displacement	2e-3	m

The 0 dB reference for the quantity Displacement is 2 mm.

12. If you want to evaluate combined signals (e.g. Vib & Ref1), define the 0 dB reference for both quantities. The software then automatically determines the 0 dB reference of the combined signals.

☞ If you want to recover the original settings for the 0 dB reference, click Default Settings.

Frequency band (only in presentation windows)

You have three different ways of selecting the frequency band displayed:

13. Select the frequency band in the toolbar of the presentation window in the list 1 = 1.200 kHz. If no frequency bands are defined, then the only entry in the list is Entire Bandwidth.

or

14. Press the key PgDn or PgUp. You will see the next or previous frequency band.

or

15. Either display the view Single Scan Point or the average spectrum. To do so, click and select Single Scan Point or Average Spectrum.
16. In the toolbar of the analyzer, click . You see the frequency bands in the analyzer in color.
17. Click the required frequency band in the analyzer. The software shows this frequency band at the top.

In table 8.2 you will find a summary of how to select domain, channel, signal and display type.

Table 8.2: Selecting the data set displayed

Click	Or select Analyzer > or Presentation >	Display of	Example
1.	Domain	Time signal, spectrum or RMS signal	FFT, 1/3 Octave RMS Time
2.	Channel	Channel or combination of channels	Vib Ref 1 Vib & Ref 1
3.	Signal	Signal or function	Velocity Acceleration Voltage FRF Displacement/Voltage AP Displacement[2]
4.	Display type	Way in which the signal or function is shown	Magnitude Magnitude [dB] Phase Real & Imag. Nyquist

You can also evaluate the spectrum with an individual cursor, see section 9.2.1 on this.

8.5 Generating Combined 3D Files (Stitching)

If you are using PSV-3D, you can group individual measurements with 3D geometries and 3D vibration data to form combined files. For this, the following conditions have to be met:

- The individual measurements must have been made using PSV-3D.
- The coordinate systems of all individual measurements must have the same origin and the same orientation. This means that for 3D alignment the same coordinate system must have been used for the alignment points of all files.
- All individual measurements must have been made using the same basic settings. These include the number of channels, the definition of the reference channel, units, averaging mode and trigger settings as well as the setting for the optional Principal Component Analysis (MIMO).
- However you can select different vibrometer settings, generator signals, input ranges and calibration factors.

☞ If you are combining measurements with different vibrometer settings, please make sure that the possible different time delays are only corrected under the following conditions:

- as of OFV-5000 with firmware version 2.0:
- as of PSV 8.3
- acquisition of measurement data in the spectral range (FFT)

No correction is made in the time domain!

- The indices of the scan points may not appear twice. Read more about this under Change indices in section 5.6.2.

  Exception: identical scan points which are included in several individual measurements and have the same index in every individual measurement.

You can also generate a new combined filed from several combined files. To do so, proceed in the same way as when grouping individual measurements.

8.5.1 Merging Individual Measurements

To group several individual measurements into a combined file, proceed as follows:

1. Select File > New > Combine File. The dialog Create Combined File appears.

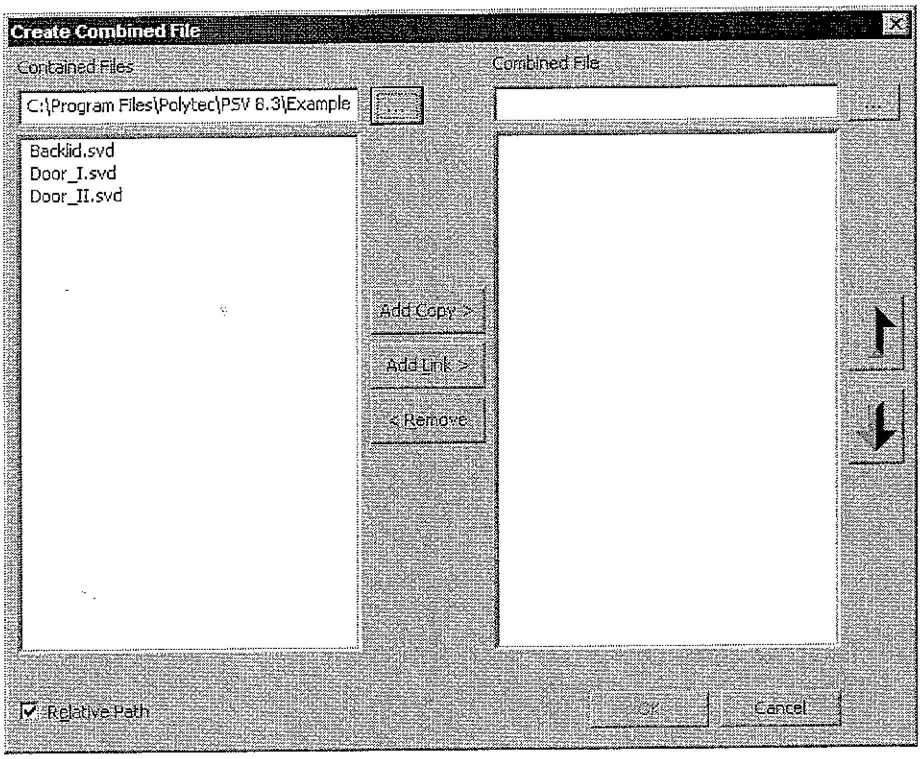


Figure 8.12: Dialog Create Combined File

Add individual measurements

2. Click next to the field Contained Files. The dialog Browse For Folder appears.

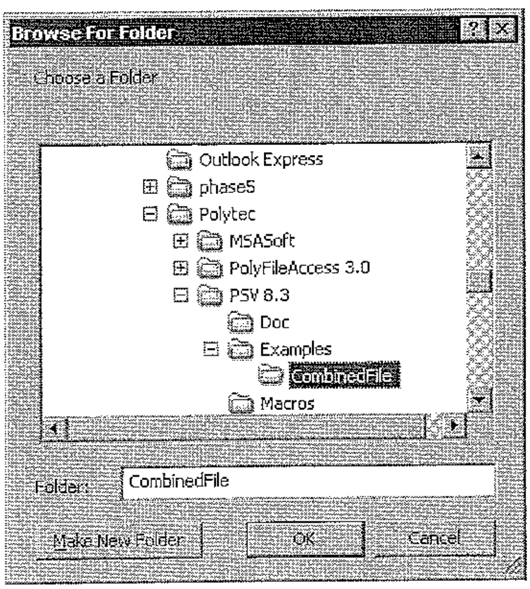


Figure 8.13: Dialog Browse For Folders

3. Navigate in the directory containing the individual measurements you want to group and click OK.

4. Mark the individual measurements you would like to group. To select several individual files at the same time, hold the Control button pressed and mark the files using the mouse. To select several consecutive files at the same time, hold the shift key pressed and mark the first and the last of these measurements with the mouse.

5. Click Copy if you want to include the selected files in the combined file.

   Or:

6. Click Link if you want to link the selected files to the combined file.

☞ If you only link individual measurements, then retrospective changes to these measurements will have an effect on the combined file.

7. Tick the box Relative Path if for linked files only the position in the file system relative to the combined file is to be saved. In this case the links also remain valid if you copy the combined file with the linked files e.g. into another directory and thereby retain the relative folder structure.

8. Click next to the field Combined File. The dialog Save As appears.

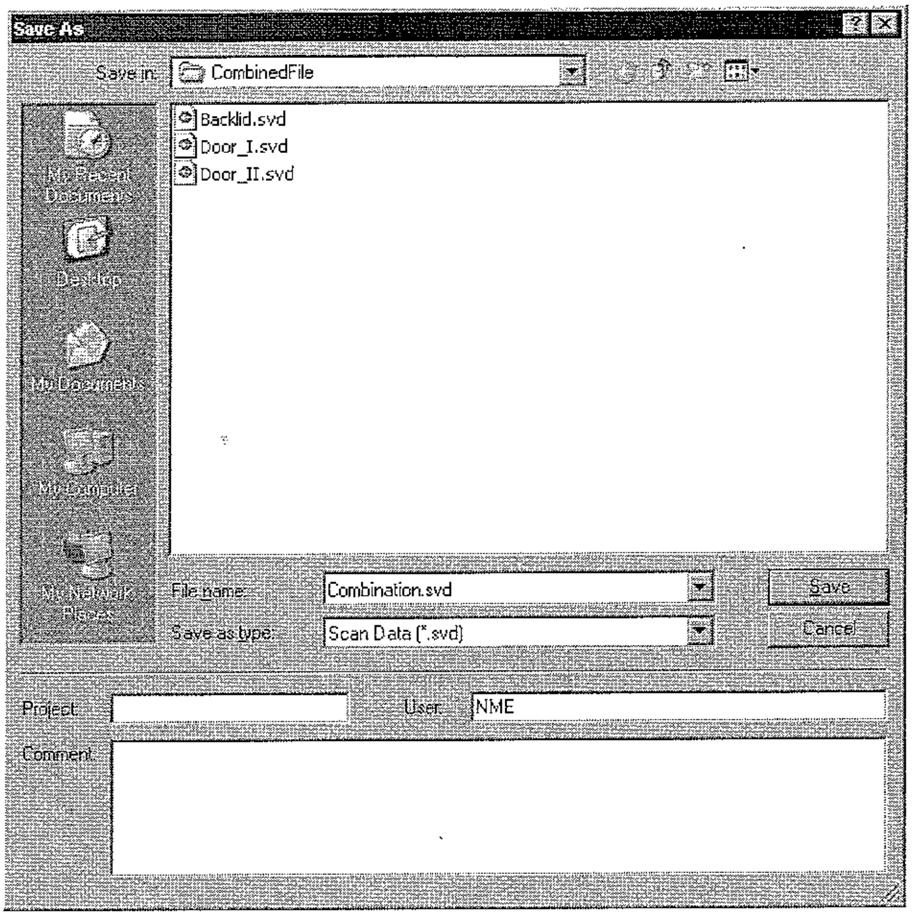


Figure 8.14: Dialog Save As

9. Navigate to the directory in which you want to save the combined files and enter the file name.

10. Click Save.

☞ If you have displayed the project browser (refer to section 2.7.4), you will then automatically be shown the directory marked there as saving location.

Remove individual measurements

11. To remove files from the list of individual measurements for the combined file, mark them as described in step 4 and click Remove.

12. Click OK.

8.5.2 Working with Combined Files

The same functions are available to you for combined files as they are for individual measurements. All other operations after merging will however only be saved in the combined file. The individual measurements remain unaffected by this.

As a general rule, every change to a file is marked with an asterisk (*) in the file name as soon as you make the change. An exception to this are the frequency bands which are immediately saved after being recalculated. Also the changes that result of you invalidate scan points are saved immediately.

Display combined file

To open the combined file, double-click the file name in the project browser or click it with the right mouse button and select Open in the pop-up menu.

In the 3D view you can simultaneously see the geometry and the 3D vibration data from all parts of the object that you scanned in the individual measurements in 3D. There are not connecting lines between the part geometries.

In the 2D view you can see the geometry and the vibration data of the individual measurements. To show the individual measurements consecutively, select them in the list Contained File.

☞ To draw a profile section (refer to section 9.3), you have to select the 2D view.

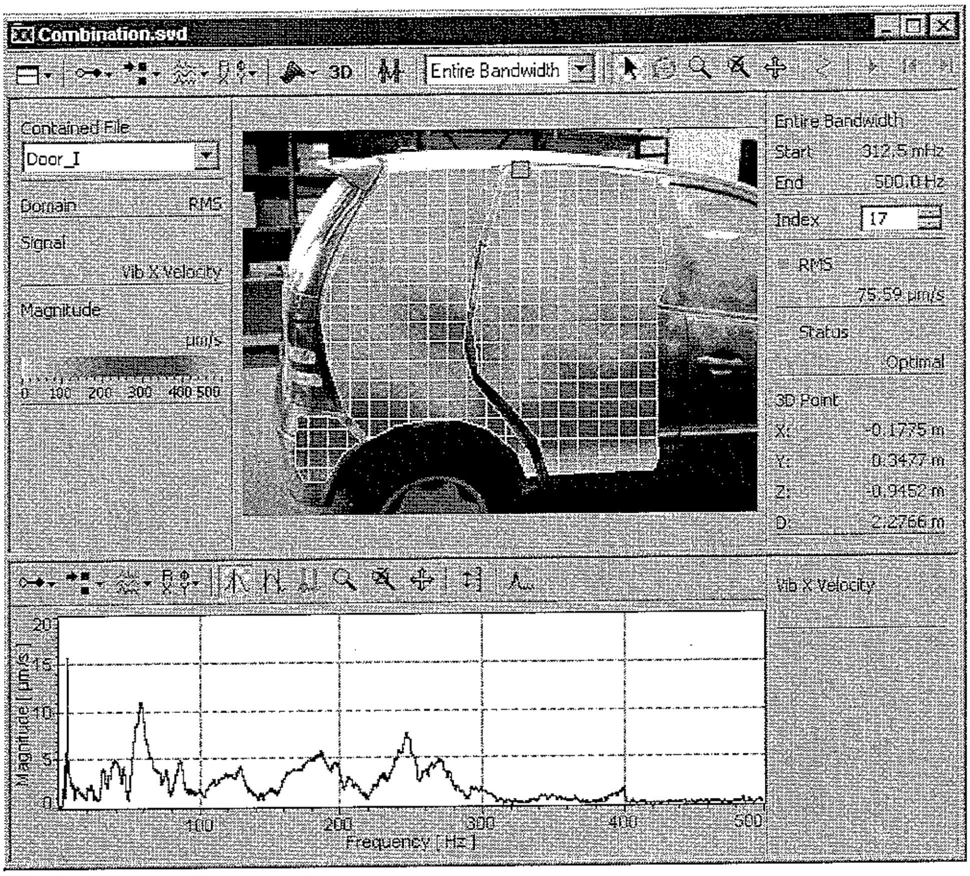


Figure 8.15: 2D view of an individual measurement from the combined file

In the project browser your can see the individual measurements as well as the settings with which these measurements were made. To do so, click the plus sign (⊞) in front of the name of the combined file or in front of the name of the individual measurements.

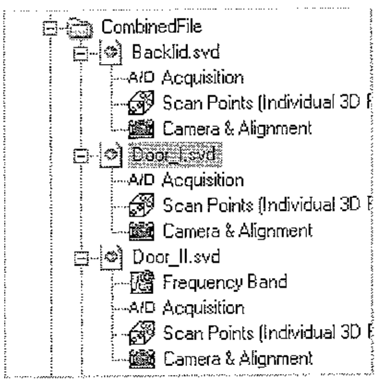


Figure 8.16: Combined file, individual measurements and settings

Overlap of individual measurements

Depending of how you defined the scan areas of the individual measurements, parts of the combined file in the 3D view can overlap.

If the combined file contains duplicate scan points which have the same indices, the software prioritizes the data for the 3D view corresponding to the order of the individual measurements in the dialog Create Combined File (refer to figure 8.12): the individual measurement which is at first place in the list Combined File is given priority 1. In the case of the 3D view of the combined file where there are scan points measured twice, the video image with the geometry data, measurement data etc. is shown from the individual measurement which contains these scan points and has the highest priority.

Sort individual measurements

To adapt the display, you have to change the order of the files. To do so, proceed as follows:

1. Open the dialog Create Combined File. To do so, click the combined file in the project browser with the right mouse button and select Properties in the pop-up menu.
2. In the list Combined File, click the individual measurement which you want to move.
3. Click ↑ or ↓, to move the selected individual measurement up or down in the list.
4. Click OK.

Apply frequency bands

You can apply frequency bands from individual measurement to the combined file. To do so, proceed as follows:

1. Open the combined file.
2. Open the frequency band definition (refer to section 9.2.2).
3. Holding the left mouse button pressed, drag the entry Frequency Band of the required individual measurement from the project browser to the frequency band definition.
4. Close the frequency band definition. A message box appears with the question whether the frequency bands are to be recalculated.
5. Click Yes.

8.6 Recalculating Data in the Signal Processor (as an Option)

If you want to further analyze measurement data you have already acquired, you can recalculate it and present the results in a direct comparison with the original data. For this purpose the signal processor is available which you can transfer the data to and can then process it further. The data calculated this way is shown in the analyzer of the signal processor. You can also save this data with the measurement file and display it again at any time.

8.6.1 Making a Calculation

To recalculate the data, you have to open the respective measurement file, transfer the measurement data to the signal processor and carry out the required arithmetic operations there.

Open the signal processor

To open the signal processor, select File > New > Signal Processor. The signal processor appears.

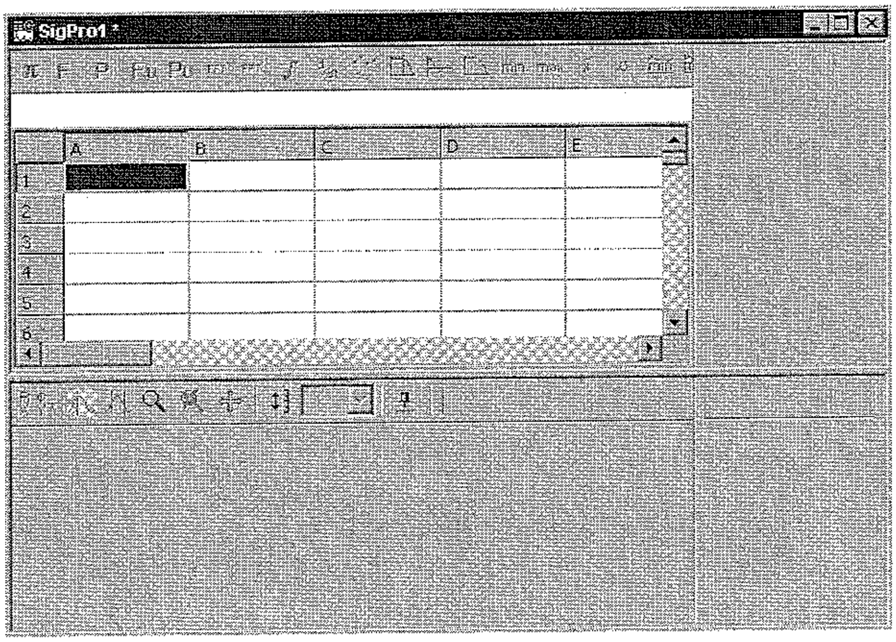


Figure 8.17: signal processor

Open a measurement file

1. To open a presentation window with a measurement file, click or select File > Open. The dialog Open appears.

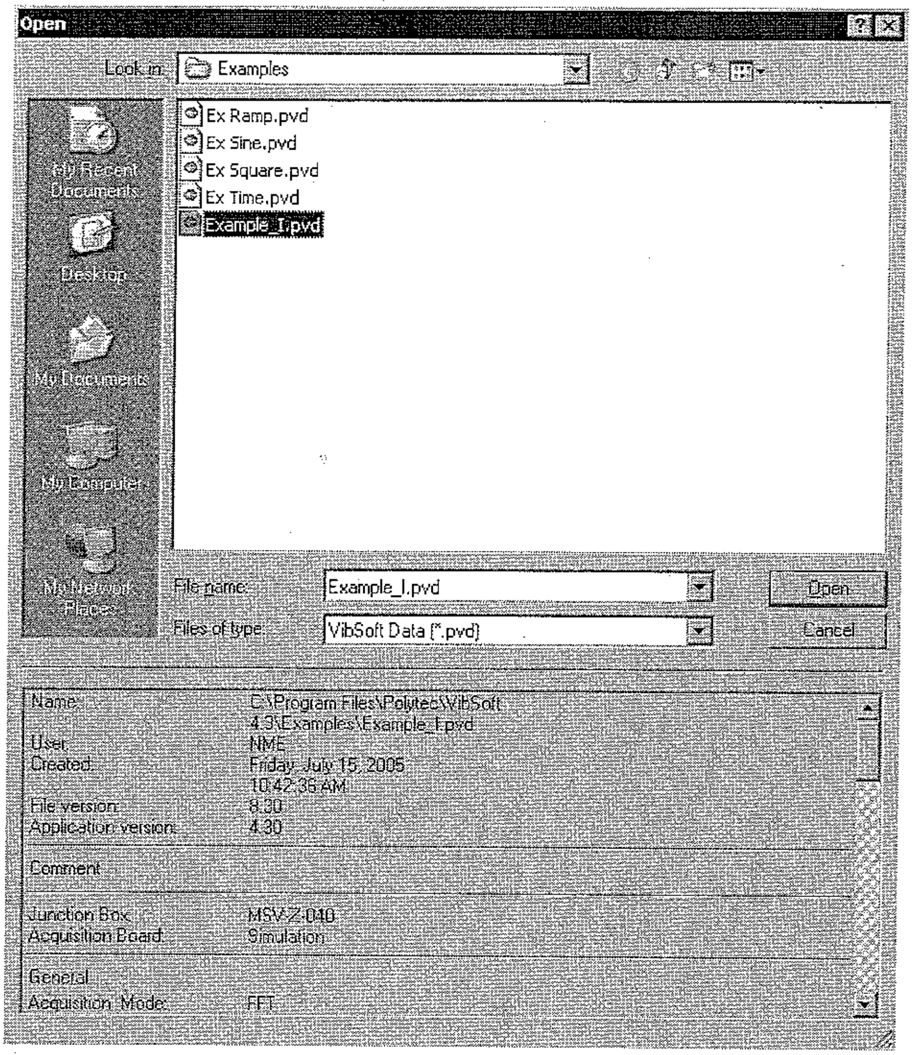


Figure 8.18: Dialog Open

2. Navigate to the saving location and select the file type and name. To make it easier to identify the files, you see meta-information at the bottom in the dialog – for example, the data acquisition board and the settings with which the data was measured.

3. Click Open. If you open a scan, a presentation window appears. If you open a single point measurement, an analyzer appears.

Recalculate measurement data

To recalculate the data in the open file, please proceed as follows:

1. In the presentation window, click a scan point with the right mouse button and select Copy in the pop-up menu. The data of the selected scan point will be copied.

   or

   Click next to the scan points and select Copy All Points in the pop-up menu. The data from all scan points will be copied.

2. Change to the signal processor.

3. Click a cell (e.g. A1) with the right mouse button and select Paste or Paste Link in the pop-up menu. The copied data is inserted in the signal processor or inserted and linked.

☞ Inserted data contains a reference to the original file and remains in the corresponding cell, even if you select other data in the sequence or close the measurement file or the signal processor. Linked data in contrast is updated in the formula as soon as you select other scan points and are lost as soon as you close the measurement file or the signal processor.

4. If you want to display the data for a single scan point, select it in the index in the analyzer of the signal processor (refer to figure 8.19).

5. If you want to display certain frames for the selected scan points, click the number of the particular frames in the analyzer of the signal processor. You can display an own graph for every frame (refer to figure 8.19 and section 8.6.3).

6. Click another cell (e.g. A2).

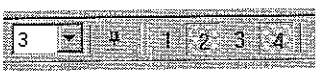


Figure 8.19: Selection of index and frames in the analyzer of the signal processor

7. Here you enter the required command and confirm it with Enter. The signal processor carries out this calculation and shows the results in the analyzer.

☞ You will find an overview of the formulae stored in the signal processor in table 8.3. You will find example applications for the signal processor in section 8.6.5.

☞ You can also enter any comments you like as text in the individual cells. In this case you just do not set an equal sign at the start of the respective text.
Invalid formulae are shown in red.

Table 8.3: Overview of the arithmetic operations of the signal processor

Command	Arithmetic operation
Add (+)	By entering + you add two numbers or Vib data sets or unite two quantities.
Sub (–)	By entering – you subtract two numbers, Vib data sets or quantities.
Mul (*)	By entering * you multiply two scalars, two Vib data sets, one Vib data set with a scalar or intersect two quantities.
Div (/)	By entering / you divide two scalars or two Vib data sets by each other, one Vib data set by a scalar or one scalar by a Vib data set.
Card	By entering Card you calculate the cardinality (number of elements) in a set.
Power (^)	By entering ^ you raise the value of scalar 1 to the power of the value of scalar 2 (notation: scalar1^scalar2, i.e. $\text{scalar1}^{\text{scalar2}}$).
Re	By entering Re you calculate the real part of a scalar or Vib data set.
Im	By entering Im you calculate the imaginary part of a scalar or Vib data set.
Exp	By entering Exp you calculate the exponential function of a scalar.
Ln	By entering Ln you calculate the natural logarithm (base e).
Sin	By entering Sin you calculate the sine (radiant).
Cos	By entering Cos you calculate the cosine (radiant).
Tan	By entering Tan you calculate the tangent (radiant).
ASin	By entering ASin you calculate the arc sine (radiant).
ACos	By entering ACos you calculate the arc cosine (radiant).
ATan	By entering ATan you calculate the arc tangent (radiant).
Abs	By entering Abs you calculate the absolute amount of a scalar or Vib data set.
Arg	By entering Arg you calculate the phase of a scalar or Vib data set.
Deg	By entering Deg you convert radiants into degrees.
Rad	By entering Rad you convert degrees into radiants.
Pi	By entering Pi you add the constant π to the formula.
Frame	By entering Frame you extract the specified frame or frames from the Vib data set. If the second parameter is a scalar, its real part is rounded up or down to the next integer and its imaginary part is ignored.
Point	By entering Point you extract the specified sample point or points from the Vib data set. If the second parameter is a scalar, its real part is rounded up or down to the next integer and its imaginary part is ignored.
FrameUnion	By entering FrameUnion you combine the frames of up to 10 Vib data sets. The maximum total number of combined frames is 12.
PointUnion	By entering PointUnion you combine the sample points of up to 10 Vib data sets. If sample points occur in more than one data set, those found first are used.

Table 8.3: Overview of the arithmetic operations of the signal processor

Command	Arithmetic operation
FFT	By entering FFT you calculate the Fourier Transformation of the Vib data set. Parameters: FFT(PSVData1, Lines[, Window, WndPar1, WndPar2]) Requirements: • PSVData1 must be a real signal. • The lines must be in the range from 25...1 046 576. • The length of the vector in PSV must at least reach the following value: Number of lines · 2, rounded up to the next power of 2. • The window function (Window) has to be one of the following characters strings: "Rectangle" "Bartlett" "BlackmanHarris" "Exponential" "FlatTop" "Force" "Hamming" "Hanning" "TaperedHanning" If you do not specify any type of window, "Rectangle" will be assumed.
Integrate	By entering Integrate you integrate the Vib data set. Requirement: The input data must be real.
Differentiate	By entering Differentiate you differentiate the Vib data set. Requirement: The input data must be real.
Resample	By entering Resample you have the Vib data set sampled again at the specified sample rate. Requirement: The input data must be real.
IFFT	By entering IFFT you calculate the inverse Fourier transformation. Requirement: The Vib data must include a complex spectrum. Note: With a measurement which is not triggered, the phase in the Vib channel is replaced by the differential phase to the Ref channel. The calculation of the inverse FFT can provide unexpected results which are hard to interpret.
Filter	By entering Filter you filter a Vib data set. Requirement: The input data must be real. As the type you select one of the strings "Lowpass", "Highpass", "Bandpass" or "Notch". As quality you select one of the strings "VeryLow", "Low", "Medium", "High" or "VeryHigh". For Flow you select the cutoff frequency for low pass and high pass and lower cutoff frequency for band-pass and notch. For Fhigh you select upper cutoff frequency for band-pass and notch.
FilterCoeff	By entering FilterCoeff you calculate a Vib data set which contains the filter core of the selected filter. Enter the sample frequency for Fsamp. As the type you select one of the strings "Lowpass", "Highpass", "Bandpass" or "Notch". As quality you select one of the strings "VeryLow", "Low", "Medium", "High" or "VeryHigh". For Flow you select the cutoff frequency for low pass and high pass and lower cutoff frequency for band-pass and notch. For Fhigh you select upper cutoff frequency for band-pass and notch.

Table 8.3: Overview of the arithmetic operations of the signal processor

Command	Arithmetic operation
Transmission	By entering Transmission you calculate a Vib data set which contains the transmission function of the selected filter. Enter the sample frequency for Fsamp. As the type you select one of the strings "Lowpass", "Highpass", "Bandpass" or "Notch". As quality you select one of the strings "VeryLow", "Low", "Medium", "High" or "VeryHigh". For Flow you select the cutoff frequency for low pass and high pass and lower cutoff frequency for band-pass and notch. For Fhigh you select upper cutoff frequency for band-pass and notch. For Count you enter the number of frequency lines for which the transmission function is to be calculated.
Min, Mean, Max, StdDev	By entering Min, Mean, Max or StdDev, you respectively calculate the minimum, average or maximum of a deviation or the standard deviation of a Vib data set which contains an individual sample point. The return value is a scalar. You can calculate Mean for real or complex data. You can only apply all the other functions to real data.
StatMin, StatMean, StatMax, StatStdDev	By entering StatMin, StatMean, StatMax or StatStdDev, you respectively calculate the minimum, average, maximum, or the standard deviation of a Vib data set. The return value is a Vib data set with an individual measurement point with the index 0. You can calculate StatMean for real or complex data. You can only apply all the other functions to real data.
	☞ It can make sense to apply StatMean to a data set which only contains a single measurement point. This does not change the data set but means that the point index is set to 0. Points with the index 0 can be compared to all other indexed points. This allows a direct comparison of the data sets from two different measurement points. For this purpose, apply StatMean to the data set of a measurement point. Then select this cell and the cell with the data set of the other sample point to compare the two.
Scale (VibData, xMin, xMax, xName, xUnit, yMin, yMax, yName, yUnit, yScale, Name, 0dBReference, Power)	By entering Scale you modify scaling information of a Vib data set. This function is usually used to adapt the scale after operations such as FFT or Integrate as these operations change the dimensions of the axes. The following list contains the changes you can make using the command Scale. • VibData: data set • xMin, xMax: boundaries of the x-axis • xName: Name of the x-axis • xUnit: Unit of the x-axis • yMin, yMax: boundaries of the y-axis • yName: Name of the y-axis • yUnit: Unit of the y-axis • yScale: the y values are multiplied with yScale • Name: Name of the data set • 0dBReference: Reference value of the dB display • Power: 1 or 2 Power = 1 shows that it is a power signal. 10dB then corresponds to a multiple of ten. For other signals you set Power = 0. 20dB corresponds to a multiple of 10.

You can also enter quantities and complex numbers. You place quantities in curly brackets and complex numbers as an option in round brackets. In table 8.4 and table 8.5 the input conventions are explained on the basis of examples.

Table 8.4: Examples for entering quantities

Command	Meaning
{1,2}	1 and 2
{1:5} or {1...5}	1 to 5
{1,4,7...9}	1, 4 and 7 to 9
{}	empty set
{*}	general set

Table 8.5: Examples for entering complex numbers

Command	Meaning
0;1 or (0;1)	i
−1.23E4;−5.67E8 or(−1.23E4;−5.67E8)	$-1.23E4-5.67E8 \cdot i$

Set up the signal description

You can adapt the presentation of the recalculated measurement data in the analyzer. To do so, proceed as follows:

8. Click the cell which contains the newly calculated measurement data with the right mouse button and select Signal Description from the pop-up menu. The dialog Signal Description appears.

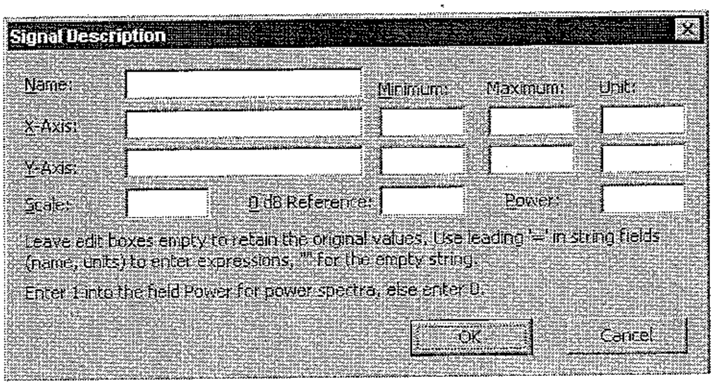


Figure 8.20: Dialog Signal Description

9. Fill in the fields as described in the following and click OK.

☞ Entries in this dialog are saved and shown in any case, even if the input data for the signal calculation changes! If you do not enter anything in a field, the original value from the input data is retained or adapted.

Name: Here you enter the description of the newly calculated measurement data. This name is shown in the respective cell. After saving the measurement data it will also appear on the list of available signals in the presentation window, refer also to section 8.6.2.

X-Axis: Here you enter the description for the x-axis.

Y-Axis: Here you enter the description for the y-axis.

Minimum: Here you enter the lower value for the scale of the x- or y-axis.

Maximum: Here you enter the upper value for the scale of the x- or y-axis.

Unit: Here you enter the abbreviation for the unit of the x- or y-axis.

Scale: Here you enter the factor by which the graphic representation of the measurement data is to be magnified or reduced.

0 dB Reference: If you have selected a view with [dB], here you enter the value which corresponds to 0dB (reference value).

Power: If for example the signal includes a cross power spectrum, here you enter the value 1. If the signal does not contain a cross power spectrum, i.e. is not a power signal, you enter the value 0 here (default).

8.6.2 Saving Calculated Data

You can add the measurement data which you calculated in the signal processor to the original file as user defined data sets. To do so, you have the following possibilities:

☞ Requirement: the geometry of the objects, i.e. the number of scan points must be the same.

1. Mark the cell which contains the newly calculated measurement data in the signal processor.
2. Click it with the right mouse button and select Copy in the pop-up menu.
3. Then click with the right mouse button the name of the original file in the project browser and select Paste in the pop-up menu.

   Or:
4. Mark the cell which contains the newly calculated measurement data in the signal processor.
5. Holding the left mouse button pressed, drag to the presentation window.

Or:

6. Mark the cell which contains the newly calculated measurement data in the signal processor.

7. Holding the left mouse button pressed, drag to the name of the original file in the project browser.

You will immediately have another channel available with the name Usr. In the list of signals you will find the newly calculated measurement data listed with the name which you entered in the dialog Signal Description.

8.6.3 Displaying Measurement Results

At the same time as the new calculation of the data, the updated graph is shown in the analyzer. The analyzer of the signal processor has the functions described in section 2.7.3. If you mark several table cells, then you will be shown the respective frames for selection. If you select several frames, you will be shown the respective graphs in parallel.

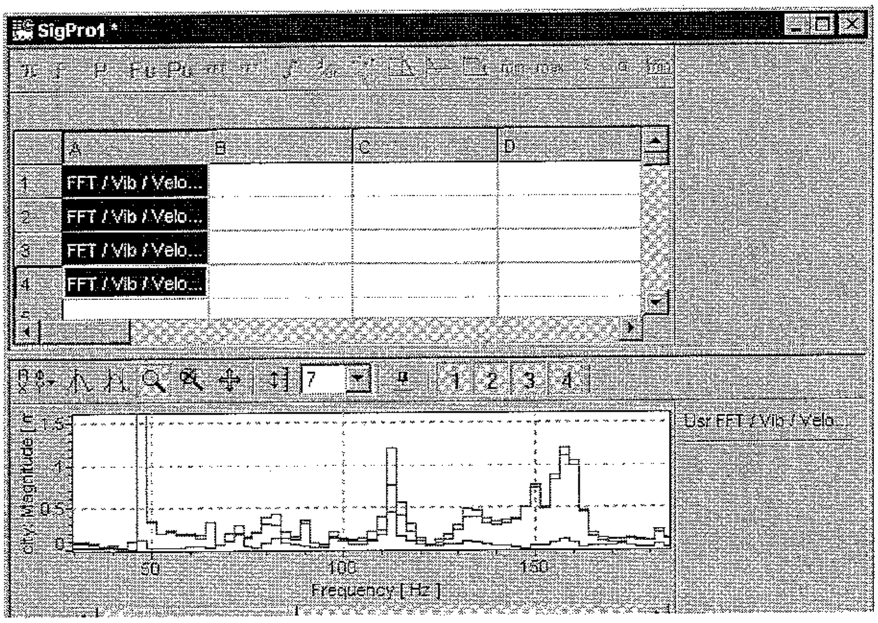


Figure 8.21: Presentation of several graphs in the analyzer

If you would like to stop updating the graph at a certain point in the arithmetic chain, click . The presentation then corresponds to the content of the table cell selected at that moment in time. All subsequent arithmetic steps are carried out anyway, but do not have any effect on the presentation of the graph. Changes in the formulae before the position marked with however still have an effect on the adaptation of the presentation up to this point.

8.6.4 Saving Formulae

To save the formula after you have recalculated the measurement data, proceed as follows:

1. Click or select File > Save As. The dialog Save As appears.

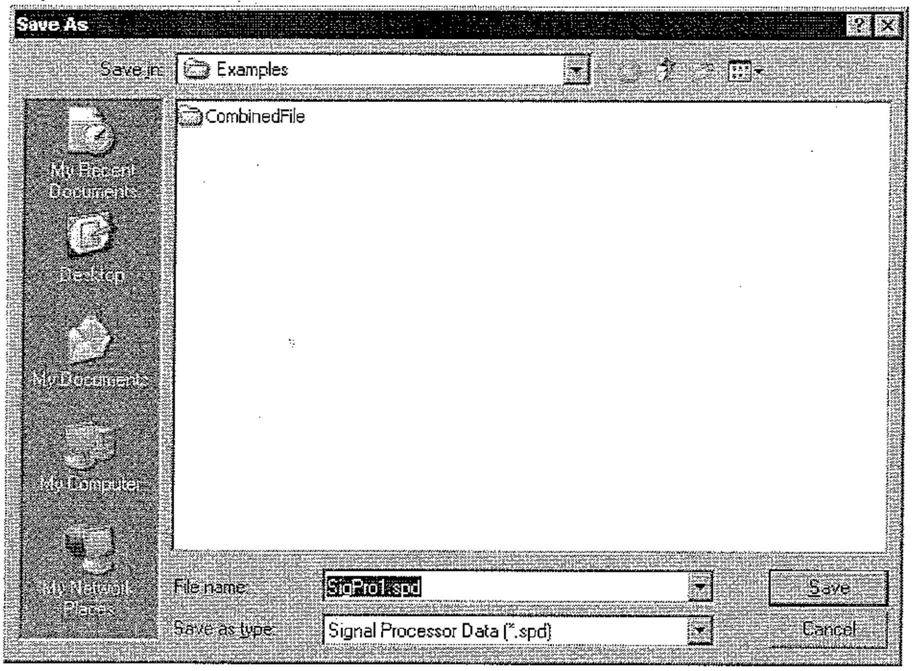


Figure 8.22: Dialog Save As

2. Navigate to the saving location and enter the file name.
3. Click Save.

☞ The file saved in this way does not contain any measurement data itself but only references to data. The reference among other things includes the full path name of the original measurement file. If you move or rename the measurement file, then the references to the measurement data become invalid. To permanently save your results, you have to add them to the original file. A file in the format .spd does not contain any data, just calculation specifications!

8.6.5 Example Applications for Editing Measurement Data

Complex average spectrum through all scan points

During data acquisition, the software calculates an average spectrum across all scan points. However, it is not complex averaging but the amplitudes of the individual spectra are calculated and these amplitudes are averaged. In this example you are shown how you can use the signal processor in presentation mode to help you calculate the complex averaged spectrum across all scan points and can then save it in the original file so that you have access to it at all times.

1. Set up a copy of the example file EXAMPLE2.SVD. To do so, copy the file from the sub-folder Examples in the PSV installation directory (normally C:\Programs\Polytec\PSV 8.2) into a directory of your choice.
2. Select File > New > Signal Processor to generate a new signal processor document.
3. Open the file EXAMPLE2.SVD and display the signal H1 Velocity / Voltage of the channel Vib & Ref1 in the domain FFT.
4. In the presentation window, click in the video image with the right mouse button and select Copy All Points in the pop-up menu.
5. Change to the signal processor.
6. Click the cell A1 with the right mouse button and select Paste in the pop-up menu. The data is available in the signal processor document.
7. Select the cell A2. To do so, click it.
8. Here you enter the command =StatMean(A1) and confirm it with Enter. The signal processor calculates the complex average through all scan points and shows this in the analyzer.

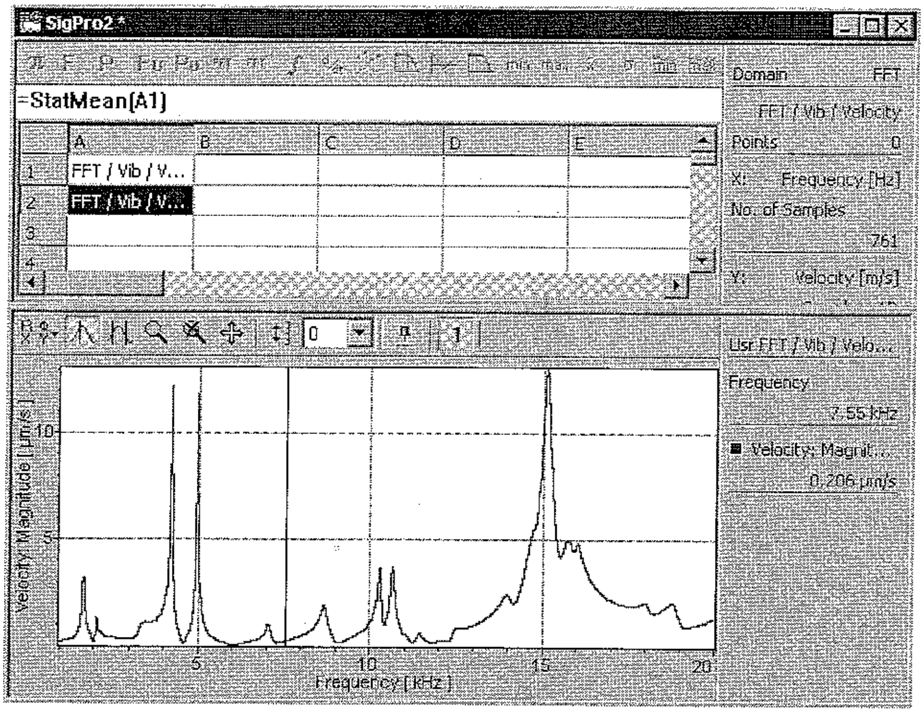


Figure 8.23: Display of the complex average through all scan points

☞ The average through all scan points is given the index 0.

9. Click [icon] in the toolbar of the analyzer and select the view Mag. [dB] & Phase in the pop-up menu to display both amplitude and also the phase of the average spectrum.

10. Click the cell A2 with the right mouse button and select Signal Description in the pop-up menu. The dialog Signal Description appears.

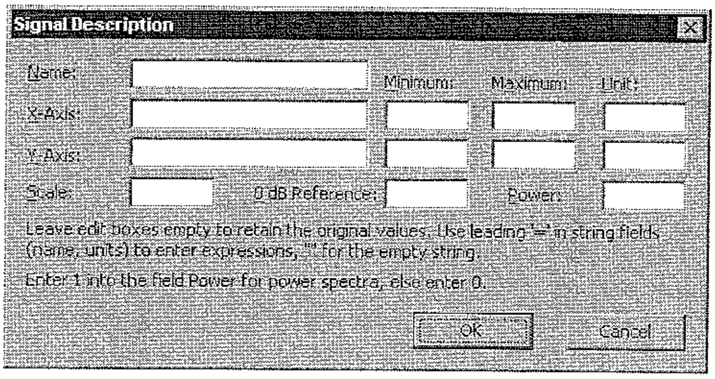


Figure 8.24: Dialog Signal Description

11. In the field Name enter the description Complex Average Spectrum and click OK to close the dialog.

12. Arrange the signal processor and the presentation window so that they are both completely visible. To do so, select Windows > Tile Horizontally.

13. Click the cell A2 in the signal processor.

14. Click the cell A2 again and holding the left mouse button pressed, drag the mouse cursor across to the presentation window. Release the mouse button there. This then means that the data in the cell A2 are added to the channel Usr as a user defined signal Complex Average Spectrum and are saved in the file.

    Or:

15. Click the cell A2 with the right mouse button and select Copy in the pop-up menu.

16. Change to the presentation window.

17. Here you select the view Average Spectrum.

18. Click the analyzer with the right mouse button and select Paste in the pop-up menu. The complex average spectrum is added to the document EXAMPLE2.SVD as a user defined signal.

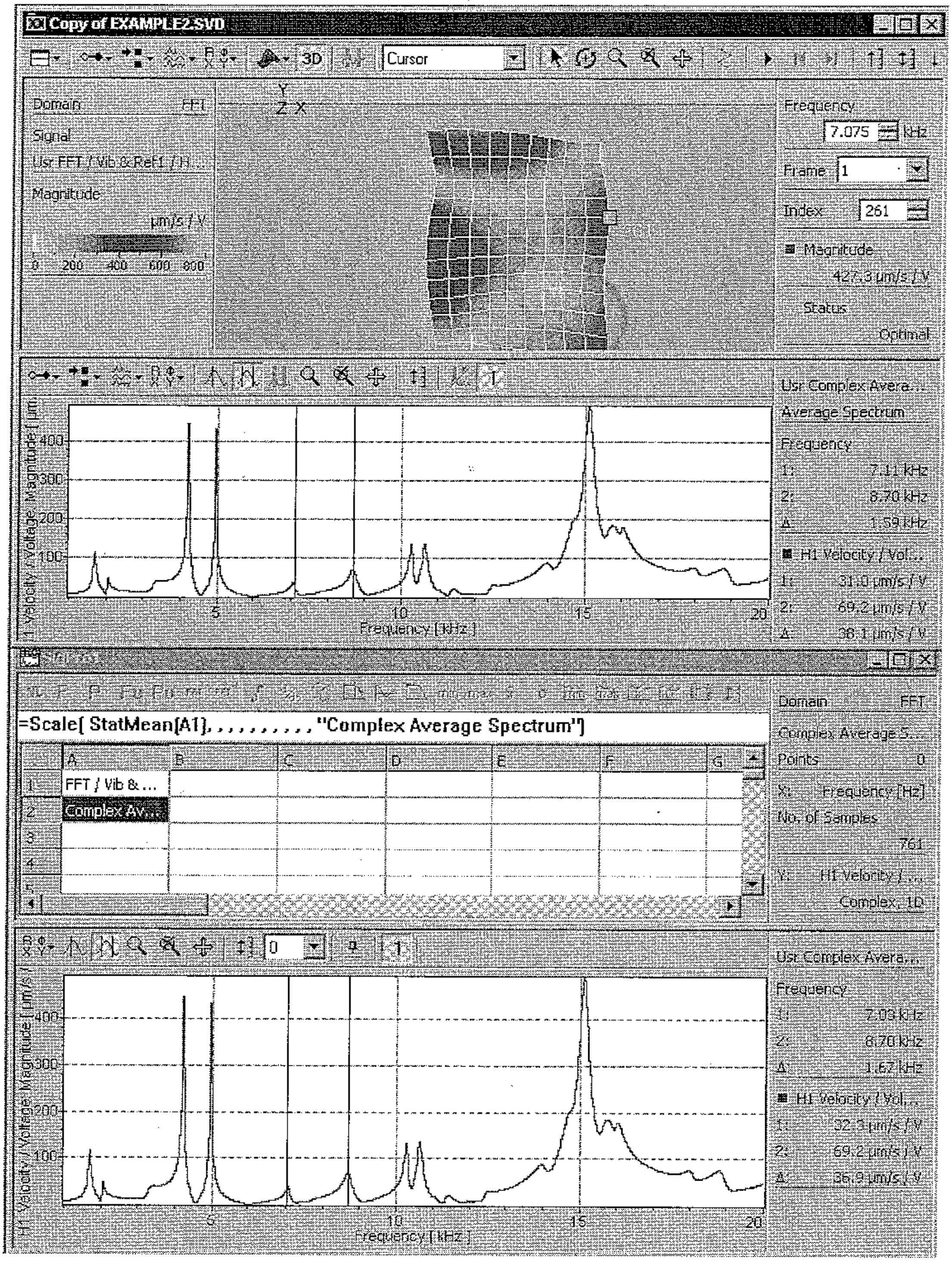


Figure 8.25: Display of complex average spectrum

You can now display the complex average spectrum again at any time. To do so, open the file EXAMPLE.SVD and select

- the view Average Spectrum in the presentation window,
- the channel Usr in the toolbar of the analyzer and
- the signal Complex Average Spectrum in the toolbar of the analyzer.

Multiplication of an FRF with the reference signal

An FRF (Frequency Response Function) is generated by dividing an answer signal (vibrometer signal) by a reference signal (excitation signal). The same applies to the signals H1 and H2. This means that the FRF has for example the unit Velocity/Voltage. The advantage of this process is that fluctuations in the excitation over the duration of the scan do not have any great effect because the measurement at every scan point relates to the excitation measured at this scan point. However, it is often desirable to show the answer in its original unit. This example shows how with the aid of the signal processor you can multiply the FRF with the average spectrum through all scan points of the excitation signal and can save and display the result in the original file.

1. Set up a copy of the example file EXAMPLE2.SVD. To do so, copy the file from the sub-folder Examples in the PSV installation directory (normally C:\Programs\Polytec\PSV 8.2) into a directory of your choice.
2. Select File > New > Signal Processor to generate a new signal processor document.
3. Open the file EXAMPLE2.SVD and display the signal H1 Velocity / Voltage of the channel Vib & Ref1 in the domain FFT.
4. In the presentation window, click in the video image with the right mouse button and select Copy All Points in the pop-up menu.
5. Change to the signal processor.
6. Click the cell A1 with the right mouse button and select Paste in the pop-up menu. The data is available in the signal processor document.
7. Change to the presentation window.
8. Here you select the signal Voltage of the channel Ref1.
9. In the presentation window, click in the video image with the right mouse button and select Copy All Points in the pop-up menu.
10. Change to the signal processor.
11. Click the cell A2 with the right mouse button and select Paste in the pop-up menu. The data is available in the signal processor document.
12. Click the cell A3.
13. Here you enter the command =A1*StatMean(A2) and confirm it with Enter. The signal processor first of all calculates the average of the spectra of the excitation signal through all scan points (StatMean(A2)) and multiplies the result at every spectrum of the signal H1, which is taken from the cell A1. The result is shown in the cell A3.

14. Click the cell A3 with the right mouse button and select Signal Description in the pop-up menu. The dialog Signal Description appears (refer also to figure 8.24).

15. In the field Name enter the description H1 Vib * Ref1 Velocity.

16. In the field Unit on the Y-axis enter the unit m/s.

17. In the field Y-Axis enter the description Velocity and click OK to close the dialog.

18. Arrange the signal processor and the presentation window so that they are both completely visible. To do so, select Windows > Tile Horizontally.

19. Click the cell A3 in the signal processor.

20. Click the cell A3 again and holding the left mouse button pressed, drag the mouse cursor across to the presentation window. Release the mouse button there. This then means that the data in the cell A3 is added to the channel Usr as a user defined signal H1 Vib * Ref1 Velocity and are saved in the file.

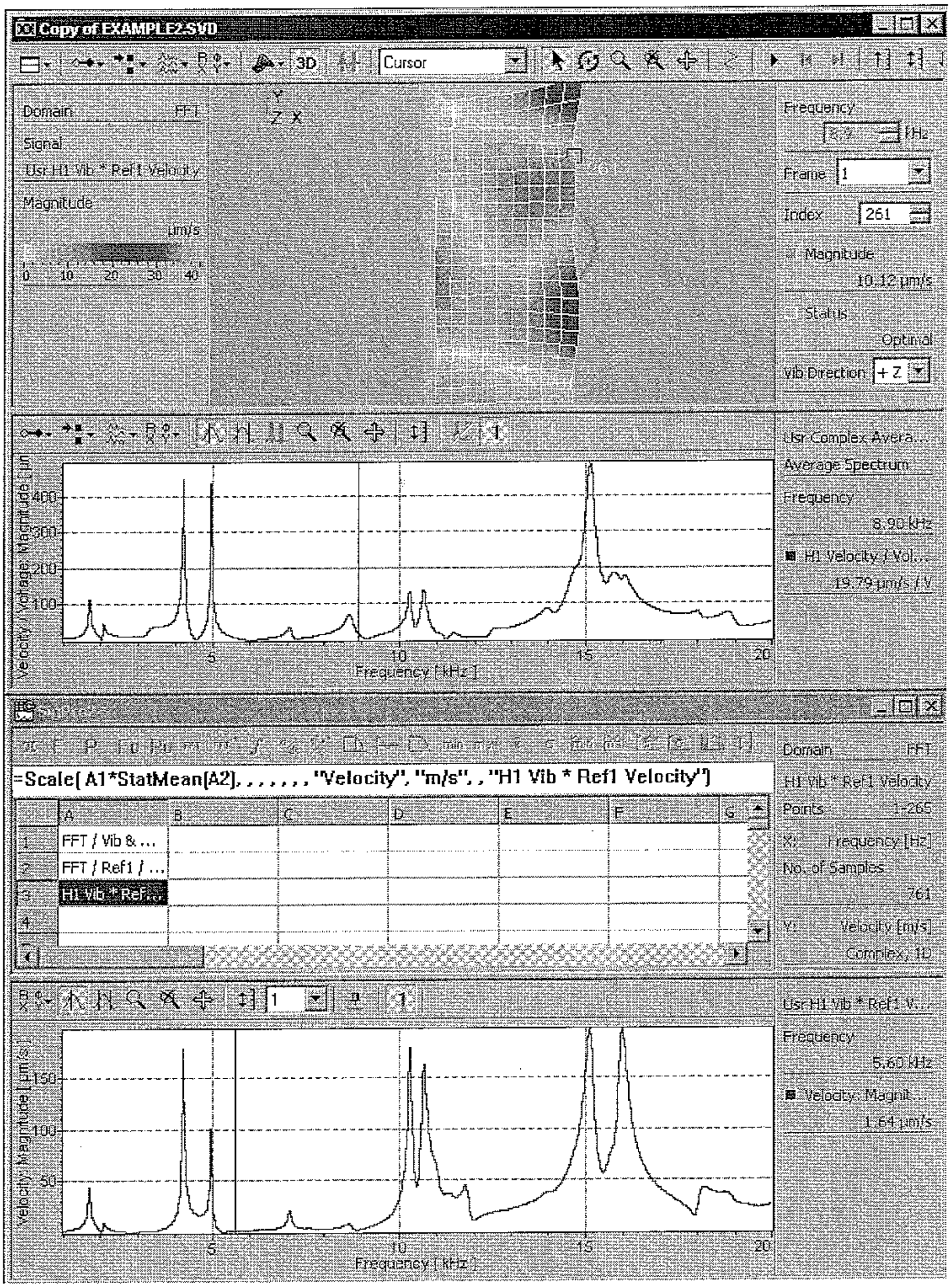


Figure 8.26: Display of the multiplication of FRF and reference signal

From now on you can display the signal H1 multiplied with the average spectrum of the reference channel at any time. To do so, open the file EXAMPLE2.SVD and select the channel Usr and the signal H1 Vib * Ref1 Velocity in the presentation window.

Postprocessing of time series

With the software option Time Domain Data, you can also capture data in the domain Time. With the aid of the signal processor this data can be evaluated. The following example shows the presentation of a time series of the response of a loudspeaker to a rectangular excitation signal.

1. Set up a copy of the example file Ex Time.pvd. To do so, copy the file from the sub-folder Examples in the PSV installation directory (normally C:\Programs\Polytec\PSV 8.2) into a directory of your choice.
2. Select File > New> Signal Processor to generate a new signal processor document.
3. Open the file Ex Time.pvd and display the signal Velocity of the channel Vib in the domain Time.
4. Click in the analyzer with the right mouse button and select Copy in the pop-up menu.
5. Change to the signal processor.
6. Click the cell A1 with the right mouse button and select Paste in the pop-up menu. The data is available in the signal processor document.
7. Click the cell A1. In the analyzer of the signal processor you will see a graphic representation of the time series measured.
8. Click the cell A2.
9. Here you enter the command =Integrate(A1) and confirm with Enter.
10. Click the cell A2 with the right mouse button and select Signal Description in the pop-up menu. The dialog Signal Description appears (refer also to figure 8.24).
11. In the field Name, enter the description Integrated to displacement.
12. In the field Y-Axis, enter the description Displacement.
13. In the field Minimum of the Y-Axis, enter the value −10e−6.
14. In the field Maximum of the Y-axis, enter the value 10e−6.
15. In the field Unit of the -Axis enter the unit m and click OK to close the dialog.

    The analyzer will now display the displacement signal gained by integrating the velocity signal. Along the time axis you will be able to see a linear decay in the signal. This decay is caused by a negative offset on the velocity signal which has an increased effect due to insufficient modulation of the data acquisition board when acquiring the velocity signal.

16. Copy the content of cell A2 into cell B2. To do so, select cell A2 and press the key combination Ctrl+C. Then select cell B2 and press the key combination Ctrl+V.

17. Click in the formulae editor where the formula from cell B2 is displayed.

18. There replace the parameter (A1) of the function Integrate by entering (A1-Mean(A1)) and confirm the change with Enter.

    This change to the formula means that the offset from the time series is subtracted in cell A1. For this purpose, first of all the average of the time series is determined and this average is subtracted from every time value in the time series. As the time series is periodic in the time window measured, this has the effect of completely correcting for the offset.
    Then the integration is calculated.

19. Click the cell B2.

20. Then also select the cell A2. To do so, hold the Ctrl key pressed and click the cell A2.

    The analyzer in the signal processor now shows two graphs. One corresponds to the signal in cell B2 and one to the signal in cell A2. Through a direct comparison of the graphs you can clearly see the disappearance of the linear decay by correction of the offset.

21. Click cell B3 and enter = here.

22. Then click  in the toolbar of the signal processor. This command inserts a template for the function FFT into the input field and the formulae editor.

23. Replace the descriptions VibData with B2, Lines with 256 and Window with "Rectangle" and delete the two descriptions WindowParameter. In doing so, make sure that you put the description "Rectangle" in inverted commas.

24. Confirm the change with Enter.

25. Click the cell B3 with the right mouse button and select Signal Description in the pop-up menu. The dialog Signal Description appears (refer also to figure 8.24).

26. In the field Name, enter the description FFT displacement.

27. In the field X-Axis, enter the description Frequency.

28. In the field Unit of the X-Axis, enter the unit Hz and click OK to close the dialog.

    From the 512 samples of the integrated time series in cell B2, the signal processor will now calculate an FFT with 256 lines and will display this in the analyzer.

29. Arrange the signal processor and the presentation window so that they are both completely visible. To do so, select Windows > Tile Horizontally.

30. Click the cell B2 in the signal processor.

31. Click the cell B2 again and holding the left mouse button pressed, drag the mouse cursor to the analyzer. Release the mouse button there. This process adds the data in cell B2 as a user defined signal Integrated to displacement to the channel Usr and saves it in the file.

32. Repeat steps 30 and 31 for the cell B3. This means you are saving the content of the cell as a user defined signal FFT displacement in the file.

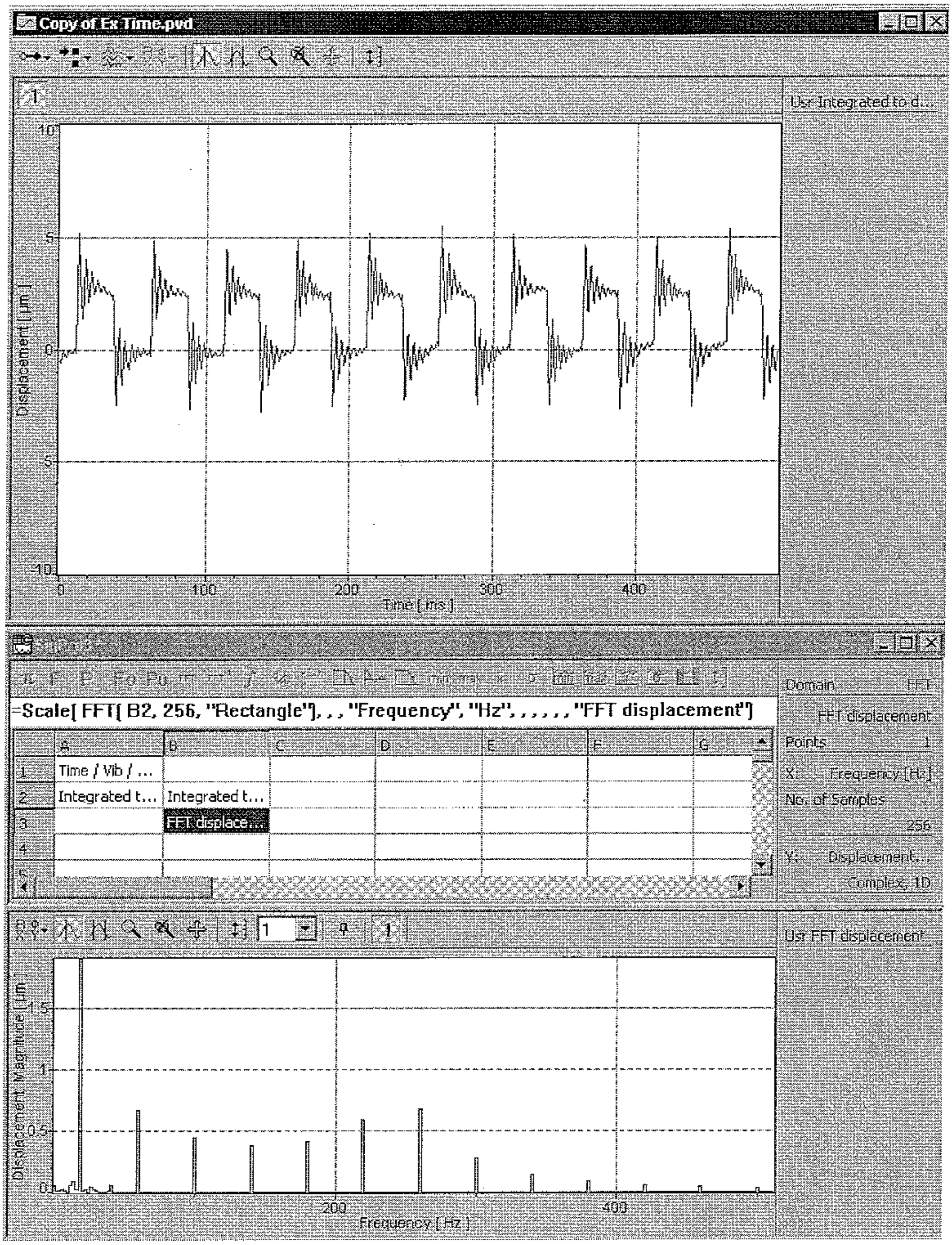


Figure 8.27: Display of postprocessed time series

You can now display the integrated time series and the FFT calculated from it at any time. To do so, open the file Ex Time.pvd and select the domain FFT or Time and the channel Usr.

9 Evaluating Scans

The software offers numerous possibilities to evaluate scans. To do this, first open the scan as described in section 10.1.1. Depending on which measurement mode you used to acquire the data, you will see the results of your measurement in the time or frequency range.

You can see which mode a measurement was carried out in by opening the additional information in the dialog at the bottom of a file.

If you have opened a scan, you will see in the status bar which mode the measurement was carried out in.

If you open a scan, which has been generated in FFT mode, in presentation mode for the first time, you will see the root mean square of the magnitude over the whole bandwidth. You can apply certain evaluation functions directly to the root mean square. See section 9.1 and section 9.3 on this. You can also evaluate sections of the measured spectrum – for example, in the proximity of resonance or 1/3 octave bands. To do so, you first have to define these frequency bands as described in section 9.2. At the peak frequencies of the frequency bands you can also animate the vibration, see section 9.4 on this. You can also evaluate the spectrum with a single cursor, on this refer to section 9.2.1.

In FastScan mode you only measure a certain individual frequency. Correspondingly you will only see a surface-like presentation of the data of this frequency if you open the scan in presentation mode.

If you open a scan generated in Time mode for the first time in presentation mode, you will see the root mean square of the magnitude over the whole sample time. With the time data animation you can present the momentary magnitude of the sample time for selected ranges.

9.1 Processing Data

You can prepare a scan for display with the following commands in the menus Edit and Presentation:

- invalid
- Valid
- Invalidate Not Optimal Points
- Interpolate Data
- Filter Data

In addition you can change specification of vibrational direction

You can undo all commands.

In presentation mode you can mark the scan points you have already measured to be measured again. To do so, allocate the points the status Invalidated as described in the following. Then change back into acquisition and open the file to measure again as described in section 6.2.

In principle, you could give all scan points the status Invalidated, but this is only necessary for those points which have not provided any meaningful measurement result (e.g. those with a bad signal-to-noise ratio). For scan points with the status Invalidated the software does not display any measurement data. The averaged spectrum over all scan points is corrected correspondingly.

☞ Scan points with the status Optimal can only be present if Signal Enhancement was active during scanning (refer to section 6.7.1 and section 7.2.7).

Invalidate

To allocate the status Invalidated to one or several scan points, proceed as follows:

1. Place a cursor at the scan point or points. See section 8.3.4 on this.
2. Press the key combination Ctrl+space bar or select Edit > Modify Selected Points > Invalidate.
3. To reinstate the original status of the scan points, press the key combination Shift+space bar or select Edit > Modify Selected Points > Valid.

Invalidate Not Optimal Points

You can allocate the status Invalidated to all scan points which do not have the status Optimal. This command is only active if

- Signal Enhancement was active while scanning (refer to section 6.7.1 and section 7.2.7)
- not all scan points have got the status Optimal.

To do so, proceed as follows:

1. Select Edit > Invalidate Not Optimal Points.
2. To return to the initial status of the scan points, select Edit > Invalidate Not Optimal Points again.

☞ If you had changed the status of single scan points with the command Invalidate (see above), these scan points are also allocated their original status.

Interpolate Data

For scan points with the status Overrange or Invalid the software does not display any measurement data. You can interpolate and display data from neighboring scan points for these as well as for not optimal scan points.

☞ The software allocates the status Overrange while scanning. You can allocate the status Invalidated manually (see above).

To interpolate, proceed as follows:

1. Select Presentation > Interpolate Data. If you would like to interpolate not optimal points as well, then in addition to that select Edit > Invalidate Not Optimal Points.

2. To undo the command, select Presentation > Interpolate Data again.

Caution!

If Interpolate is active, then in ASCII export only the interpolated data is saved. If you export as a Universal File or access via Polytec File Access, you will obtain the original data.

Filter Data

You can smooth the display of scans with a filter. Filtering is done on two levels. First of all median averaging and then center value filtering of neighboring scan points is carried out.

To smooth the display, proceed as follows:

1. Select Presentation > Filter Data.

2. To undo the command, select Presentation > Filter Data again.

Caution!

If Filter Data is active, then in ASCII export, only the smoothened data is saved. If you export as a Universal File or access via Polytec File Access, you will obtain the original data.

☞ The commands Interpolate Data and Filter Data represent measures taken to rid measurements of interference signals and noise levels. When defining the quantity of scan points, already ensure that there is a sufficient scan point density, depending on the maximum vibration frequency in the object to be measured. Careful scan point definition also helps avoiding interference signals caused by unsuitable selection of scan points, e.g. glancing incidence at the edge of an object or undesirable measurements in object openings.

Change specification of vibrational direction

You can still retrospectively change the direction of the vibration in the presentation window. The vibration direction shown in the legend is the one you selected in the dialog Acquisition Settings on the page Channels (refer to section 7.2.2). Here you can select the direction of the vibration.

☞ You can not change the direction of the vibration for 3D geometries.

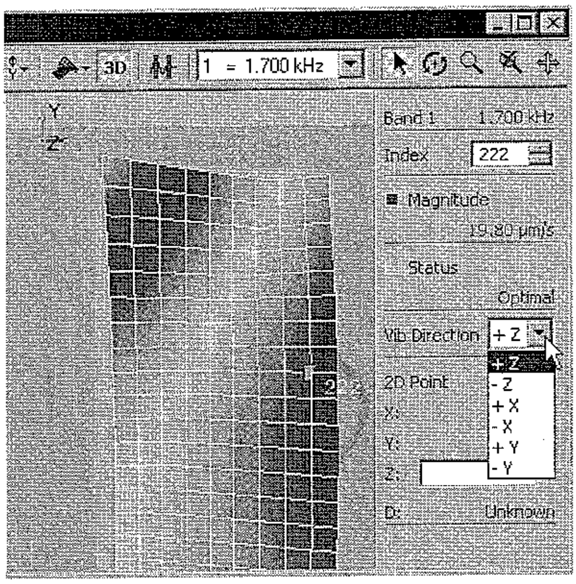


Figure 9.1: Selecting vibration direction

The direction of the vibration defines the scanning head coordinate system. Read up on this in section 4.1 as well (Enter coordinates of axes) and in your theory manual.

9.2 Evaluating Sections of a Spectrum

You can evaluate sections of the measured spectrum. There are two ways of doing this: Select the required points in the spectrum with a cursor, or define so-called frequency bands.

9.2.1 Setting Cursors and Evaluating the Frequency Range (Cursor Mode)

Requirement

With a single cursor you can evaluate spectra for scans which contain a complete spectrum. Scans without a complete spectrum are those

- in which only frequency bands are saved (refer to section 10.2.1)
- which were measured in the measurement mode FastScan
- which were measured in the measurement mode Time.

For evaluation, proceed as follows:

1. Select the domain FFT.
2. From the list Frequency Band, in the toolbar of the presentation window, select the entry Cursor.

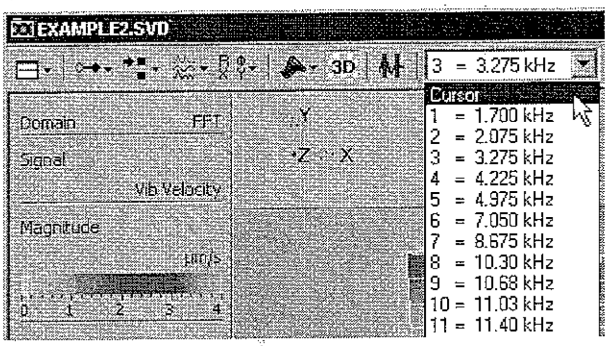


Figure 9.2: Select the entry Cursor

3. Set a single cursor in the analyzer as described in section 8.2.3. The frequency and the amplitude at the current cursor position can be seen in the legend on the right. If the legend is not visible on the right in the analyzer, select Analyzer > Legend to display it. In the presentation window you will see the vibration position which the object under investigation takes at the selected frequency.
4. Drag the cursor while holding the left mouse button pressed to the left or right. This updates the data in the legend and the analysis window.

☞ If you do not set a cursor or delete the cursor you had set, you can also enter the required frequency directly in the legend of the presentation window.

9.2.2 Defining Frequency Bands (not in Time Mode)

To analyze the spectrum with the aid of frequency bands, start by entering the start and end frequencies of the frequency band in the frequency band definition. The software determines the peak frequency and the bandwidth of the frequency bands.

Requirement

You can define frequency bands for scans

- whose file is not write-protected and
- which contain a complete spectrum.

Scans without a complete spectrum are those

- in which only frequency bands are saved (refer to section 10.2.1)
- which were measured in the measurement mode FastScan
- which were measured in the measurement mode Time.

Save

The software automatically saves the frequency band definition in the scan and loads it when you reopen the scan. You can also save frequency band definitions separately as an ASCII file and load them into several scans. See section 10.2.5 and section 10.1.2 on this.

☞ As a general rule, every change to a file is marked with an asterisk (*) in the file name as soon as you make the change. When calculating frequency bands, all changes made thus far are saved.

Define

To define frequency bands, proceed as follows:

1. Either display the view Single Scan Point or Average Spectrum. To do so, click and select Single Scan Point or Average Spectrum.
2. Open the frequency band definition. To do so, click or select Setup > Frequency Bands. The dialog Frequency Band Definition appears.
3. Enter the start and end frequencies of the frequency bands as described below. You have two possibilities to do so: directly in the analyzer or in the dialog Frequency Band Definition. The software determines the peak frequencies of the frequency bands for the data set displayed in the view set.
4. You can change between different views or display other data sets without closing the frequency band definition. The software does not determine the peak frequencies again at that point. To determine the peak frequencies again, in the dialog Frequency Band Definition click .
5. If the software is to calculate 1/3 octave bands, then in the dialog Frequency Band Definition click .
6. When you have defined all frequency bands, close the frequency band definition. To do so, click again or select Setup > Frequency Bands. The software calculates the root mean square of the frequency bands and saves them in the scan.

Analyzer

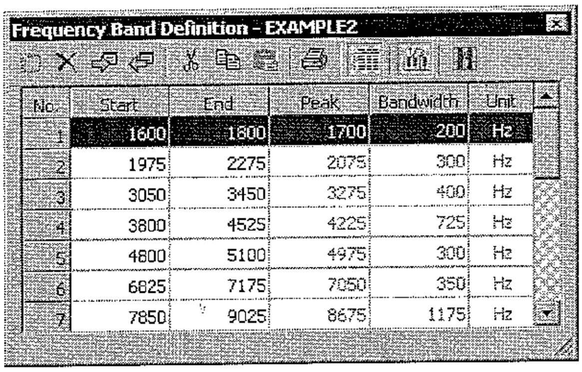
To enter start and end frequency of a frequency band directly in the analyzer, proceed as follows:

1. Click in the analyzer.
2. Point at the diagram (not at the edge of the diagram).
3. Point at the start point of the required frequency band.
4. Press the mouse button and then drag right or left to the end point. The software displays the frequency band in color and enters it in the dialog Frequency Band Definition (see below).

Dialog

To enter start and end frequency of a frequency band in the dialog Frequency Band Definition, proceed as follows:

1. The dialog Frequency Band Definition consists of a toolbar and a table, the frequency band editor. If you can not see the table, display it. To do so, in the toolbar, click .



No.	Start	End	Peak	Bandwidth	Unit
1	1600	1800	1700	200	Hz
2	1975	2275	2075	300	Hz
3	3050	3450	3275	400	Hz
4	3800	4525	4225	725	Hz
5	4800	5100	4975	300	Hz
6	6825	7175	7050	350	Hz
7	7850	9025	8675	1175	Hz

Figure 9.3: Dialog Frequency Band Definition

2. In the toolbar, click . A new line is added to the bottom of the table.
3. Enter the start frequency in hertz. The start and end frequency must be on FFT lines. The software replaces the value entered by the next possible one.
4. Press Tab or click the corresponding cell in the column End.
5. Enter the end frequency in hertz.
6. Press Enter. The software enters the peak frequency and the bandwidth in the frequency band editor and displays the frequency band in the analyzer in color.

Select

To delete or copy frequency bands from the definition, you have to select them first. To do so, proceed as follows:

1. Click the frequency band in the analyzer or its line number in the frequency band editor.
2. To select further frequency bands, press the Control key and click the number of the line in the frequency band editor.
3. To select all frequency bands or to undo a selection, click the top left of the table.

Delete

To delete frequency bands from a definition, proceed as follows:

1. Select the frequency bands as described above.
2. Press the Delete key or in the frequency band editor, click .

Copy

You can copy a frequency band definition via the clipboard into another scan. To do so, proceed as follows:

1. Select the frequency bands as described above.
2. In the dialog Frequency Band Definition, click .
3. Close the frequency band definition. To do so, in the presentation window click or select Setup > Frequency Bands.
4. Open the scan into which you want to copy the frequency bands.
5. Open the frequency band definition again.To do so, click or select Setup > Frequency Bands.
6. In the dialog Frequency Band Definition, click .

Drag with the mouse

You can also apply frequency bands to another scan in the project browser by dragging with the mouse. To do so, proceed as follows:

1. Holding the left mouse button pressed, drag the entry Frequency Band from the project browser to the frequency Band definition.

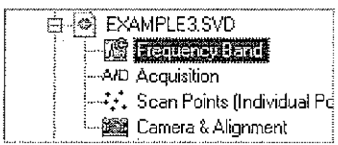


Figure 9.4: Entry Frequency Band in the project browser

2. Close the frequency band definition. A message box appears with the question whether the frequency bands are to be recalculated.
3. Click Yes.

9.3 Displaying Profiles

You can display profiles of the data. To do so, you first draw profile sections on the object. You will see the profiles at the bottom in the analyzer. The software automatically saves the profile sections in the scan and loads them when you reopen the scan.

☞ If you want to draw profile section in a file (including a combined file) or want to display a profile, you first of all have to change over to 2D view.

Draw profile section

To draw a profile section on the object, proceed as follows:

1. Display the Profile view. To do so, click and select Profile in the pop-up menu.
2. Display the view style Surface, Wireframe, Isolines or Scan Points. To do so, click and select the view style in the pop-up menu.
3. Click .
4. Point at the object and click the start point of the profile section. The cursor becomes a .
5. Click as many other vertex points as you like. You can see the profile at the bottom in the analyzer.
6. To define the end point of the profile section, double-click.

Select profile sections

To edit profile sections, you have to select them first. To do so, proceed as follows:

1. Click .
2. Point at a profile section. The cursor becomes a .
3. Click. The software marks the vertex points of the profile section with white handles.
4. To select further profile sections, click them while holding the shift key pressed.
5. To select all profile sections, press the key combination Ctrl+A or select Edit > Select All.
6. To remove a profile section from the selection, click it while holding the shift key pressed. The white handles disappear.

Move profile sections

To move profile sections, proceed as follows:

1. Select the profile sections as described above.
2. Point at one of the lines (not at a vertex point). The cursor becomes a .
3. Press the mouse button and drag in the direction required.

Move vertex points

You can change the shape of profile sections by moving the individual vertex points. To do so, proceed as follows:

1. Select a profile section as described above.
2. Point at a vertex point. The cursor becomes a .
3. Press the mouse button and drag in the direction required.

Duplicate profile sections

To duplicate profile sections, proceed as follows:

1. Select the profile sections as described above.
2. Click  or select Edit > Copy. The profile sections are copied onto the clipboard.
3. Click  or select Edit > Paste.

Delete profile sections

To delete profile sections, proceed as follows:

1. Select the profile sections as described above.
2. Press the Delete key or select Edit > Delete.

Animate

You can animate the profiles' vibrations. See section 9.4 on this.

9.4 Animating Vibrations

For you to be able to animate the measured vibration, during the scan either the signal has to be triggered (phase-related measurement) or a reference signal has to have been captured.

☞ In the measurement mode Time you can not capture a reference signal.

9.4.1 Measurement Mode FFT, Zoom-FFT, FastScan, MultiFrame

If you have carried out a measurement in one of the above mentioned modes, you can set how many images per animation cycle are shown.

To animate a vibration, proceed as follows:

Preparation

1. Define frequency bands for the scan. See section 9.2 on this.
2. Display the frequency band whose peak frequency you want to animate.

   Or:
3. Go to cursor mode (refer to section 9.2.1).
4. Display the FFT spectrum. To do so, click and select FFT in the pop-up menu.
5. Display a complex signal.

☞ For complex signals, the display type Phase is available.

6. It is useful to display the 3D view style. To do so, click 3D. You can animate in all view style apart from the Status view style.
7. If from the list Frequency Band in the toolbar of the presentation window you select the entry Cursor, then depending on the size of the file and the memory capacity of your computer, the following dialog may appear:

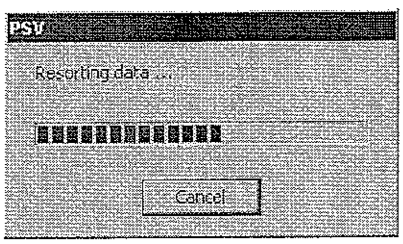


Figure 9.5: Resorting data

If you click Cancel here, you will be given the following message:

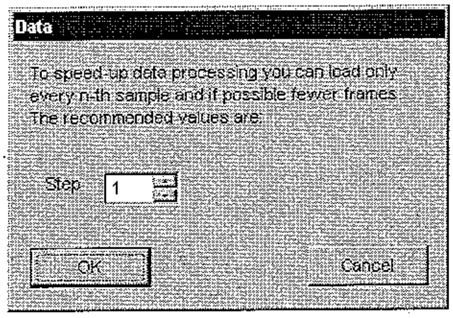


Figure 9.6: Dialog to reduce the quantity of data (general)

It is recommended that you use the suggested value or enter a higher one. Click OK. Subsequently the data will be resorted and you can start animation.

☞ If you set a smaller step size than the one suggested, the subsequent resorting of the data can take quite some time!

User defined data sets

If you are working with user defined data sets (see section 8.6 on this as well), you can also evaluate these.

8. To do so, click and select the channel Usr in the pop-up menu. It is also necessary to resort the data for this. If you abort this, the dialogs shown in figure 9.5 and figure 9.6 will also be shown. In addition to this you can also limit the display of frames here to reduce the quantity of data. The same recommendations as above also apply here.

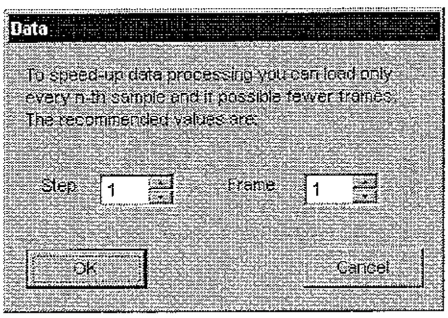


Figure 9.7: Dialog to reduce the quantity of data (for user defined data sets)

Start

There are two ways of starting animation:

9. To start the animation in the active presentation window, click or select Animation > Start. The software shows the signal in the display type Instant Value and animates the vibration. You can see the instantaneous angle in the legend in the field Angle 120°. If the legend is not visible on the right of the object, select Presentation > Legend to display it.

or

To start animations simultaneously in all open presentation windows, select Animation > Start All.

Velocity

10. To increase or decrease the speed of the animations, select Animation > Increase Speed or Animation > Decrease Speed.

Stop

There are two ways of stopping animations:

11. To stop the animation in the active presentation window, click again or select Animation > Stop.

or

To stop all current animation, select Animation > Stop All.

Step forward, step backward

You can manually make animations run forwards and backwards. To do so, click and or select Animation > Step Forward and Animation > Step Backward. You will see the next or previous animation frame respectively.

Frames per animation cycle

If you have carried out the measurement in FFT mode, you can set the number of frames per animation cycle in the dialog Preferences. To open the dialog, select Setup > Preferences. Then display the page Display.

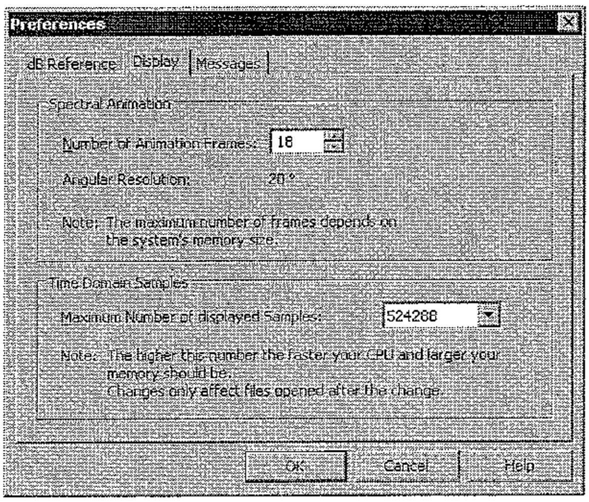


Figure 9.8: Page Display in the dialog Preferences

Number of Animation Frames: Here you enter how many frames per animation cycle you want to see. The minimum number is 8, the maximum number depends on the capacity of your computer's memory. The default setting is 18.

Angular Resolution: The software calculates the phase angle between the data of two frames and displays it here.

Maximum Number of displayed Samples: Here you enter an upper limit for the number of samples to be shown simultaneously in the time domain.

Scale

You can scale the degree of deflection in the animation with non-scalar data. To do so, you have three possibilities:

- To increase the deflection shown, click or select Presentation > Scale Up.
- To show the deflection with the default setting, click or select Presentation > Auto Scale.
- To weaken the deflection shown, click or select Presentation > Scale Down.

Display the vibrational directions (only 3D data)

Once you have made a measurement with the PSV-3D you can show the vibrations of the object individually in x, y and z direction. You can also combine displaying two vibrational directions with each other. To display and hide the vibrations in the various directions, click the icons X, Y and Z. If the letter in the icon is shown in black, then the vibration is being shown in the respective plane. If the letter in the icon is shown in gray, then the vibration is not being shown in the respective plane.

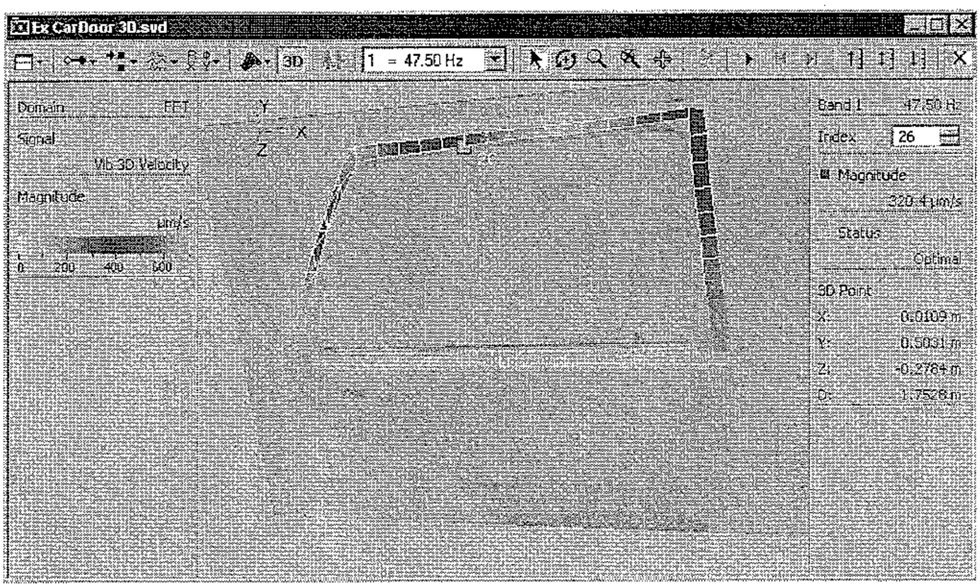


Figure 9.9: Presentation window in the view Object

Save

You can save animations in multimedia format *.avi. See section 10.2.6 on this.

9.4.2 Measurement Mode Time

If you have carried out the measurement in Time mode, you will see the animation in the time domain. To animate a vibration, proceed as follows:

Preparation

1. Display the time domain. To do so, click and select Time in the pop-up menu.

   Depending on the size of the scan file and capacity of your computer's memory, the following dialog may appear:

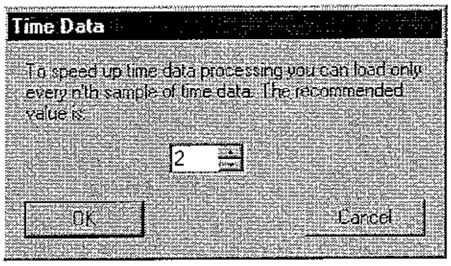


Figure 9.10: Dialog for reducing the time data step size

   It is recommended that you use the suggested value or enter a higher one. Click OK. This means that the time data is resorted and the z-axis scaled correspondingly and you can start the animation in time domain.

☞ If you set a smaller step size than the one suggested, the subsequent resorting of the time data can take quite some time!

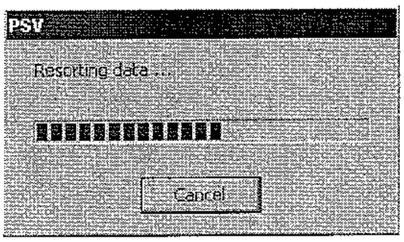


Figure 9.11: Resorting data

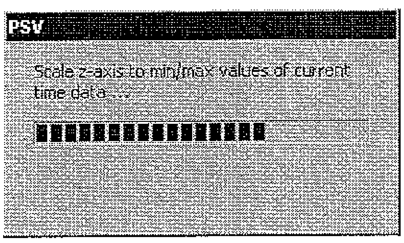


Figure 9.12: Scaling the z-axis

☞ If you click Cancel during resorting, the dialog to reduce the time data step size opens again (refer to figure 9.10).

To return to RMS mode, click Cancel.

2. It is useful to display the 3D view style. To do so, click 3D. You can also animate in all other view styles, however not in the Status view.

3. Select the section within the sample time in which the data is to be animated. There are two ways to do this:

- Enter the start and end time directly into the legend to the right of the presentation window. If the legend is not visible, select Presentation > Legend to display it.

or

Open an analyzer. To do so, click and select Single Scan Point.

Click and with a further mouse click, set the starting point directly in the diagram. (As initially the starting point is identical with the current point in time, it is marked by a red line.)
Hold the mouse button pressed and drag it to the right. A second black line will appear which marks the end point. If the line is in the right place, release the mouse button.

Start

There are two ways of starting animation:

4. To start the animation in the active presentation window, click or select Animation > Start. You can see the defined time frame and the current status of the animation and also the step size in the legend.

or

To start animations simultaneously in all open presentation windows, select Animation > Start All.

You can let the animation run forwards or backwards and stop it at any time, change its speed or save it as described in the following:

Velocity

5. To increase or decrease the speed of the animations, select Animation > Increase Speed or Animation > Decrease Speed.

Stop

There are two ways of stopping animations:

6. To stop the animation in the active presentation window, click again or select Animation > Stop.

or

To stop all current animation, select Animation > Stop All.

Step forward, step backward

You can manually make animations run forwards and backwards. To do so, click and or select Animation > Step Forward and Animation > Step Backward. You will see the next or previous animation frame respectively.

Save

You can save animations in multimedia format *.avi. See section 10.2.6 on this.

10 Managing Data

10.1 Opening Files

The software can open the following files:

- scans in proprietary binary format Scan Data *.svd
- single point measurements in proprietary binary format Single Point Data *.pvd
- signal processor files in proprietary binary format *.spd,
- frequency band definitions in ASCII format
- settings in proprietary binary format *.set.

☞ You can only open files which have been generated with the same or an older version of the software.

Once you have opened a file, you can use the command Info to display additional information in the project browser which you saves with the file. See also section 2.7.4 on this. The dialog File Information appears.

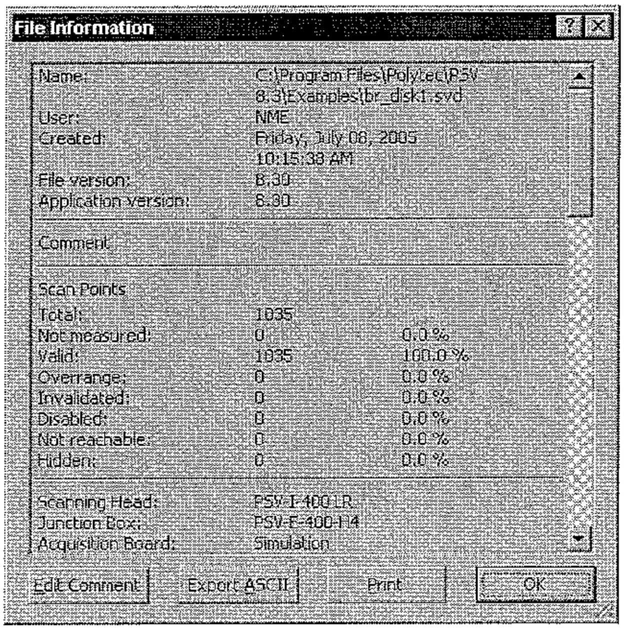


Figure 10.1: Dialog File Information

10.1.1 Opening Scans, Single Point Measurements and Signal Processor Documents

In presentation mode, you can open scans and single point measurements in the proprietary binary formats Scan Data *.svd and Single Point Data *.pvd. There are two ways of doing this:

- the dialog Open
- the list of most recent files in the menu File.

You can also open the last scan measured if you change into presentation mode. To do this, follow the instructions in the software.

You can use the project browser to open the files, refer to section 2.7.4 on this.

Dialog

To open a scan or a single point measurement, proceed as follows:

1. Click  or select File > Open. The dialog Open appears.

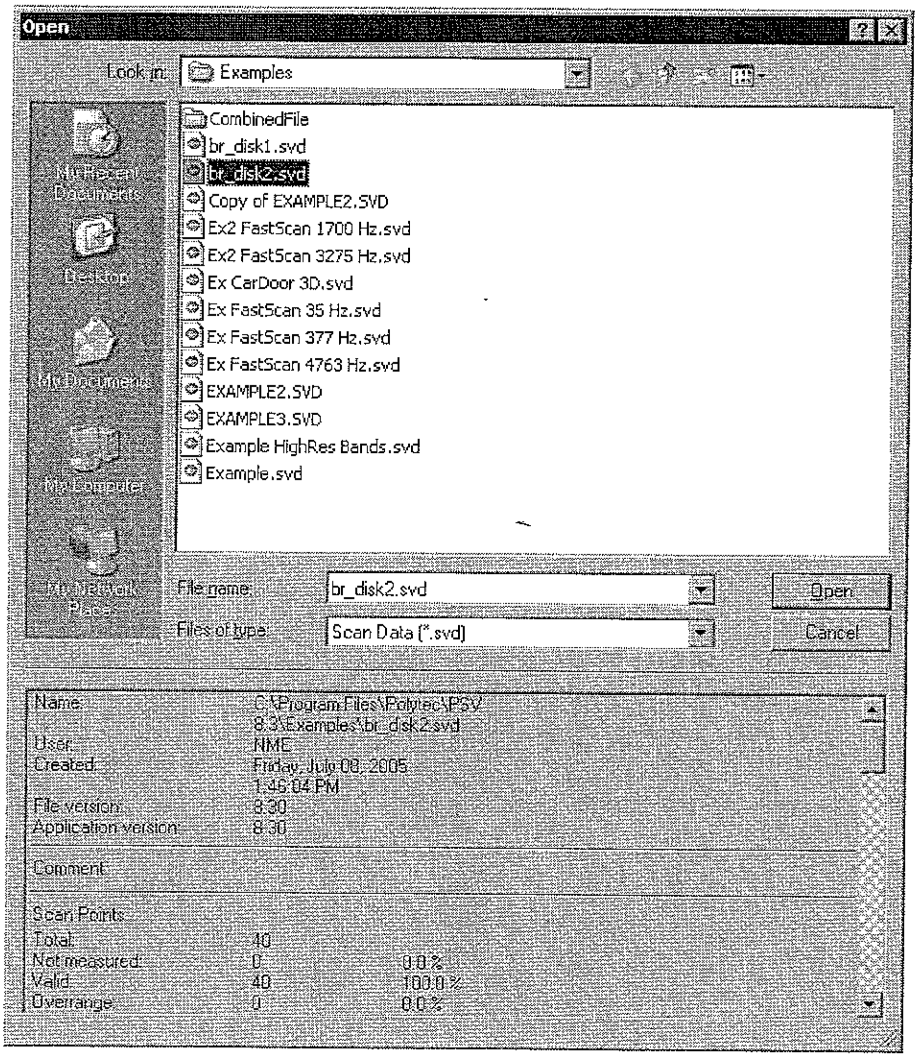


Figure 10.2: Dialog Open

2. Navigate to the saving location and select the file type and name. To make it easier to identify the files, look at meta-information at the bottom in the dialog – for example, the data acquisition board and the settings with which the data was measured.

3. Click Open. If you open a scan, a presentation window appears. If you open a single point measurement, an analyzer appears.

File list

In presentation mode, in the menu File at the bottom there is a list with up to nine files which you last opened. In the menu File at the bottom there is a list with up to nine files which you last opened.To open one of these files again, click it in the list.

10.1.2 Loading Frequency Band Definition

In presentation mode, you can load frequency band definitions in ASCII format.

☞ When you load a frequency band definition, the existing one is overwritten.

To load a frequency band definition, proceed as follows:

1. Open the scan you want to load a frequency band definition for. See section 10.1.1 on this.

2. Open the frequency band definition. To do so, click . The dialog Frequency Band Definition appears.

3. In the dialog Frequency Band Definition, click . The dialog Open appears.

4. Navigate to the saving location and select the file.

5. Click Open.

6. Close the frequency band definition. To do so, click again.

10.1.3 Loading and Deleting Settings

In acquisition mode, you can load settings from files in proprietary binary format *.set and load them from measurement files. You can only delete settings if they are saved in a settings file (*.set). You can not delete the settings of a measurement file.

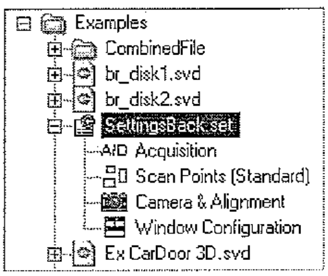
You can load the following information from setting files and measurement files:

- the settings for data acquisition in the dialog Acquisition Settings (only possible for identical data acquisition boards)
- the scan point definition
- the settings of the optics (alignment, only PSV 400 and PSV 300: zoom and focus of the video camera)
- the window configuration (not possible from scans).

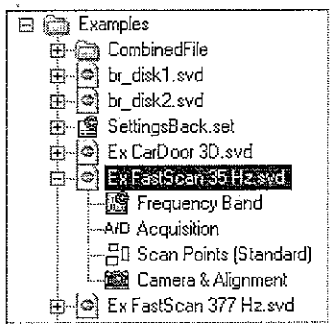
Load

To load settings, proceed as follows:

1. Open the project browser (refer tosection 2.7.4).
2. Open a directory which contains setting files or measurement files.
3. Click the plus sign (⊞) in front of the setting file (*.set) or measurement file (*.svd), whose settings you want to load. You will see a list of settings which are saved in the file.



Settings in the setting file



Settings in the measurement file

Figure 10.3: List of saved settings

Load individual settings

4. If you only want to load certain settings from a file, mark them. To mark several settings at once, hold the control key pressed and click the respective settings.
5. Double-click the selected line(s).

   Or:
   Click the marked settings with the right mouse button and select Load in the pop-up menu.

Load all settings

6. If you want to load all settings from a setting file, double-click the file name.

   Or:
   Click the file name with the right mouse button and select Load in the pop-up menu.

A message box appears with the question whether you want to overwrite your settings until now. Click Yes.

Delete

To delete settings, proceed as follows:

☞ You can only delete settings if they are saved in a settings file (*.set). You can not delete the settings of a measurement file.

1. Open the project browser (refer to section 2.7.4).
2. Click the plus sign (⊞) in front of the setting file (*.set), whose settings you want to delete. You will see a list of settings which are saved in the file (refer to figure 10.3).

Delete individual settings

3. If you only want to delete certain settings from the setting file, mark them. To mark several settings at once, hold the control key pressed and click the respective settings.
4. Click the marked settings with the right mouse button and select Delete in the pop-up menu.

Delete the setting file

5. If you want to delete the setting file, click the file name with the right mouse button and select Delete in the pop-up menu.

10.2 Saving and Exporting

The software provides the following ways of saving and exchanging data:

- save scans in proprietary binary format Scan Data *.svd
- save scans with frequency band data, but without point data in proprietary binary format Scan Data *.svd
- save scans with user defined data sets, but without frequency band data and original point data in proprietary binary format Scan Data *.svd
- save single point measurements and average spectrum in the proprietary binary format Single Point Data *.pvd
- export measurements in Universal File Format *.uff (as an option)
- export measurements in ME'Scope format (as an option)
- saving frequency band definitions in ASCII format
- save animations in multimedia format *.avi
- save settings in proprietary binary format *.set
- export measurement data in ASCII format
- save windows in various graphics formats
- copy windows as graphics onto the clipboard.
- newly calculated measurement files as a signal processor document in the format *.spd.

10.2.1 Saving Scans

Complete scan

When you start a scan, the software automatically creates a file for the scan and prompts you to save. See section 6.2 on this. When scanning, the software saves the following data in proprietary binary format Scan Data *.svd:

- the settings (refer also to section 10.2.7),
- the spectra at all completely measured scan points (single point spectra),
- the average spectrum of all scan points,
- the root mean square of the magnitude over the entire bandwidth.

Even if you abort a scan, the software has saved all scan points which had already been measured.

In presentation mode you can define frequency bands for a scan (refer to section 9.2) and draw profile sections (refer to section 9.3). The software automatically saves the frequency band definitions and profile sections in the scan.

Frequency bands

In presentation mode, often only certain sections of the frequency range measured are of interest. For these sections you usually define frequency bands and then evaluate only those frequency bands. You can then save this scan without the single point spectra, as the frequency bands contain all relevant information. This means you can save a lot of disc space. The scan is then subject to certain limitations:

- You can not define any other frequency bands.
- The view Single Scan Point is not available.

Please note that the average spectrum saved corresponds to the original data and not to the spectrum created by removing invalidated single points (refer also to section 9.1).

To save a scan without single point spectra, proceed as follows:

1. Open the scan you want to save. See section 10.1.1 on this.
2. Define the frequency bands which you want to evaluate. See section 9.2 on this.
3. Select File > Save Bands. The dialog Save As appears.
4. Navigate to the saving location and enter the file name. The software suggests the file name scan name_b. However, you can also select another file name.

☞ If you have displayed the project browser (refer to section 2.7.4), you will then automatically be shown the directory marked there as saving location.

5. Click OK.

10.2.2 Saving Single Point Measurement and Average Spectrum

In acquisition mode, you can save the measurement in the active analyzer in the proprietary binary format Single Point Data *.pvd. In presentation mode, you can save the single scan point or the average spectrum displayed from a scan. Please note that the average spectrum saved corresponds to the original data and not to the spectrum created by removing invalidated single points (refer also to section 9.1). In doing so, the software saves the following data:

- time signals
- spectra
- parameters for data acquisition and evaluation.

To save, proceed as follows:

1. Select File > Save Analyzer As. The dialog Save As appears.

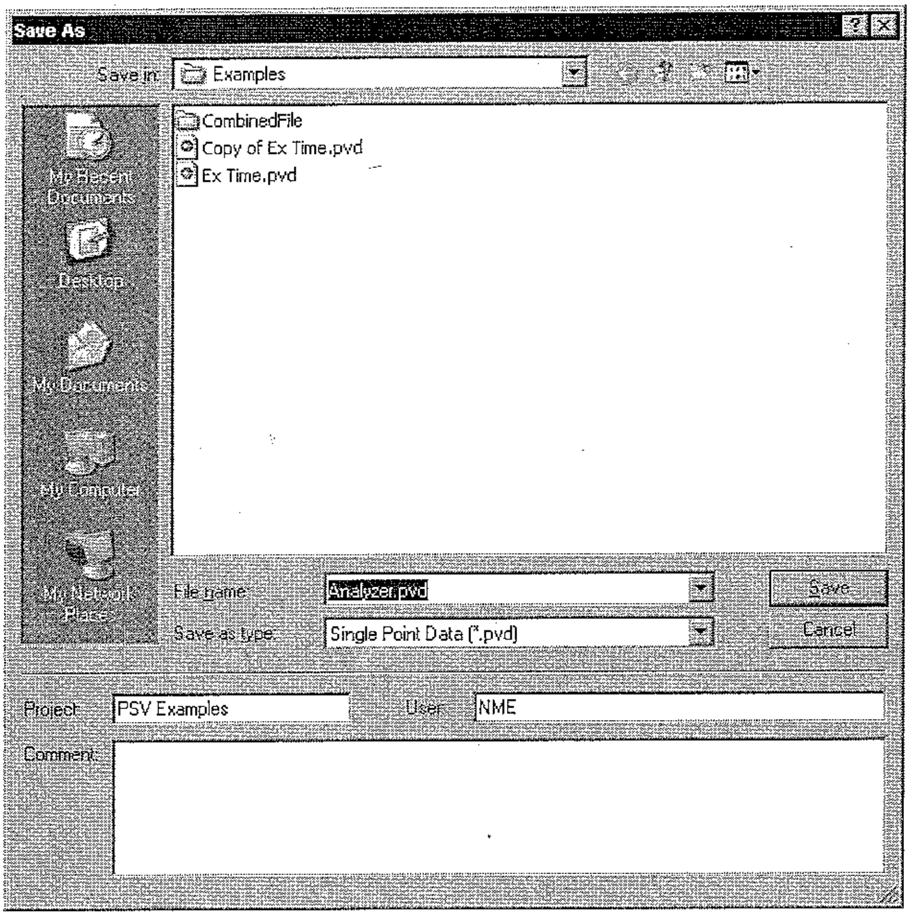


Figure 10.4: Dialog Save As

2. Navigate to the saving location and enter the file name.

☞ If you have displayed the project browser (refer to section 2.7.4), you will then automatically be shown the directory marked there as saving location.

3. At the bottom in the dialog you can enter meta-information to give the file more precise properties. This meta-information is part of the file properties which you can also view and edit in Explorer. You can also call up this information using the command Info in the project browser (refer to section 2.7.4).

4. Click Save.

10.2.3 Exporting Universal File (as an Option)

In both acquisition and presentation mode, you can export files in Universal File format which is compatible with the modal analysis software from the companies SDRC (MTS), LMS and STAR and Vibrant (ME'Scope). To do this, you need the option Universal File Format.

☞ You can export Universal Files in acquisition, but not in APS mode.

Scan points with the status Not Measured, Overrange or Invalidated are not exported. Data evaluation with Presentation > Filter Data and Presentation > Interpolate Data does not have any effect on export, the measured data is exported. Only with option VDD: Measurements in measurement mode I/Q can not be exported as Universal Files.

Signals which have been gained from the original signals through integration and differentiation can be exported.

To export a Universal File, proceed as follows:

1. If you want to carry out a Universal File Export in presentation mode, open the scan you want to export. See section 10.1.1 on this.
2. Select File > Export > Universal File. The dialog Save As appears.

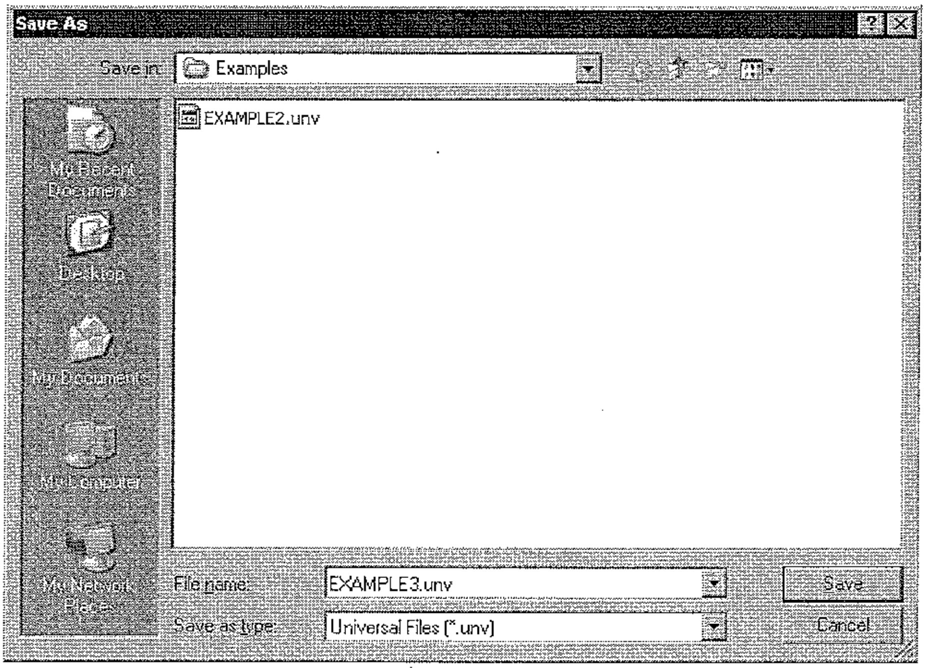


Figure 10.5: Dialog Save As

3. Navigate to the saving location and enter the file name.

☞ If you have displayed the project browser (refer to section 2.7.4), you will then automatically be shown the directory marked there as saving location.

4. Click Save. The dialog Universal File Export appears.

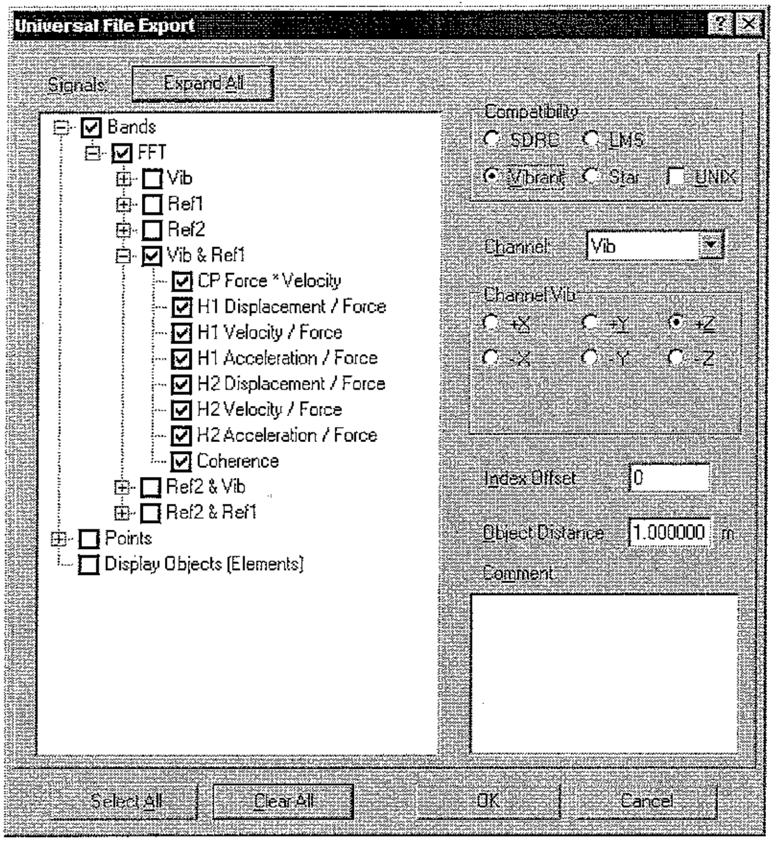


Figure 10.6: Dialog Universal File Export in presentation mode

5. If you export the data in acquisition mode, you are only offered the display of objects to choose from.

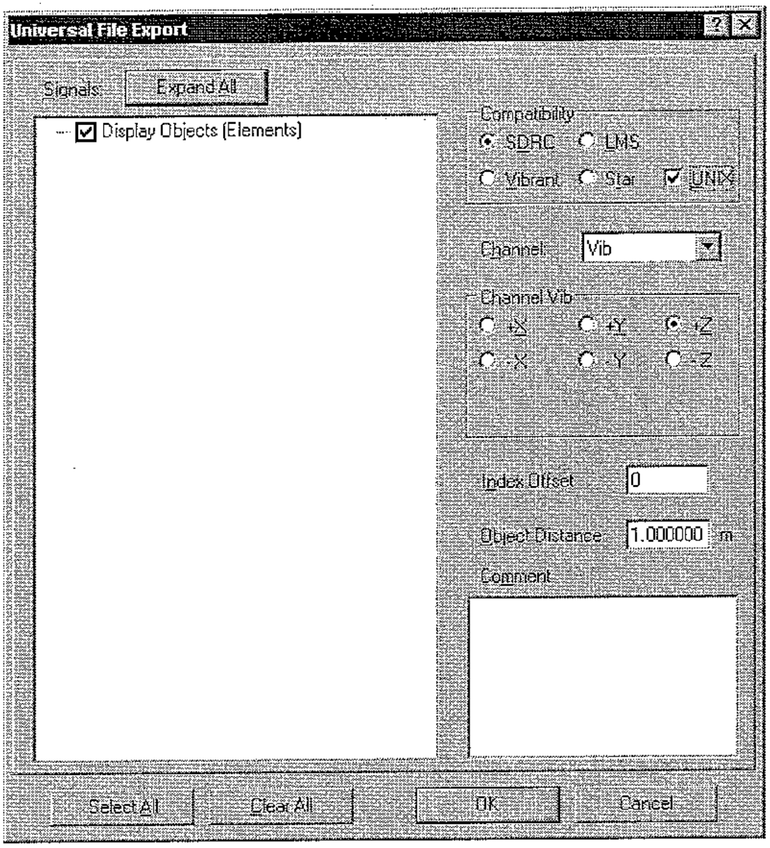


Figure 10.7: Dialog Universal File Export in acquisition mode

6. Mark the signals which you want to export and set the parameters for export. You will find information on this in the following.

7. Click OK.

You can correct the entries from the measurement file again for the current export and also enter new settings for files which already exist. The changes however do not have any effect on the measurement file saved.

Signals

On the left you mark the signals which you want to export. The selection available depends on which signals you have measured and whether frequency bands have been defined. If Display Objects (Elements) is ticked, then a graphic representation of the scan points and their connections is exported.

☞ If you want to export a Universal File in acquisition mode, here you can only select the display of the objects.

Parameters

On the right you set the parameters for export.

Compatibility: Here you select the modal analysis software which the Universal File is to be compatible with. You will find a brief description of the data sets used in table 10.1. For detailed information on this, see the manual for your modal analysis software.

Table 10.1: Data sets which are exported in the Universal File

Data Set	Description	SDRC (MTS)	LMS	STAR	Vibrant
Header	General information, e.g. file name, date, comment	151	151	151	151
Units	Units of the signals and coordinates	164 Double precision	164 Double precision	164 Double precision	164 Double precision
Nodes (Geometry)	Coordinates of the scan points	2411 Double precision	2411 Double precision	15 Single precision	2411 Double precision
Elements (Trace Lines)	Graphic representation of the scan points and their connections	2412+82 Integer	82 Integer	82 Integer	2412+82 Integer
Frequency bands	A data set for every frequency band and every signal	55 Single precision	55 Single precision	55 Single precision	55 Single precision
Scan points	A data set for every signal and every scan point	58 Single precision	58 Single precision	58 Single precision	58 Single precision

UNIX: Tick the box if you carry out modal analysis under UNIX. Text lines will then be ended with a line feed to be UNIX-compatible. Special characters in the comment – for example, German umlauts – are not adapted to UNIX.

Channel: Here you select the channel for which you want to see or change the direction of the vibration or the reference excitation.

Channel <Name>: Here you can see the direction of the vibration or the reference excitation for the selected channel (e.g. Ref3) and change it if necessary.

☞ It is not possible to specify the vibrational direction for the channel Vibrometer 3D.

Reference Point: If you have measured the reference signal at one of the scan points, then you can enter the index of this reference point here.

Index Offset: Here you can enter an offset which the software adds to the indices of the scan points. This helps avoid an index being allocated more than once if you want to evaluate several scans at the same time.

Object Distance: Here you enter the stand-off distance in meters, measured from the front panel of the scanning head. In proprietary file format, the coordinates of the scan points are saved as angles, in the Universal File however in cartesian coordinates. Thus the stand-off distance is required for the conversion. For measurements with the close-up unit PSV-A-410 or OFV-056-C, you have to add 41 millimeters to the stand-off distance. This corresponds to the optical path length within the close-up unit. As a preset the software shows the distance here which you have given in the legend in the element 2D Point (refer to section 4.1). You can correct this distance here again however, this does not have any effect on the distance saved in the measurement file.

☞ This field does not appear for 3D geometries.

Comment: Here you can enter comments up to 80 characters long.

10.2.4 Exporting ME'Scope (as an Option)

You can export files in ME'Scope format in both data acquisition and also in presentation mode. To do this, you need the option ME'Scope.

In data acquisition you can export the object geometry so that you can makes further use of it in other applications for example. You can export scans in presentation mode. Export will provide up to three files with the following data:

- single points in the format *.blk (block)
- frequency bands in the format *.shp (shape)
- geometry in the format *.str (structure)

Scan points with the status Not Measured, Overrange or Invalidated are not exported. Data evaluation with Presentation > Filter Data and Presentation > Interpolate Data does not have any effect on export, the measured data is exported. Only with option VDD: Measurements in measurement mode I/Q can not be exported as ME'Scope.

To export to ME'Scope, proceed as follows:

1. If you want to carry out an ME'Scope Export in presentation mode, open the scan you want to export. See section 10.1.1 on this.

2. Select File > Export > ME'Scope. The dialog Save As appears.

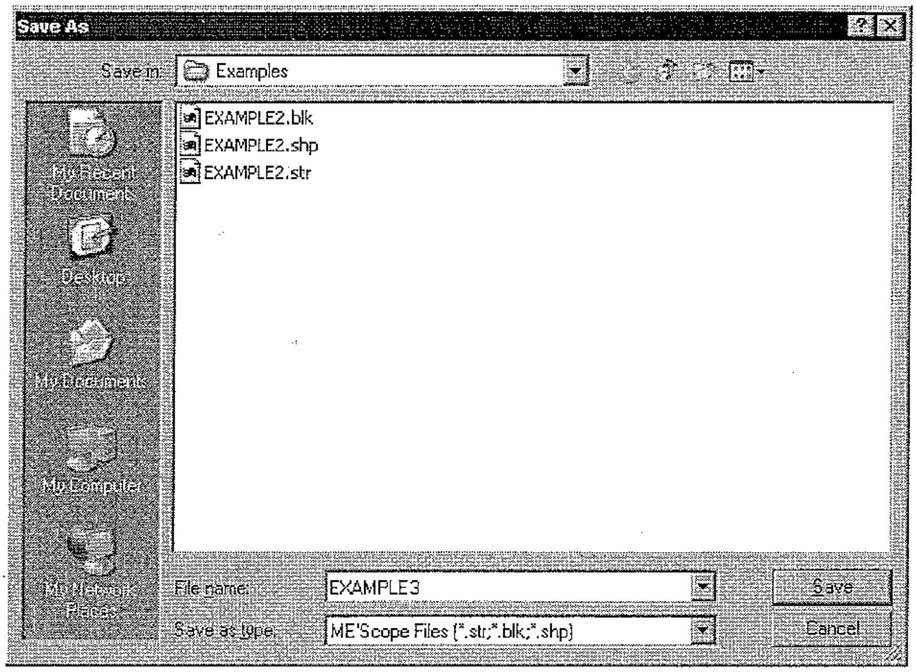


Figure 10.8: Dialog Save As

3. Navigate to the saving location and enter the file name.

☞ If you have displayed the project browser (refer to section 2.7.4), you will then automatically be shown the directory marked there as saving location.

4. Click Save. The dialog ME'Scope Export appears.

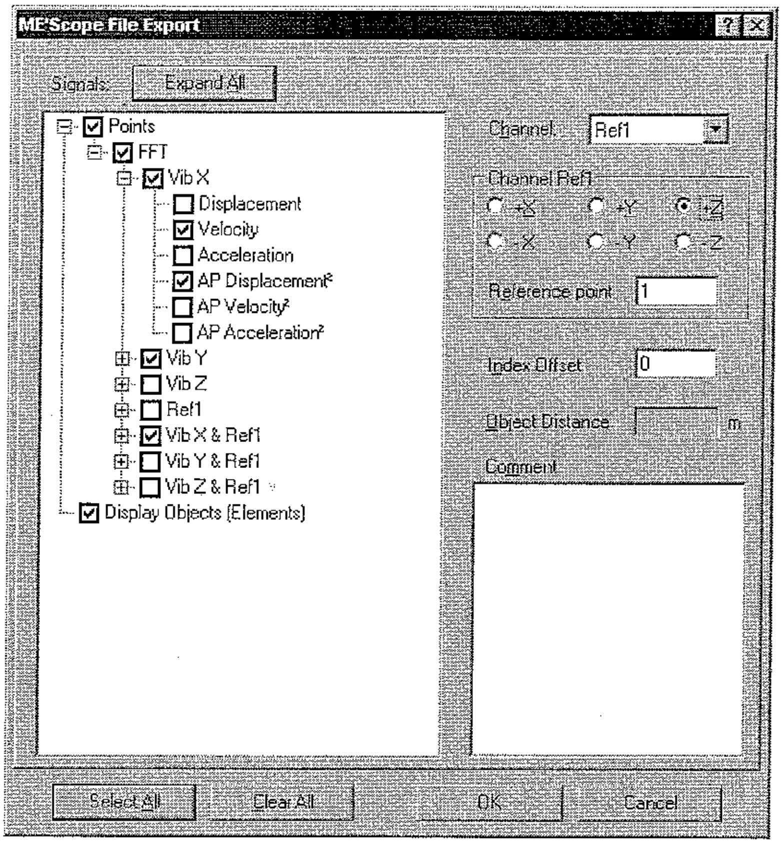


Figure 10.9: Dialog ME'Scope Export in presentation mode

5. If you export the data in acquisition mode, you are only offered the display of objects to choose from.

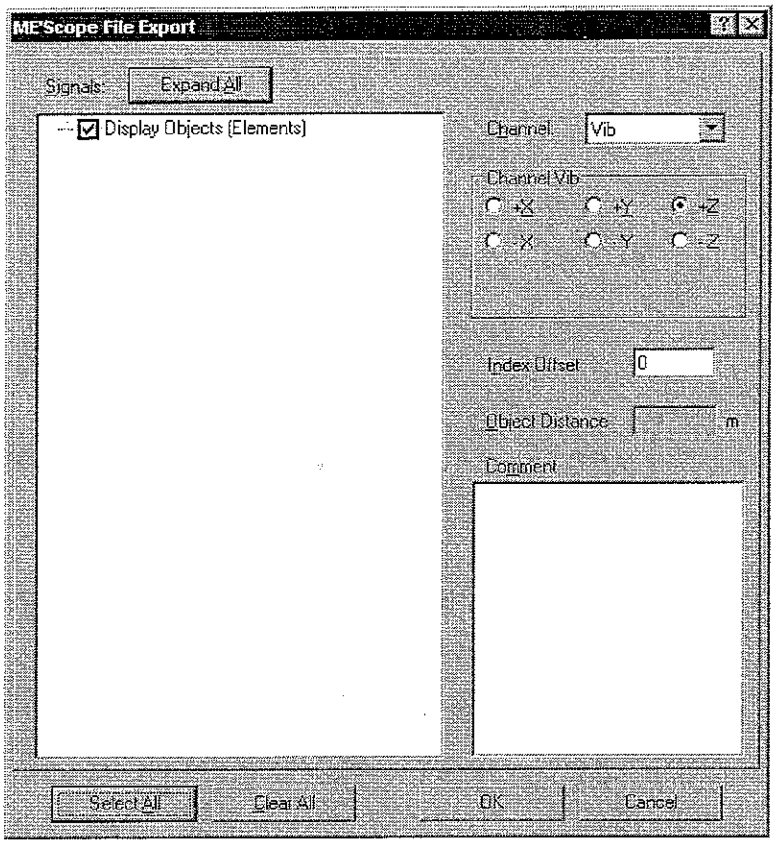


Figure 10.10: Dialog ME'Scope Export in acquisition mode

6. Mark the data which you want to export and set the parameters for export. You will find information on this in the following.

☞ Different domains, e.g. Time and FFT, can not be exported together. Export these domains individually one after the other.

7. Click OK.

You can correct the entries from the measurement file again for the current export and also enter new settings for files which already exist. The changes however do not have any effect on the measurement file saved.

Signals

On the left you mark the signals which you want to export. The selection depends on whether you are exporting in acquisition or in presentation mode, which signals you measured and whether frequency bands have been defined. If Display Objects (Elements) is ticked, then a graphic representation of the scan points and their connections is exported.

Parameters

On the right you set the parameters for export.

Channel: Here you select the channel for which you want to see or change the direction of the vibration or the reference excitation.

Channel <Name>: Here you can see the direction of the vibration or the reference excitation for the selected channel and change it if necessary.

☞ It is not possible to specify the vibrational direction for the channel Vibrometer 3D.

Reference Point: If you have measured the reference signal at one of the scan points, then you can enter the index of this reference point here.

Index offset: Here you can enter an offset which the software adds to the indices of the scan points. This helps avoid an index being allocated more than once if you want to evaluate several scans at the same time.

Object Distance: Here you enter the stand-off distance in meters, measured from the front panel of the scanning head. In proprietary file format, the coordinates of the scan points are saved as angles, in ME'Scope format however, as cartesian coordinates. Thus the stand-off distance is required for the conversion. For measurements with the close-up unit PSV-A-410 or OFV-056-C, you have to add 41 millimeters to the stand-off distance. This corresponds to the optical path length within the close-up unit. As a preset the software shows the distance here which you have given in the legend in the element 2D Point (refer to section 4.1). You can correct this distance here again however, this does not have any effect on the distance saved in the measurement file.

☞ This field does not appear for 3D geometries.

Comment: Here you can enter comments up to 80 characters long.

10.2.5 Saving Frequency Band Definition

In presentation mode, you can save the current frequency band definition in ASCII format. To do this, proceed as follows:

1. Open the frequency band definition. To do so, click . The dialog Frequency Band Definition appears.

2. In the dialog Frequency Band Definition, click . The dialog Save As appears.

3. Navigate to the saving location, enter the file name and select the file extension.

☞ If you have displayed the project browser (refer to section 2.7.4), you will then automatically be shown the directory marked there as saving location.

4. Click Save.

5. Close the frequency band definition. To do so, click again.

10.2.6 Saving Animations

In presentation mode, you can save animations in multimedia format *.avi. You will find information on animations in section 9.4.

To save an animation, proceed as follows:

1. Open the scan you want to save an animation for. See section 10.1.1 on this.

2. Set your animation up as described in section 9.4.1 or section 9.4.2.

3. Select File > Save Animation. The dialog Save As appears.

☞ If the presentation window contains an analyzer, you can select whether you would like to save an animation from top, bottom or both diagrams.

4. Navigate to the saving location and enter the file name.

☞ If you have displayed the project browser (refer to section 2.7.4), you will then automatically be shown the directory marked there as saving location.

5. Click Save.

10.2.7 Saving Settings

In acquisition mode, you can save the current settings in proprietary binary format *.set. A setting file contains:

- the settings for data acquisition in the dialog Acquisition Settings
- the scan point definition
- the settings of the optics (alignment, only PSV 400 and PSV 300: zoom and focus of the video camera)
- the window arrangement .

To save settings, proceed as follows:

1. Click or select File > Save Current Settings As. The dialog Save As appears.

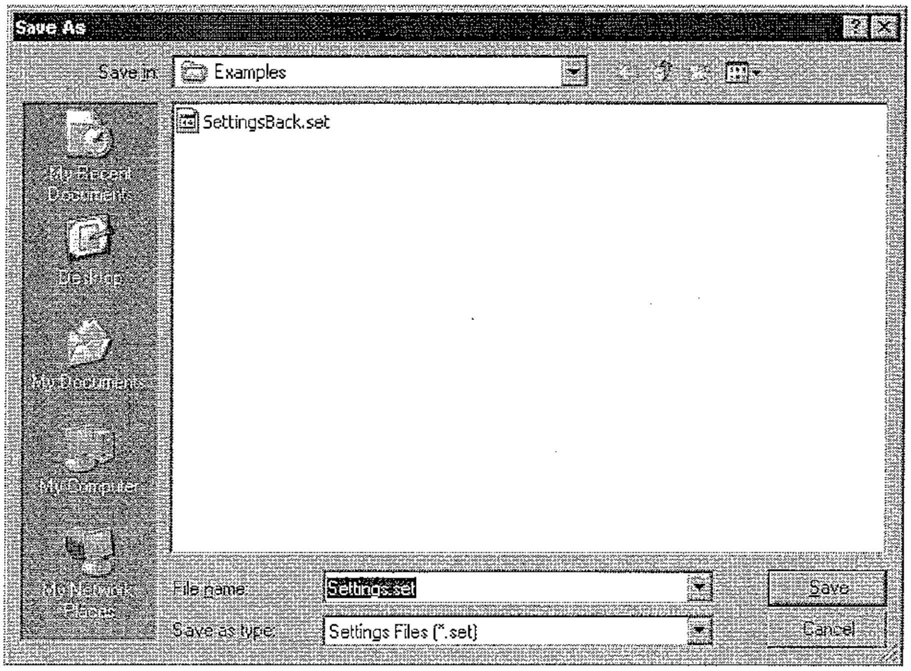


Figure 10.11: Dialog Save As

2. Navigate to the saving location and enter a file name.

☞ If you have displayed the project browser (refer to section 2.7.4), you will then automatically be shown the directory marked there as saving location.

3. Click OK. All current settings are saved in the file.

10.2.8 Exporting Measurement Data in ASCII Format

You can export the data in the active analyzer or presentation window as an ASCII file. The coordinate system for ASCII export corresponds to the coordinate system of the live video image which you set the scan points on. The upper left corner in the coordinate system of the live video image is defined as u=0, v=0, the bottom right corner as u=4/3, v=1. To calculate the angles of the scanner mirrors from the coordinates, you will need the information from the alignment. You will get this from Polytec File Access.

To export the measurement data in ASCII format, proceed as follows:

1. Select File > Export > ASCII. The dialog Save As appears.
2. Navigate to the saving location, enter the file name and select the file extension.

☞ If you have displayed the project browser (refer to section 2.7.4), you will then automatically be shown the directory marked there as saving location.

3. If you are exporting from the presentation window in the view Single Scan Point, Average Spectrum or Profile, then at the bottom of the dialog you see the field Select Data. Select whether you want to export the data sets from the upper or the lower diagram.
4. Click Save.

10.2.9 Saving Graphics

You can save the active window in different graphics formats. The title bar and the frame are not saved. The live video image is saved without scan points.

To save, proceed as follows:

1. Select File > Save Graphics. The dialog Save As appears.
2. Navigate to the saving location, enter the file name and select the file type.

☞ If you have displayed the project browser (refer to section 2.7.4), you will then automatically be shown the directory marked there as saving location.

3. If you are saving the graphics from the presentation window in the view Single Scan Point, Average Spectrum or Profile, then at the bottom of the dialog you see the field Select Graphics. Select whether you want to save the upper, the lower or both diagrams.
4. Click Save.

10.2.10 Copying Graphics onto the Clipboard

You can copy the active window as graphics onto the clipboard. The title bar and the frame are not copied. The live video image is copied without scan points.

To copy, proceed as follows:

1. Click  or select Edit > Copy.
2. If you are copying diagrams from the presentation window in the view Single Scan Point, Average Spectrum or Profile, then the dialog Select Graphics appears. Select whether you want to copy the upper or the lower diagram.
3. Click OK.

You can then paste the graphics from the clipboard into other applications.

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Numerics

A

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Z

Polytec Deutschland

POLYTEC GmbH
Hauptsitz
Polytec-Platz 1-7
76337 Waldbronn

Tel.: (07243) 604-0
Fax: (07243) 69944
E-mail: info@polytec.de
Internet: http://www.polytec.de

POLYTEC GmbH
Vertriebs- und Beratungsbüro Berlin
Schwarzschildstraße 1
12489 Berlin

Tel.: (030) 6392-5140
Fax: (030) 6392-5141
E-mail: polytecberlin@polytec.de
Internet: http://www.polytec.de

International from outside Germany (D)
POLYTEC GmbH
Headquarters
Polytec-Platz 1-7
D-76337 Waldbronn

Tel.: +49 7243 604-0
Fax: +49 7243 69944
E-mail: info@polytec.de
Internet: http://www.polytec.com

Polytec International

France (F)
Polytec-PI, S.A.
32 rue Délizy
F-93694 Pantin

Tel.: +33 (0) 1 48 10 39 34
Fax: +33 (0) 1 48 10 09 66
E-mail: info@polytec-pi.fr
Internet: http://www.polytec-pi.fr

Great Britain (GB)
Lambda Photometrics Ltd.
Lambda House, Batford Mill
GB-Harpenden, Hertfordshire AL5 5BZ

Tel.: +44 (0) 1582 764334
Fax: +44 (0) 1582 712084
E-mail: info@lambdaphoto.co.uk
Internet: http://www.lambdaphoto.co.uk

Japan (J)
Polytec KK
Hakusan High Tech Park
1-18-2 Hakusan, Midori-ku
J-Yokohama-shi, 226-0006 Kanagawa-ken

Tel.: +81 (0) 45 938-4960
Fax: +81 (0) 45 938-4961
E-mail: info@polytec.co.jp
Internet: http://www.polytec.co.jp

USA West
Polytec, Inc., North American Headquarters
1342 Bell Avenue, Suite 3-A
Tustin, CA 92780

Tel.: +1 714 850 1835
Fax: +1 714 850 1831
E-mail: info@polytec.com
Internet: http://www.polytec.com

USA Midwest
Polytec, Inc., Midwest Office
3915 Research Park Dr., Suite A-12
Ann Arbor, MI 48108

Tel.: +1 734 662 4900
Fax: +1 734 662 4451
E-mail: info@polytec.com
Internet: http://www.polytec.com

USA East
Polytec, Inc., East Coast Office
25 South Street, Suite A
Hopkinton, MA 01748

Tel.: +1 508 544 1224
Fax: +1 508 544 1225
E-mail: info@polytec.com
Internet: http://www.polytec.com

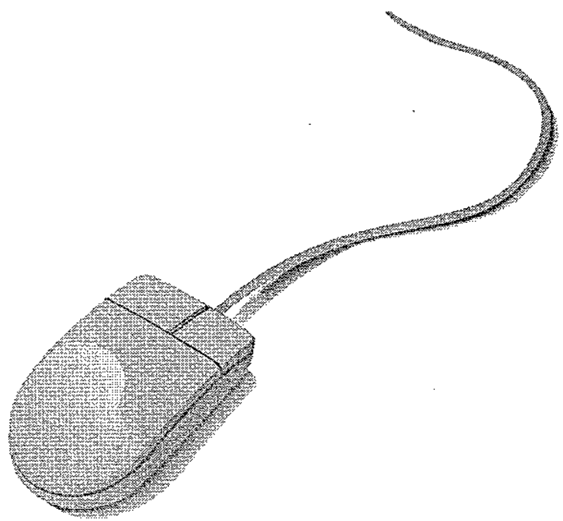
41031-Man-Vib-PSV-Soft8.3-0805-01e

Polytec

Software Manual

Polytec Scanning Vibrometer

Software 8.3



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PSV 300

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PSV 300-3D

PSV 400-3D

MSV 300

MSV 400

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Contents

1 Quick-start

This introduction will quickly familiarize you with important functions of the measurement system based on an FFT measurement. For this purpose, first of all run a scan and then evaluate it using some of the software functions. Use an object with simple geometry for the scan. If you have a function generator, use it to excite the object and then use this signal as a reference signal for the measurement. If you do not have a function generator, you can also excite it by other means.

☞ Although you can also make a measurement without a reference signal, if you do you will not be able to animate the vibration during evaluation.

Preparation

1. Connect up the measurement system and start it as described in the hardware manual.

2. If available, connect the reference signal to the jack REF 1 on the front of the junction box.

3. Start the software. To do so, double-click the icon  PSV on the desktop. You will find more information on this in section 2.5.

4. If the software has not been started in Acquisition mode, go into acquisition. To do so, in the toolbar of the application window, click . You will find more information on this in section 2.6. You will now see the video window at the top and an analyzer at the bottom. On the left you will see the project browser (refer also to section 2.7.4 and on the right the scanning head control (refer also to section 2.7.1).

5. Select Setup > Preferences. The dialog Preferences appears.

6. Display the page Devices.

7. From the list Junction Box, select the junction box which is connected to the PC.

8. If you are using a function generator, then set the connection for Generator (internal or GPIB).

9. Display the page Scanning Head.

10. In the list Scanning Head, select the scanning head you have connected.

11. Click OK.

12. Only with the option VDD: Run test mode as described in section 6.6.

You will find more information on setting up the software in chapter 3.

Set the Optics

You set the optics using the scanning head control. See also section 4.1 on this.

13. Point the scanning head at the object, either manually or using the optional pan-tilt stage.

14. Zoom in the video camera so that the object appears as large as possible in the video window. To do so, use the slider Zoom in the field Camera.

15. Now focus the video camera. To do so, first of all point the laser beam at the top left corner of the video image. Otherwise the light from the laser beam disrupts the video camera focusing automatically. To adjust the laser beam, use the icons Position. Then click Autofocus in the field Camera.

16. Then point the laser beam at the object again.

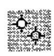
17. Focus the laser beam with the icons  and . As an option, you can automatically focus the laser beam using the icon . You will find more information on this in section 4.4.

18. Align the coordinates on the live video image with the measurement plane. To do so, click  or select Setup > Align Coordinates. The software will maximize the video window. Distribute the alignment points evenly over the whole measurement surface. If, for example, you want to scan a rectangular surface, it would make sense to choose four alignment points near the corners.

19. Move the laser beam to an alignment point on the object using the icons Position in the scanning head control.

20. In the live video image, point the mouse precisely at the laser beam and click. You can now see a target there. If the laser beam is not precisely in the middle of the target, click again.

21. Repeat steps 19 and 20 for at least three more alignment points.

22. Once you have aligned all points, click  again or select Setup > Align Coordinates.

You will find more information on aligning coordinates in section 4.2.

☞ To be able to import 3D geometries in 3D point mode (optional), you also have to carry out a 3D alignment. See section 4.2.4 on this.

Defining Scan Points

23. Go to scan point definition. To do so, in the toolbar of the application window, click . The software maximizes the video window and displays a graphics toolbar.

24. Go to standard mode. To do so, in the graphics toolbar, click .

25. First of all delete all scan points which may already be defined. To do so, select Edit > Select All and then Edit > Delete.

26. In standard mode the software will superimpose a global grid on the live video image. If the grid is not visible, display it. To do so, click . You can define scan points at the grid points. First of all, define the density of the grid points. To do so, in the graphics toolbar, enter a value in both the fields X: and Y: respectively (for example 20).

27. Now draw a rectangle as large as possible over the object. To do so, first of all click .

28. Check whether the icon is active. If yes, then click it to deactivate it (refer also to section 5.1.4).

29. Point the mouse approximately at the center of the object under investigation. The cursor becomes a cross.

30. Press the control key and the mouse button simultaneously and drag across to a corner point of the area you want to scan. First of all release the mouse button and then the control key.

31. You will see the rectangle you have drawn with a red edge and white squares which mark the edge. You will see the scan points as blue points inside the rectangle.

32. You have now finished defining scan points. Click in the toolbar of the application window again to quit scan point definition.

33. Now point at the live video image and click a scan point. The laser beam moves to this point on the object. Click additional scan points to check and see if the laser beam is positioned exactly on the scan points.

You will find more detailed information on scan point definition in chapter 5.

Setting the Parameters

34. In the toolbar of the application window, click A/D. The dialog Acquisition Settings appears.

35. Display the pages in the dialog from left to right and set the parameters there. The suitable settings depend on the object. If you know suitable settings, then set them. If not, use the settings in table 1.1.

Table 1.1: Parameters for an example measurement

Page	Settings
General	Measurement Mode: FFT Averaging: Off Remeasure: active
Channels[1]	Vibrometer: Active, Range 10V, Coupling DC, Quantity Velocity Reference 1: Active, Range 10V, Coupling DC, Quantity Voltage
Filters	Channel Vibrometer: Filter Type No Filter, Int/Diff Velocity (0) Channel Reference 1: Filter Type No Filter
Frequency	Bandwidth: 10kHz From: 0kHz To: 10kHz FFT Lines: 400
Window	Channel Vibrometer: Rectangle Channel Reference 1: Rectangle
Trigger	Source: Off
SE	Channel Vibrometer: Channel Reference 1: not active Speckle Tracking: active Slider: Fast
Vibrometer	Velocity: lowest available measurement range Tracking Filter: Slow Low Pass Filter: Off
Generator	Active: active

[1] Only with option VDD: Some parameters on the page Channels are not available or are fixed.

36. Click OK.

You will find detailed information on the parameters for data acquisition in chapter 7.

Single Point Measurement

37. If available, start signal output from the function generator. To do so, in the toolbar of the application window, click .
38. Start a continuous measurement. To do so, in the toolbar of the application window, click . The analyzer displays the measurement signal on the vibrometer channel.

☞ Autoscale the y-axis. To do so, in the toolbar of the analyzer, click .

39. Click a scan point in the video window. The software will position the laser beam on the object at this scan point. Check whether the display OVER in the scanning head control is permanently red. If yes, then the measurement range for the velocity is being exceeded at this scan point.
40. Repeat step 39 for a few additional scan points.
41. If the display OVER is red at several scan points, increase the measurement range for the velocity. To do so, click again, display the page Vibrometer and select the next highest measurement range in the list Velocity. Then click OK.
42. Repeat steps 40 to 41 until the measurement range for the velocity is no longer exceeded.
43. Stop the continuous measurement. To do so, in the toolbar of the application window, click .

You will find detailed information on making measurements in chapter 6.

Scanning

44. Start the scan. To do so, in the toolbar of the presentation window, click . The dialog Save As appears.
45. Navigate to the saving location and enter the file name.

☞ If you have the project browser displayed (refer to section 2.7.4), you will then automatically be shown the directory marked there as saving location.

46. Click Save. The scan starts. The software immediately saves every scan point measured.
47. In the video window you can follow the progress of the scan. See chapter 9 on this.

Displaying Data

Select data sets

48. Display a spectrum. To do so, in the toolbar of the analyzer, click and select FFT in the pop-up menu.

49. Click to autoscale.

50. For spectra, you can display other signals apart from the measurement signal. To do so, click and select Acceleration in the pop-up menu. Click again to autoscale.

51. Display the magnitude of the acceleration signal together with its phase. To do so, click and select Mag.&Phase in the pop-up menu.

Zoom

52. Zoom the range between 5 kHz and 10 kHz. To do so, point the mouse at the x-axis at 5 kHz. The cursor becomes a magnifying glass.

53. Press the mouse button and drag to the right to 10 kHz.

54. Undo zooming. To do so, click .

Set a cursor

55. Activate a cursor. To do so, click .

56. Set the cursor in the analyzer. To do so, click in the diagram. A vertical line appears at the point which you have clicked.

Read data

57. You can see the cursor's coordinates in the legend. If the legend is not visible on the right in the analyzer, select Analyzer > Legend to display it.

58. Move the cursor to the right or left using the mouse. The data in the legend is updated simultaneously.

You will find detailed information on displaying data in chapter 8.

Now you have finished the introduction. You will find further example measurements in section 6.7.

2 First Steps

Polytec's Scanning Vibrometer measures the two-dimensional distribution of vibrations. In the measurement system, the software has the following functions:

- controlling the hardware
- defining scan points
- setting parameters for data acquisition
- generating excitation signals (as an option)
- acquiring digital data
- saving data
- displaying data and evaluating it.

First of all, read the following sections to familiarize yourself with the basics of how to work with the software.

2.1 System Requirements

So that you can work optimally with the software, please make sure that the following components have been installed:

- National Instruments driver NiDaq 6.9.3 (recommended)
- Microsoft® DirectX 9
- Current Service Packs for Windows® 2000 or Windows® XP, you will find detailed information on this in the Release Notes

Please use either Windows® 2000 or XP as your operating system.

2.2 Installing the Software

To install the software, proceed as follows:

☞ When installing the software, please make sure you pay attention to the supplements and special features in the Release Notes!

1. Only for a new installation: Install the required hardware as described in both your hardware manual under Cabling and in the manual for your data acquisition board.

2. Check that your hardlock (dongle) is available and has been installed correctly.

3. Switch on your PC and log in with administrator rights. See your operating system manual on this.

4. Install the required software as described in the file \\PSV\ReleaseNoteseng.doc on your PSV CD.

Now you have finished the installation. Should any problem occur during installation, please contact Polytec.

2.3 Integration of the Hardware

Caution!
Do not change any address or interrupt settings! This could prevent the software from running properly.

You can control two Polytec vibrometers using the software and as an option, an external function generator as well. Refer also to section 6.7.2 or section 6.7.6. Connect up the devices as described in your hardware manual.

IEEE-488/GPIB

If you control some devices via IEEE-488/GPIB, then we recommend you set the following addresses:

- Vibrometer controller 1: IEEE-488/GPIB address 5
- Vibrometer controller 2: IEEE-488/GPIB address 4
- Function generator: IEEE-488/GPIB address 10.

RS-232

If you control vibrometers via RS-232, then the software recognizes the controller connected to the lower COM port as vibrometer controller 1.

2.4 Controlling the Hardware with the PSV-A-PDA (as an Option)

With the optional PSV-A-PDA, you can also call up several software functions, such as focusing the laser beam, defining and deleting scan points, etc.

2.4.1 Starting the PDA

To start the PDA and to call up the required function, proceed as follows:

1. Install the PDA as described in your hardware manual.
2. Make sure that your WLAN Access Point is ready to use and switch it on as described in your hardware manual.
3. Switch the PDA on.
4. Switch WLAN on the PDA on as described in the manufacturer's manual.

5. Select Start > Programs in the PDA menu bar and touch PDASoft. The user interface of the PDA software appears.

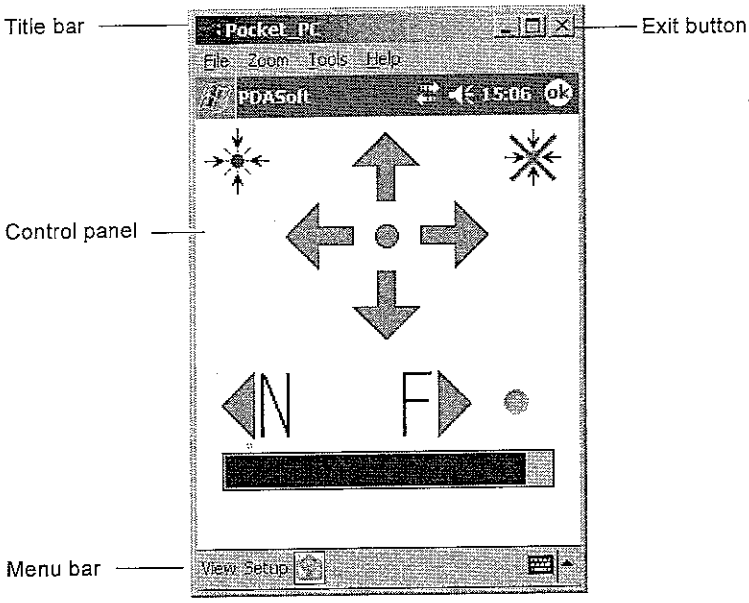


Figure 2.1: Control window of the PDA

Control panel You can use this control panel to call up and execute the PDA functions. You will find more information on this in section 4.2.2 and section 4.2.5.

Menu bar The menu bar contains additional functions. You will find more information on this in section 2.4.2. Apart from that, you make the connection to the PSV system here. To do so, touch the icon .

Exit button Touch the icon to exit the PDA software.

The PDA supports the following software functions:

- controlling the optics (refer to section 4.1.2)
- switching the scanning heads (only PSV-3D, refer to section 4.2.5)
- defining and deleting alignment points (refer to section 4.2)
- defining and deleting scan points (refer to section 5.3)

2.4.2 Adapting the IP Address

So that the PDA can communicate with the PSV software, the IP address of the network board which the WLAN Access Point is connected to must be entered in PDA. On delivery of the PSV system, the correct IP address is set. If you have to change the address at a later point in time, proceed as follows:

☞ You can only change the IP address if the PDA is not connected to the PSV system. If required, touch the icon to disconnect it.

1. Select Setup > Preferences in the PDA menu bar. The dialog Edit Settings appears.

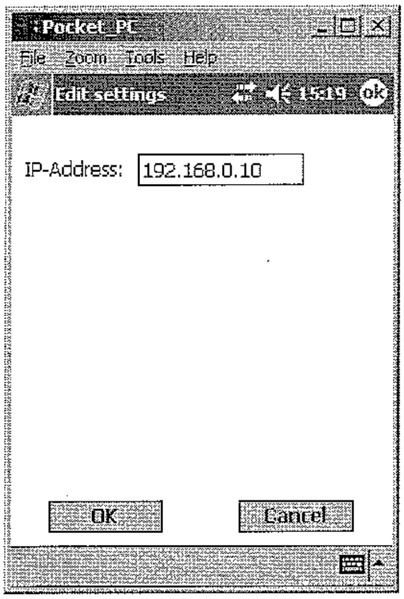


Figure 2.2: Dialog Edit Settings

2. Touch the icon in the menu bar. A keyboard is shown in the dialog.
3. Use this keyboard to enter the new IP address and touch OK.

2.5 Starting the Software

To start the software, proceed as follows:

1. Check that the hardlock has been correctly installed on the PC.
2. Connect up the PSV and start it as described in your hardware manual.
3. Then afterwards switch the PC on.
4. After a short while you will be asked to log in. Refer to the operating system manual on this. In the condition the PC is supplied in, you have to log in as administrator. A password has not been set prior to delivery.
5. Double-click the icon PSV on the desktop or select Start > PSV.
6. Change to acquisition mode. The application window appears. You may receive an error message and information on it (refer to section 2.6).

You can now work with the software.

2.6 Acquisition Mode and Presentation Mode

In the software you work in two different modes: Acquisition and Presentation. You can use some functions in both modes. Acquisition mode is not available in the desktop version.

Presentation mode

To go to presentation mode, click or select View > Presentation.

Acquisition mode

To get into acquisition mode, click or select View > Acquisition.

When changing into acquisition mode, the software searches the interfaces of the PC for external devices and initializes them. You may receive an error message and information on it. You can switch off this error message as described in section 3.5.

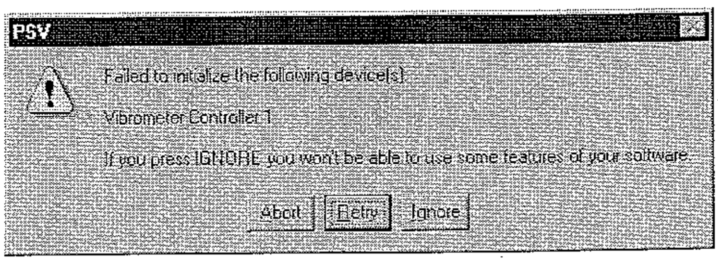


Figure 2.3: Error message when changing into acquisition mode

7. If you want to check the connection between the devices and if necessary correct it, select Setup > Preferences and open the page Devices.

2.7 Windows in the Software

2.7.1 Application Window

After starting the software, the application window appears. At the top you will see the title bar, menu bar and toolbar, at the bottom the status bar. In the menu View, you can show (hide) the toolbar and the status bar.

Initially the application window is empty. By clicking you change into acquisition mode. There you will see the video window, an analyzer and the project browser. The windows are described in the following sections in detail.

By clicking you can display further analyzers.

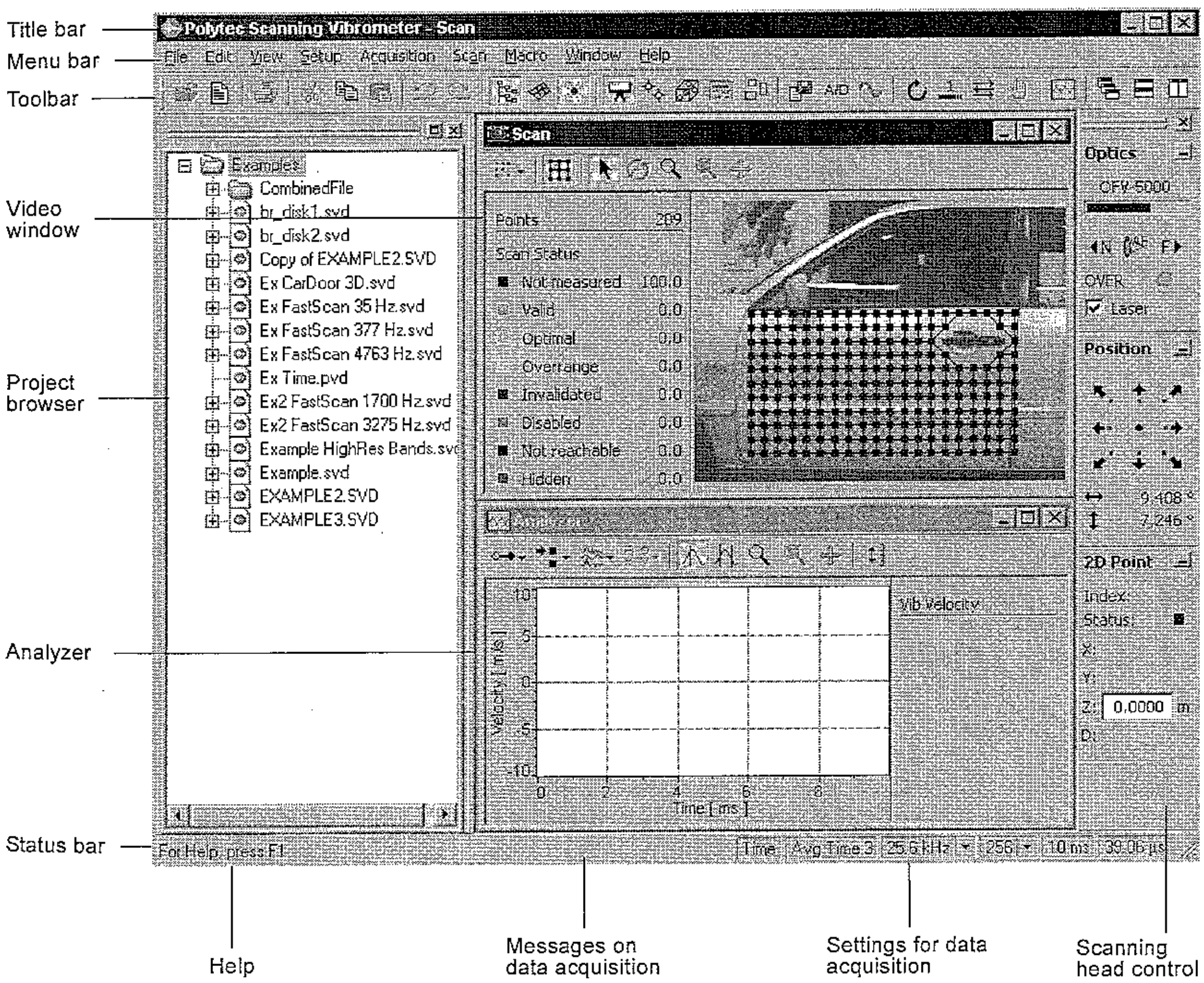


Figure 2.4: Example of the application window in acquisition mode

In the application window you can display and evaluate data. To do so, you can use various windows:

- In acquisition mode: a video window, any number of analyzers.
- In presentation mode: any number of presentation windows and analyzers.

If you restart the software, then the arrangement and signal selection of the most recent windows will be restored.

Menu bar

Every menu contains a group of commands for working with the software. Some menus are only visible if an analyzer or a presentation window is open.

Toolbar

By clicking the icons, you can execute some commands quickly which you would otherwise have to select in the menus.

Status bar

On the right, the status bar shows several settings for data acquisition. On the left, in certain situations, you will see a short help text. Point the mouse at one of the settings on the right, for example, and leave the cursor there for a moment. Then you will see on the left which parameter it is for. For more information on how to get help in the software, see section 2.10.

When making a measurement, messages on data acquisition can appear in the middle of the status bar. See section 6.4 on this.

Scanning head control

In acquisition mode you can show (hide) the scanning head control in the application window. To do so, click  or select View > Scanning Head. You adjust the optics using the scanning head control. See section 4.1 on this.

2.7.2 Video window

The video window displays the live image of the video camera in the scanning head.

Open

The video window appears when you change into acquisition mode.

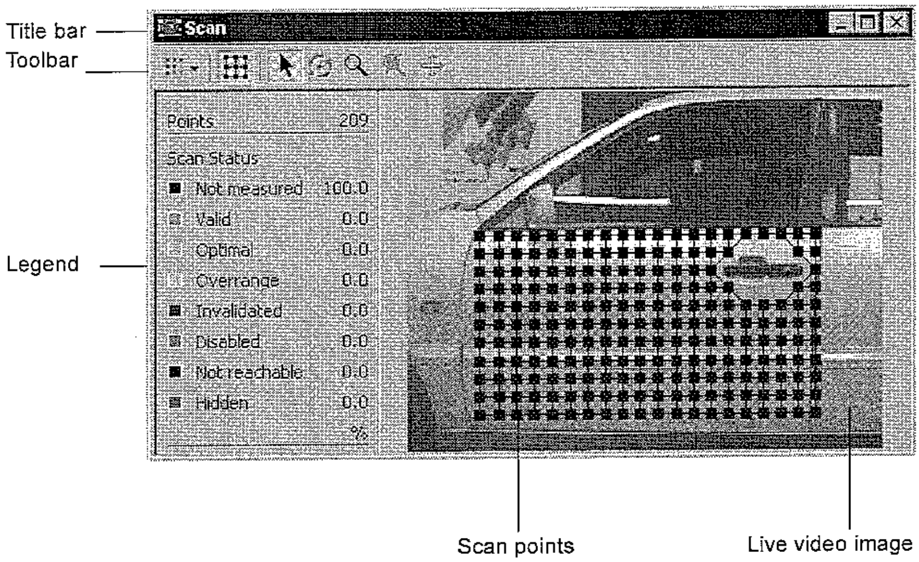


Figure 2.5: Example of the video window

Live video image

In the live video image, you control the position of the laser beam, define scan points and follow the progress of a scan. You adjust the settings of the live video image (contrast, brightness, color) as described in section 4.7.

Toolbar

By clicking the icons, you can execute some commands quickly which you would otherwise have to select in the menus. To change between the 2D view and the 3D view, click 3D. If you change from the 2D view to the 3D view, a snapshot of the live video image is shown as a fixed-image. You can also use the mouse to set the line of sight directly in the video window. To do so, click . The mouse cursor becomes a . Drag in the direction you require.

To change the view of the scan point status, click . Please see section 8.1 on this as well.

Scan points

If scan points are defined, you can show (hide) them in the video window. To do so, click or select View > Scan Points. You see the scan points as squares in different colors. These colors show the status of the scan points.

Legend

On the left you see a legend for the status of the scan points. The legend also shows the number of defined scan points and the estimated time needed for the scan. The display of the scan point status changes depending on which status view you have selected.

Zoom function In the video window you can zoom in on sections of the image and can pan the zoomed sections. You will find the necessary tools in the toolbar of the application window, refer also to section 2.8.

2.7.3 Analyzers

Analyzers show measurement data and evaluated data in x-y diagrams. You can follow current measurements in analyzers or use them to display measurement data from a file. In presentation mode, an analyzer can also be part of a presentation window. See section 2.7.5 on this.

Open An analyzer appears if you

- go into acquisition mode
- start a measurement
- open a single point measurement.

If an analyzer is open, the menu bar of the application window is extended by menus for working with analyzers. To open further analyzers, click or select Window > New Analyzer.

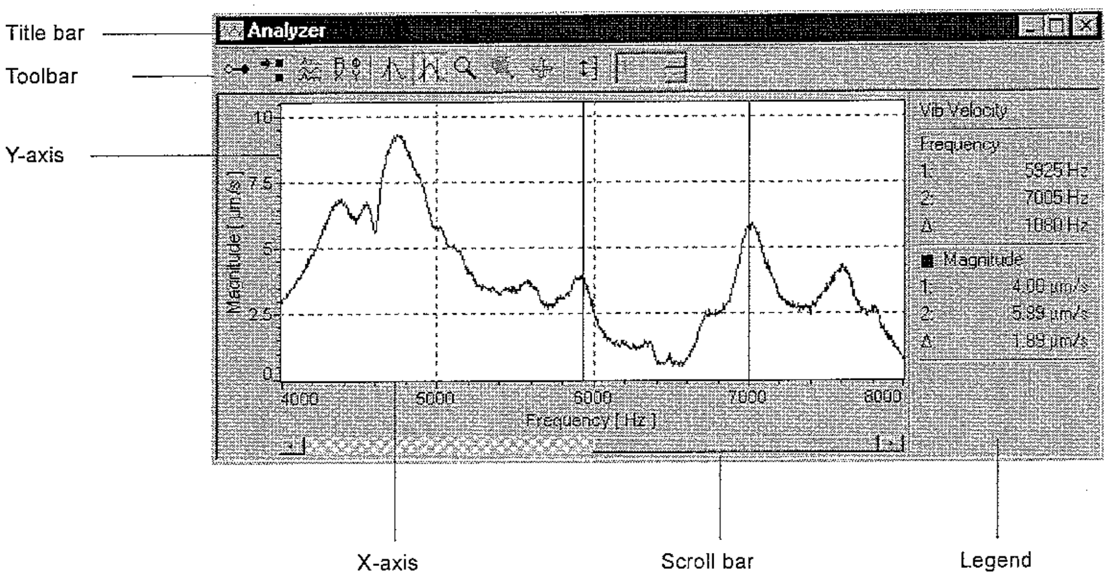


Figure 2.6: Example of an analyzer

Title bar If an analyzer has the function of a measurement window, you will see the name Analyzer in the title bar. If you have already saved the measurement or have opened a measurement, you will see the file name in the title bar.

Toolbar You can show (hide) the toolbar by selecting Analyzer > Toolbar. By clicking the icons you can quickly execute some commands from the menu Analyzer.

Diagram You can see the data graphically in x-y diagrams. You can set up the look of the diagrams and the graphs yourself.

Legend

On the right you can show (hide) a legend for the diagrams. To do so, select Analyzer > Legend.

Zoom function

In the analyzer you can zoom on sections of the diagram and can pan the zoomed section. In the toolbar of the analyzer you will find the necessary tools, refer also to section 8.2.1.

Scroll bar

You can use the scroll bar to scroll if you have zoomed the x-axis.

2.7.4 Project Browser

In the project browser you can display folders in a tree structure with the subdirectories and files in them. To do so, open a program on file management, e.g. Microsoft® Explorer and use the mouse to drag the required folder or folders into the project browser. These folders can now be managed from here. Please note that all actions are executed directly in the respective folder.

☞ The folders in the project browser are not copies, but are direct links to folders on your harddisk or network drives! Changes made in the project browser, e.g. deleting or renaming subdirectories and files are carried out in parallel in your file management and in reverse.

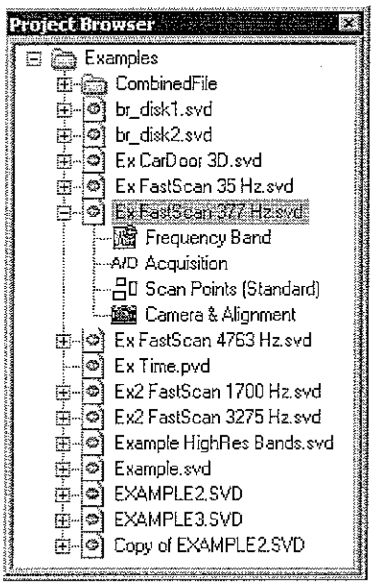


Figure 2.7: Example of the project browser

☞ You can not transfer individual files to the project browser.
You can remove folders again. To do so, click the folder with the right mouse button and select Remove in the pop-up menu. You can also delete individual files.

The contents of the project browser remain saved, even after the program is stopped. The display of contents is user-specific.

Open

To open the project browser, click or select View > Project Browser. You can adapt the way the project browser is displayed, i.e. make it smaller and move it to another part of the screen. If you drag the project browser near to one of the edges of the software window and release the mouse button, the project browser is automatically placed next to the corresponding window edge. Click in the title bar of the project browser to reduce its size again and position it freely in the software window.

Add directory

To add another project directory to the project browser, click in the project browser with the right mouse button, however do not click in a file or a folder. Select Add Project Folder in the pop-up menu. The dialog Select Folder appears. Navigate to the required directory and click Select.

☞ Alternatively you can also select File > Add Project Folder.

Click a file or a folder with the right mouse button to edit the contents in the project browser. The commands shown in the pop-up menu are different depending on the level in the tree structure, the type and number of objects selected and the mode you are currently working in (acquisition or presentation). The individual commands are explained in the following.

Explorer: Click here if you want to display the selected folder in Microsoft® Explorer additionally. This command is only available for folders.

Refresh: Click here to update the display of folders and files in the project browser.

Remove: Click here if you want to remove the selected objects from the project browser, but do not want to delete them. This command is only available for folders on the top level.

Rename: Click here if you want to give the selected object a different name.

Delete: Click here if you want to irrevocably delete the selected objects. Before deleting them permanently, you have to confirm a safety check. This command is only available for files.

☞ You can only delete settings if they are saved in their own file (*.set) (refer to section 10.2.7 and section 10.1.3). You can not delete the settings of a measurement file.

Load: If you select Load, then the setting files (.set) that you selected in the project browser are loaded. See also section 10.1.3 on this.

Open: In principle, you can open files from all programs installed on your PC in the project browser. Click Open and the selected file will be opened using the corresponding program. If you open a file with the extension svd, a presentation window will open. If you select a file with the suffix spd, the signal processor will open (as an option).

New Window: Click here if you want to display the file you have already opened in a second window again.

Info: Click here if you want to display the file information on the file you have already opened. See also section 10.1 on this.

Close: Click here if you want to close the selected file.

Save As: Click here if you want to save the selected file under a different name or in another directory.

Paste: This command is only available if you are using the optional signal processor (refer also to section 8.6). If you have copied data in the signal processor, you can insert this data into the selected file by using the command Paste.

Edit: If you select Edit, a macro window will appear with the macro you selected in the project browser.

Run: If you select Run, then the macro you selected in the project browser is executed.

Properties: This command is only available to you for combined files. You will then see the dialog Create Combined File with the individual files in the set order. See also section 8.5 on this.

Copy and move

You can copy files or folders in the project browser into other directories. To do so, mark them and holding the left mouse button pressed, drag the marked objects onto the required directory.

To move files or folders in the project browser, proceed as described above. Hold the shift button pressed while you are dragging with the mouse.

2.7.5 Presentation Window

In presentation windows you analyze scans in 2D and 3D diagrams.

Open A presentation window appears when you open a scan. The menu bar of the application window is then extended by menus for working with presentation windows. You can then open further presentation windows by selecting Window > New Window.

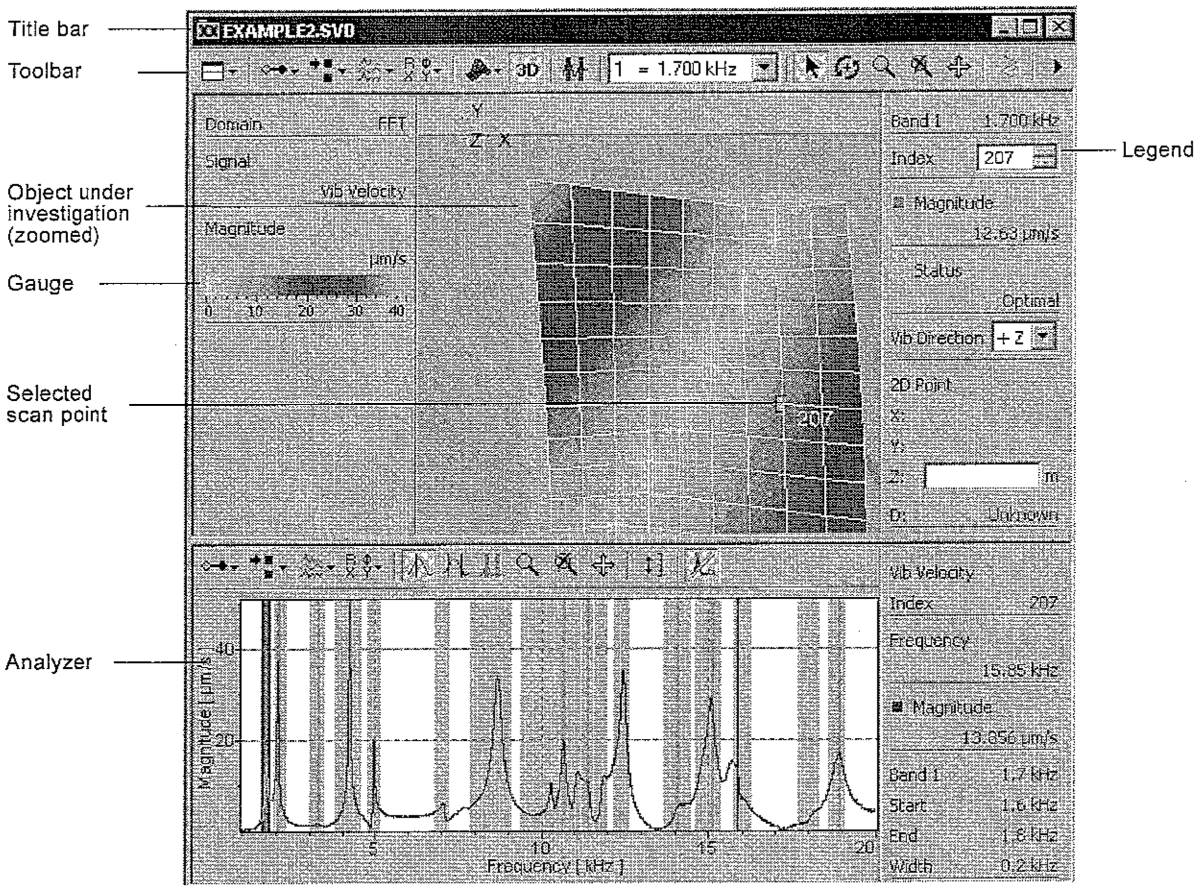


Figure 2.8: Example of a presentation window in the Single Scan Point view

Toolbar You can show (hide) the toolbar by selecting Presentation > Toolbar. By clicking the icons you can quickly execute some commands from the menus Setup, Presentation and Animation.

View You can display the presentation window in different views. To do so, click and select the view required in the pop-up menu. You can also select Presentation > View.

Object You see the object in all views. You can present the object in different ways. To do so, click and select the view style required in the pop-up menu. You can also select Presentation > View Style.

Gauge On the left you can show (hide) a gauge for color-coding. To do so, select Presentation > Gauge.

Zoom function In the presentation window you can zoom on the object in all views and in all view styles and also pan the zoomed section. You will find the necessary tools in the toolbar of the presentation window, refer also to section 2.8.

Analyzer In the views Single Scan Point, Average Spectrum and Profile you will see an analyzer at the bottom of the presentation window. See section 2.7.3 on this.

Legend On the right you can show (hide) a legend for the data displayed. To do so, select Presentation > Legend.

2.7.6 Signal Processor (as an Option)

You can use the signal processor to recalculate measurement data for further analysis and then compare the results with the original data. You can read section 8.6 to find out how to work with the signal processor.

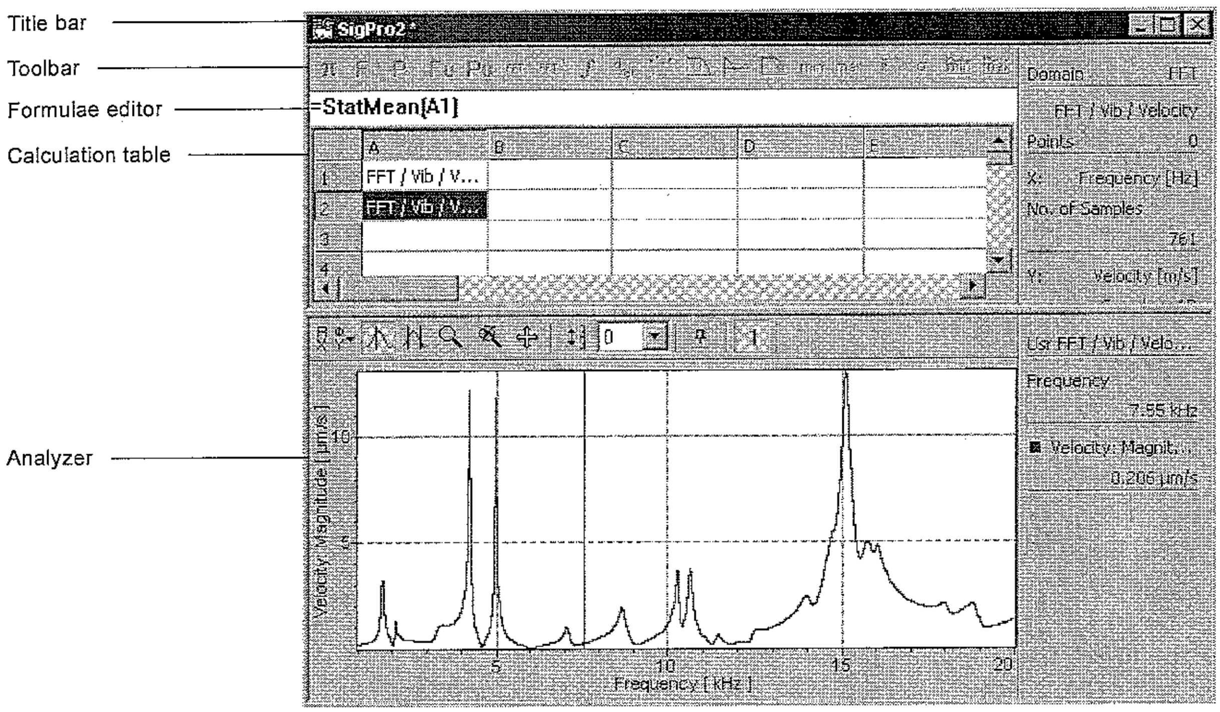


Figure 2.9: Example of recalculating measurement data in the signal processor

Toolbar In the toolbar you will find the most important arithmetic operations you can execute with the signal processor. By clicking the icons, you can transfer the formulae directly to the formulae editor instead of having to enter them using the keyboard. The icons are active as soon as the cursor is in the formulae editor.

Formulae editor You are shown the content of the selected table cell in the formulae editor. This is also where you enter text or formulae which are to appear in the selected cell.

Calculation table

You enter the measurement data and the formulae in the cells of the calculation table. By linking the individual cells via the formulae, the software can make various calculations using the measurement data and then display the results at any point in the computing chain. Apart from that, you can also enter comments into the cells.

Analyzer

The signal processing results are shown as a graph in the analyzer.

2.7.7 Arranging Windows

You can arrange all open windows in the application window using the commands in the menu Window.

New window

To open further analyzers or presentation windows, click or select Window > New Analyzer.

Cascade

You can arrange all windows over each other so that only the title bar and the y-axis name are visible respectively. To do so, click or select Window > Cascade.

Tiling horizontally and vertically

You can display all open windows so that they are completely visible and maximum size. To do so, click or . You can also select Window > Tile Horizontally or Window > Tile Vertically.

Close all

To close all open windows, select Window > Close All.

Window list

At the bottom of the menu Window you will find a list of open windows. To activate a window – i.e. move it to the foreground – click it in the list.

2.8 Zooming in Windows

You can zoom on image sections in both the video window and also in the presentation window. You will find the necessary tools in the toolbars of the application window and of the presentation window.

Zoom

If you would like to take a closer look at a certain section of the image in either the video or the presentation window, you can zoom on it.

☞ The zoom function is executed by the graphics card in your PC, not by the video camera in the scanning head. This means that the resolution of the image may deteriorate slightly when zooming. However you do not have to carry out a new alignment - unlike when zooming with the camera.

Zooming in on the object helps you define the points and carry out alignment more accurately, thus enabling you to present the data more precisely. This is an advantage, particularly if your object under investigation has complex geometry or if your scan points are very close together.

To zoom in on a video or presentation window, proceed as follows:

1. Click . The mouse cursor becomes a magnifying glass with a plus sign.
2. Holding the left mouse button pressed, draw a rectangle around the area of the image which you want to zoom in on. You can repeat this step several times.

☞ If you zoom in the video window, on the left in the legend a smaller view of the measurement object will appear with a frame marking the zoomed section of it. This means you can always ascertain which part of the object under investigation you are currently viewing.Once maximum magnification has been attained, you will receive a message.

or

3. You can also zoom in the presentation window by scrolling down with the middle mouse button (mouse wheel).

Pan the image section

You can pan the zoomed image section.

☞ Depending on the video board, the image section selected may not pan smoothly, but may move across the screen in small jumps.

To do this, you have the following options:

1. Using the middle mouse button (mouse wheel) click in the zoomed view in the video window. Hold the mouse button pressed and pan the image section. If you have given the middle button a special function (e.g. double-click), then you will have to proceed as described in step 2.
2. In 3D point mode (APS, refer to section 5.4) and during alignment (refer to section 4.2)click and pan the image section while holding the left mouse button pressed.

Zoom out

You can zoom out again.

To undo zooming, scroll up with the middle mouse button (mouse wheel).

To undo all previous zoom actions at once, click .

Exit zooming

To leave the zoom function again, click . The last image section selected remains.

2.9 Printing

You can print out analyzers, presentation windows and signal processors. The title of the window as well as the date and time are automatically printed as a header.

Print setup

To set the paper size, feed and orientation, select File > Print Setup. The dialog Print Setup appears. Here you can select the current printer and set up the page.

Preview

To see a print preview, select File > Print Preview.

Start

To print out the active window, click or select File > Print. If you want to print out a signal processor or if you have selected the view Single Scan Point, Average Spectrum or Profile in the presentation window, you can define whether you only want to print one of the graphics or both. The dialog Print will then appear. Here you can select the printer and set up further print properties. To start printing, then in the dialog Print click OK.

2.10 How to Get Help

You can get help in the software as online help and through short explanations of commands. You can also display the version of the software and the software options which are installed.

Online help

To open the online help, click or select Help > Contents.

Context-sensitive help

For dialogs and windows you can get context-sensitive online help. There are several ways of doing this:

1. Activate the window or dialog you need help with. To do so, click it.
2. Press the key F1. The corresponding page of the online help appears.

or

When a dialog is open, then click Help in this dialog. The corresponding page of the online help appears.

Explanation of commands

For icons and commands you can also get explanations without opening the online help. To do so, point the mouse at the command or the icon and leave the cursor there for a moment. The explanation appears on the left in the status bar. For icons you will also see a brief description on a yellow background next to the cursor.

Software version and options

To display the version of the software, select Help > About PSV. The dialog About Polytec Scanning Vibrometer appears. To display the installed software options, click Options in the dialog.

You can also display information on the operating system, the memory and on the available space on the harddisk. To do so, click System Info.

3 Setting up the Software

Before making a measurement, you have to set up the software for data acquisition.

☞ In almost all views and modes, you can use the right mouse button to call up additional menus which contain several commands and functions often needed at this point.

To set up the software, proceed as follows:

1. Go to acquisition mode. To do so, click or select View > Acquisition.

☞ You can also set some options in presentation mode.

2. Select Setup > Preferences. The dialog Preferences appears.
3. The dialog contains several pages, each with a group of parameters. To display a certain page, click the name of the group.
4. Set the parameters on all pages. You will find information on this in section 3.1, section 3.2, section 3.3 and section 3.4.
5. When you have set all parameters, click OK.

Test mode (only with option VDD)

6. If you have installed the option VDD (with VDD decoder), run test mode. See section 6.6 on this.

PSV-3D

The measurement system PSV-3D enables you to measure and display vibration vectors in three dimensions.

☞ The settings in the software apply for all three controllers respectively. For this reason, no distinction is made on the user interface between the individual devices.

3.1 Devices

On the page Devices you set which measurement system and which external devices you want to control with the software.

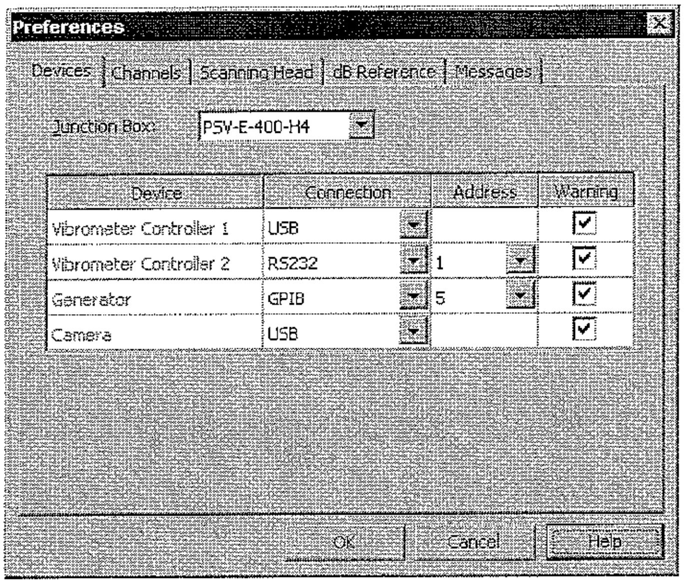


Figure 3.1: Page Devices

Junction Box: This list is only active for certain hardware configurations. Junction boxes connected via the USB interface are recognized automatically and displayed.

To use the option VDD, you must select the junction box VDD-Z-010, VDD-Z-011 or MSA-E-400 (VDD). In this case it is not possible to connect up a controller which is remotely controlled. Only the reference signal is connected, but not the vibrometer signal.

Connection: Here you can select which interfaces should be searched to look for external devices.

For the vibrometer controller you can either have the available interfaces automatically searched for devices (Auto) or you can state where the devices are connected (RS-232 or GPIB). You will speed up the start of the application with a fixed preference. If the vibrometer controller is connected via the USB interface, it will be recognized automatically. Then you do not have to make any more settings for this controller.

If you are using a generator, you can also state whether the device is integrated into the PC (internal) or whether it is an externally connected device.

Address: If you have given a fixed connection, then select the address here or carry out an automatic search for it.

Warning: If you change into acquisition mode or have changed any settings, then the software will search the PC's interfaces for external devices and initialize them. Here you mark the devices which you want a warning message issued for if the software can not find them.

☞ These warnings are not shown if under Setup > Preferences on the page Messages you have selected Errors or Show none (refer also to section 3.5).

Activate PSV-3D

You can operate the PSV-3D in 1D mode (PSV-3D (1D)) and in 3D mode (PSV-3D (3D)). In contrast to 3D mode, in 1D mode the signals of every scanning head are displayed and processed without transforming the coordinates. The channels measured are described as Vib Top, Vib Left and Vib Right.

PSV-3D in 3D mode

To activate PSV-3D in 3D mode, select the junction box PSV-Z-3D-H or PSV-E-400-3D.

The first device shown to you in the list is the PSV-3D Multiplexer. This enables you to control all three controllers from the PC via a single RS-232 or USB cable using the software. Apart from that, here you can select the video cameras which you would like to use to view the object. If you have arranged the scanning heads relatively far apart, then we recommend that you select the optional video camera Center.

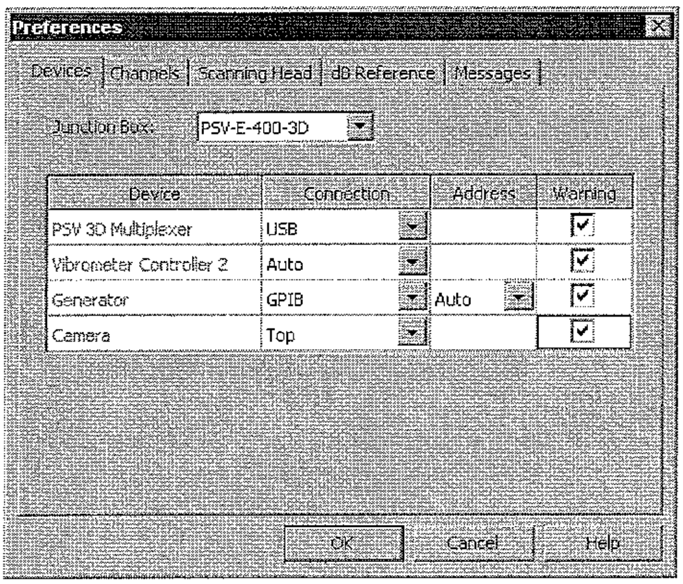


Figure 3.2: Page Devices for the PSV-3D

If you are not using the video camera Center and the scanning heads are mounted close to each other, then the camera Left is closest to the middle.

You will find information on connecting up the PSV-3D in the separate hardware manual.

PSV-3D in 1D mode

There are two applications for 1D mode:

- fault diagnosis for 3D mode
- operating the PSV-3D with just a single scanning head (as a standard scanning vibrometer)

☞ If you make a measurement in 1D mode and only use the scanning head Top, then select the video camera Top.

Fault diagnosis

If you have any misgivings about the measurement results in 3D mode being correct, you can make a 1D measurement without coordinate transformation and check the plausibility of the vibration signals in this mode. The limitations mentioned in the following apply.

Standard scanning vibrometer

If you operate the PSV-3D with just one scanning head, then you have to deactivate the other two scanning heads. To do so, click A/D and open the page Channels, refer also to section 3.2. Deactivate the top two scanning heads.

However you can also use the other two scanning heads to make reference measurements. To do so, click A/D and identify the scanning heads as reference channels.

☞ The scanning head Top can not be used as a reference channel.

Once you have identified the scanning heads as reference channels, they are not moved during scanning and can also not be controlled via the video image. Move the reference scanning heads using the icons Position in the scanning head controller. You will find more information on this in section 4.1.

To activate 1D mode, proceed as described above. However select the junction box PSV-Z-3D-H (1D).

If the scanning heads have not been defined as reference channels, but simply as Channel, then they are moved during scanning and every scanning head supplies separate 1D information.

3.2 Channels

On the page Channels you set which channels you want to use to control Polytec vibrometers.

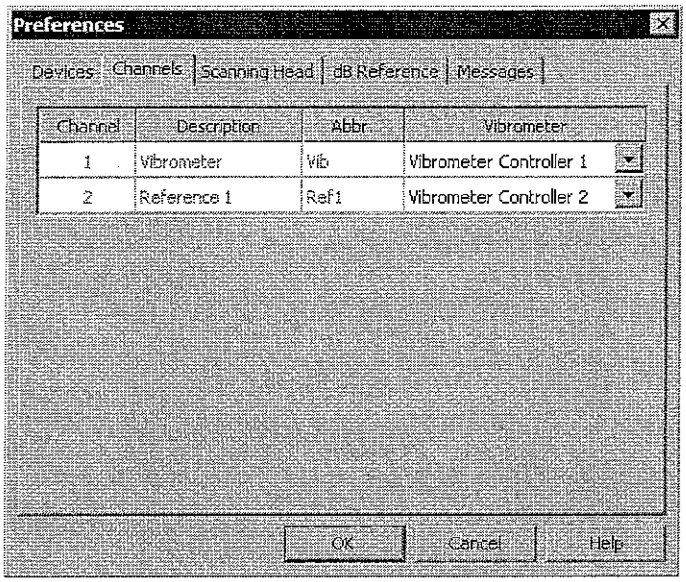


Figure 3.3: Page Channels

Channel: The number of channels displayed depends on which data acquisition board(s) you are using and which junction box has been selected on the page Devices (refer to section 3.1). However, the number of channels is only updated if you close the dialog Preferences by clicking OK and then reopening it.

Description: A meaningful name for every channel is shown here.

Abbr. An abbreviated name for every channel is given here.

Vibrometer: In this column, a channel is only active if: a Polytec vibrometer is connected, the vibrometer had already been switched on before changing into acquisition mode, and on the page Devices, the correct connection has been set. Here you select which vibrometer provides the signal for this channel. You can use the software to control the connected vibrometers as described in section 6.7.6. For certain hardware configurations and measurement modes, channels are already permanently connected.

In the following tables you will see the allocation of digital channels to the different connections from the individual junction boxes.

Channel	Junction box			
	PSV-Z-040-H	PSV-Z-040 -F, -U	PSV-Z-3D-H (3D/1D)	MSV-Z-040
1	VELO	VELO	VELO TOP	VELO
2	REF 1	REF	VELO LEFT	REF
3	REF 2	-	VELO RIGHT	-
4	REF 3	-	REF	-

Channel	Junction box		
	PSV-E-400	PSV-E-400-3D-H (3D/1D)	MSA-E-400
1	VELO	VELO TOP	VELO IN
2	REF 1	VELO LEFT	REF IN
3	REF 2	VELO RIGHT	-
4	REF 3	REF	-
5	REF 21[1]	REF 21[1]	-
6	REF 22[1]	REF 22[1]	-
7	REF 23[1]	REF 23[1]	-
8	REF 24[1]	REF 24[1]	-

[1] with PSV-E-408

Channel	Junction box					
	VIB-Z-010	VIB-Z-012	VIB-Z-014	VIB-Z-015	VIB-Z-016	VIB-Z-017
1	SIG IN	VELO	VELO	CHANNEL 1	VELO	VELO
2	REF IN	REF 1	REF 1	CHANNEL 2	REF 1	REF 1
3	-	-	REF 2	-	REF 2	REF 2
4	-	-	REF 3	-	REF 3	REF 3

Channel	Junction box		
	VDD-Z-010	VDD-Z-011	MSA-E-400 (VDD)
1	Vibrometer signal[1]	Vibrometer signal[1]	Vibrometer signal[1]
2	REF IN	REF 1	REF IN
3	-	-	
4	-	-	

[1] Only with option VDD: The vibrometer signal is not fed in through the junction box, it is only available directly in the software.

With the junction boxes VIB-Z-012, VIB-Z-016, PSV-E-400 and PSV-E-400-3D you can select ICP® for the reference channels and also switch the differential input for all channels on or off. You will find additional information on this in section 7.2.2 under the keywords ICP and Differential Input and also in your hardware manual.

If in addition to the junction box PSV-E-400 or PSV-E-400-3D respectively, you are also using the junction box PSV-E-408, you can use a second data acquisition board (PCI-4452) to measure four additional reference channels. Principal Component Analysis (refer to section 7.2.1) is also available.

Assigning channels for the PSV-3D

With the PSV-3D, you can only adjust settings on the page Channels if you also have an additional reference (single point) vibrometer connected.

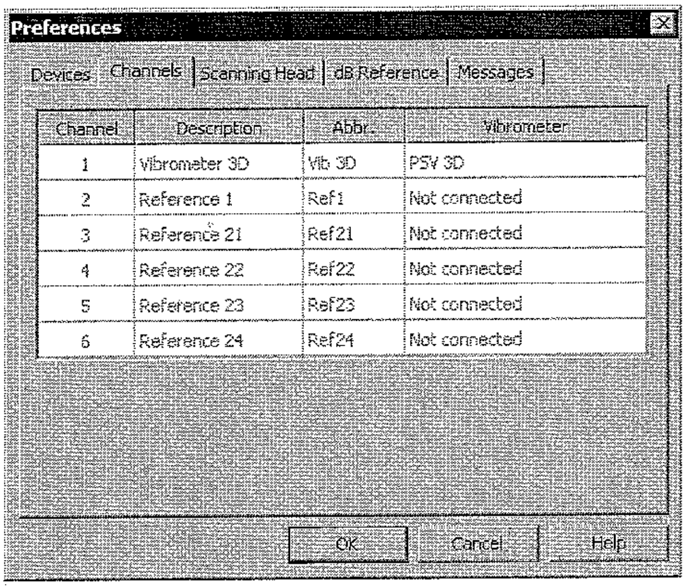


Figure 3.4: Page Channels for the PSV-3D

3.3 Scanning Head

You can set up the optics of the measurement system on the page Scanning Head.

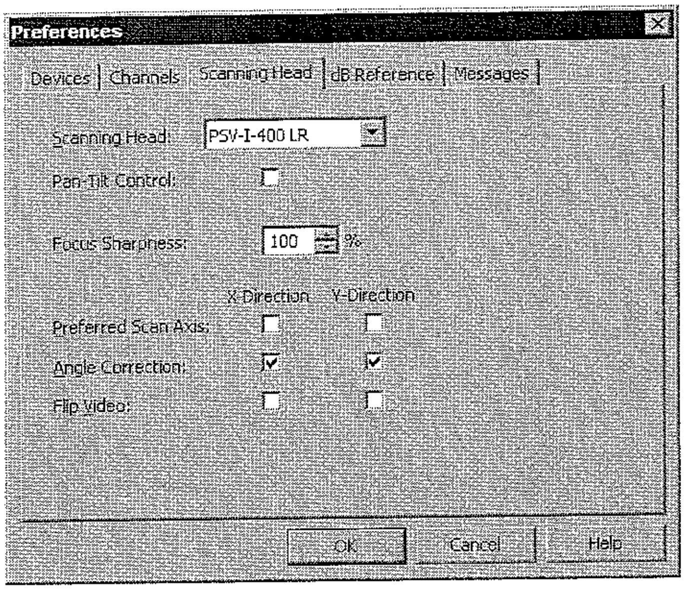


Figure 3.5: Page Scanning Head

Scanning Head: Select the scanning head of your measurement system here. The scanning head PSV-I-400 is delivered with the LR (Long Range) front lens as standard, as an option you can also have the MR (Mid Range) front lens. It is necessary to make a distinction between the two front lenses in the software to calculate the depth of focus correctly. Only PSV 200: Select the OFV-055F if your scanning head is equipped with a color camera.

Pan-Tilt Control: This line only appears if you have selected the scanning head OFV-056 or PSV-I-400 above. Tick the box if you want to control the optional pan-tilt stage using the software.

Focus Sharpness: This line only appears if you have selected the scanning head PSV-I-400 LR or MR. You can set the depth of focus here. The smaller the value you select, the less often the focus is corrected during a measurement. The standard value is 100%. However you can also set values to be greater than 100%. But please note that frequent readjustment of the focus can considerably increase the measurement time.

☞ So that focus is adjusted during the measurement, in the menu Scan you have to select the command Focusing during Scan.

Preferred Scan Axis: Here you select how the laser beam is to be moved when scanning. If the scan points are to be hit row by row, select the x-axis. If the scan points are to be hit column by column, select the y-axis. In the latter case the scanning time is shorter, as the scanner mirror for the y-axis is smaller and thus has a shorter settling time. If you do not mark any of the boxes, the software independently optimizes the order in which the scan points are hit.

Angle Correction: The vibrometer measures vibrations parallel to the laser beam. If the laser beam is at an oblique angle to the measurement surface, then an angle error occurs. Here you select whether the software is to correct the angle error for the respective axis. The angle correction only provides correct measurement values if you are measuring a flat surface at right angles to the scanning head. You should switch off angle correction for curved surfaces.

Flip Video: These boxes are only automatically activated for certain video boards. Here you can mirror the live video image on the x- or y-axis and thus, if necessary, set it up properly again. Normally the appropriate boxes for the scanning head have already been selected. However you can also change the setting as necessary, if, for example, you redirect the laser beam with external mirrors and thus obtain a flipped image, or if the scanning head has been mounted in such a way that it generates a flipped image.

Arrangement of scanning heads for the PSV-3D

With the PSV-3D you can mount the scanning heads tilted to one side. The software will compensate for this tilt if you move the beam with the icons Position in the scanning head control (refer to section 4.1). So that the laser beams can travel in the required direction, you have to set the tilt angle for every scanning head. Two configurations have already been predefined:

- staggered horizontally 
- star shaped 

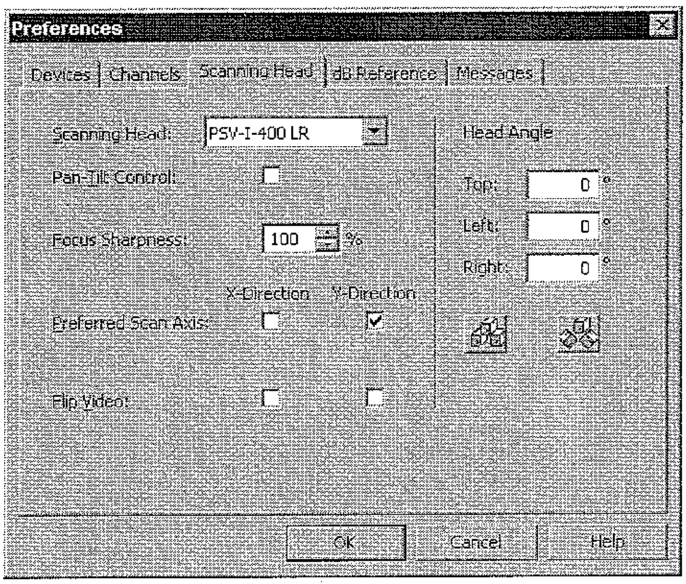


Figure 3.6: Page Scan head for the PSV-3D

Head Angle: Click  if you have the scanning heads mounted so that they are staggered horizontally. Click  if you have the scanning heads mounted in a star shape. In both of these cases, the tilt angles will be entered automatically.

If you have mounted the scanning heads with a different tilt, then please enter the values yourself.

☞ The function Angle Correction is not available in 3D mode.

Special features for the MSA

If you are using the MSA, you have other optional settings in the page Scanning Head.

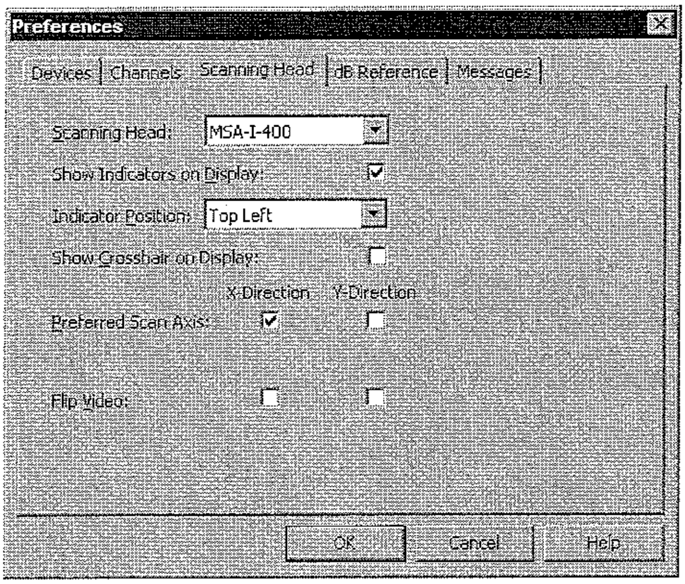


Figure 3.7: Page Scanning Head for the MSA

Scanning Head: Here you are shown the MSA-I-400 as the scanning head.

Show Indicators on Display: Tick this box if the indicators for the activity of the laser beam (on/off) and for the signal level on the MSA monitor are to be displayed.

Indicator Position: Here you select at which position on the MSA monitor the indicators are to be shown.

Show Crosshair on Display: Tick this box if a crosshair is to be shown on the MSA monitor. You can use this crosshair to help you accurately find the center of the screen and launch the laser beam precisely.

3.4 dB Reference

On the page dB Reference you can define dB = 0. You can thus directly follow an online measurement with a certain dB reference.

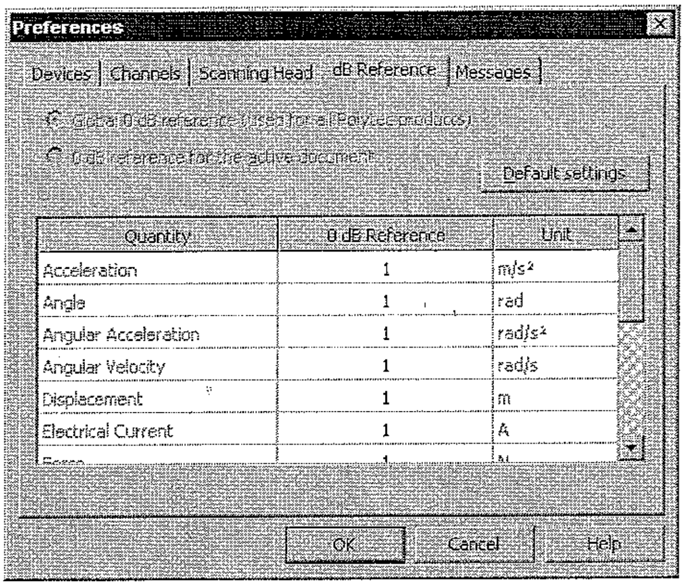


Figure 3.8: Page dB Reference

☞ Changes you make here only have an effect on the global 0 dB reference (applies to all Polytec products). If you want to change the local 0 dB reference for the active document, you have to open the page in presentation mode. See also section 8.4 under 0 dB reference on this.

Default settings: Click here if you want to recover the original settings for the 0 dB reference.

Quantity: All available physical variables are shown here.

0 dB Reference: Here you can define the factor for the respective unit.

Unit: The unit for the respective physical variable is shown here.

Example:

Variable	0 dB Reference	Unit
Displacement	2e-3	m

The 0 dB reference for the variable Displacement is 2 mm.

☞ If you want to evaluate combined signals (e.g. Vib & Ref1, see also section 8.4 on this), define the 0 dB reference for both variables.

3.5 Messages

On the page Messages you can select which system messages you would like to have displayed:

- If you would like to see all messages (notes, errors and warnings), then select Show all.
- If you would like to be informed of warnings and errors, then select Warnings.
- If you would only like to see error messages, then select Errors.
- If you do not want to receive any system messages at all, then select Show none.

☞ Message windows which contain queries or advise you of faulty input will appear in any case.

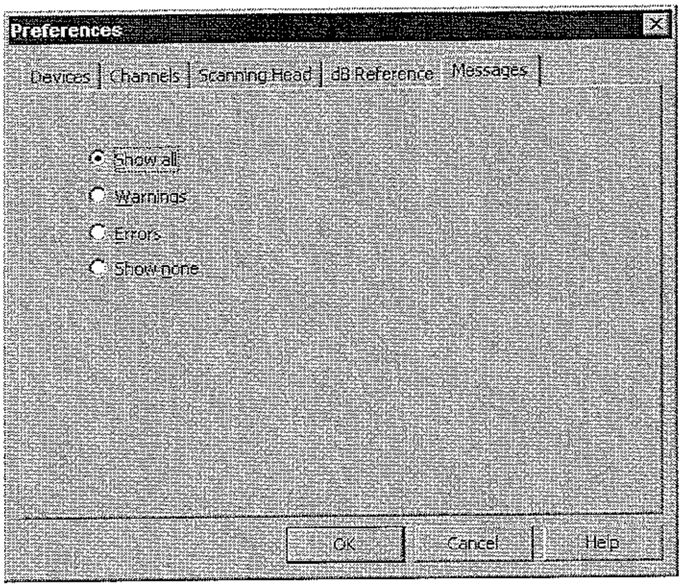


Figure 3.9: Page Messages

4 Setting the Optics

Depending on your measurement system, you may be able to control certain optics functions using the software. See section 4.1.1 on this. Alternatively you can use the optional PDA. See section 4.1.2 on this.

To define scan points on the live video image and to move the laser beam using the mouse, you have to align the coordinates on the live video image with the measurement plane. See section 4.2 on this.

You adjust the settings of the live video image (contrast, brightness, color) as described in section 4.7.

4.1 Controlling the Hardware

For the PSV 400 and the PSV 300 you can use the software to control all the optics and the optional pan-tilt stage.

For the MSA 400 or MSV/MMA 400 with the sensor head OFV-551/-552 respectively, you can use the software to position the laser beam and also remotely control the beam shutter and the optional dimmer on the sensor head. You set the other functions using the hardware. See your hardware manual on this.

For the MSV/MMA 300 with the sensor head OFV-511/-512 you can only position the laser beam with the software. You set the other functions using the hardware. See your hardware manual on this.

For the PSV 200 you can only use the software to focus and position the laser beam. You control the video camera and the optional pan-tilt stage with the video box. See your PSV 200 manual on this.

☞ You can remotely control the connected vibrometer controller. To do so, proceed as described in section 7.2.8 or use the range changer in the status bar.

4.1.1 Controlling the Optics with the Software

To control the optics with the software, proceed as follows:

1. Go to acquisition mode. To do so, click or select View > Acquisition.
2. If you do not see the scanning head control in the application window, then click to display it. You can also select View > Scanning Head.

3. Only scanning head MSV and MSA-I-400: From the list Lens, select the magnification which your microscope is set at.

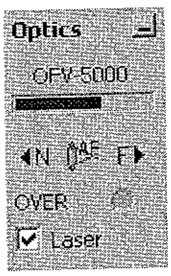
☞ If you can not see the list Lens in the scanning head control, then first of all set up the software for your measurement system. See chapter 3 on this.

4. If necessary, maximize the video window. To do so, in the title bar of the video window on the right, click ▣.

5. If necessary, adjust the focus of the live video image. See section 4.7 on this.

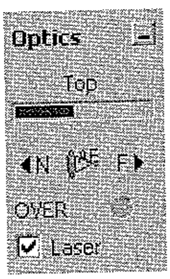
6. Using the icons in the scanning head control, you can now work as described in the following.

Focus the laser beam



Focus the laser beam with the icons ◀N (close-up) and F▶ (infinity). With the PSV 400 you can also focus the laser beam automatically with the icon AF. You will find more information on this in section 4.4. Above the icons you will see the optical signal level shown as a bar. This makes manual focusing easier. The Led OVER shows when the set measurement range is exceeded. In this case it lights up red. If it lights up permanently, then you have to select the next highest measurement range.

Switch the laser beam on or off



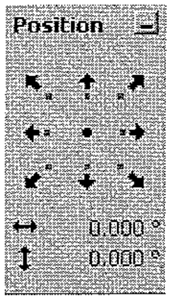
If you are using the junction box PSV-E-400 or PSV-E-400-3D, for every scanning head you will see the box Laser. Click the boxes to switch the respective laser on or off.
If you are using the optional geometry scan unit, then the box Laser for the scanning head Top is not active. In this case it is not the optical signal level of the vibrometer controller that is shown but that of the geometry scan unit. If the geometry scan unit receives too much light, the LED OVER lights up. If there is not enough light available, the signal level display disappears. This means you can tell whether your measurements will provide an acceptable result.
To display the signal level, the geometry scan unit has to continuously determine the lighting conditions. This is why the laser beam flashes approx. every 2 seconds.

If an additional vibrometer controller is connected and active, then another field is shown in the scanning head control. As this vibrometer controller is not connected up to the system via the junction box, you can not switch any laser beam on and off here. The display for signal level and overrun of the measurement range as well as focusing the laser beam are however available to you as described above.

Dim the laser beam (as an option)

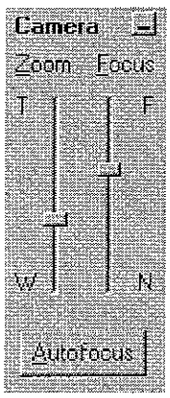
If you are using the junction box MSV-E-400 and the scanning head MSA-I-400, you can control the beam shutter and use it to switch the laser on and off. To do so, click the box Laser. You can also switch the laser beam on or off directly by pressing the button Laser on the sensor head. Refer to the sensor head manual on this. Apart from that, in the scanning head control, the slider Laser Dimmer is shown as an option. By moving this slider with the mouse in the direction Max. you can reduce the light intensity of the laser beam.

Position the laser beam



You move the laser beam with the icons Position. To do so, click the icon for the direction required. If you click , the laser beam is positioned in such a way that it is emitted at a right angle to the front panel of the scanning head (position 0; 0).
Under the icons you will see the position of the laser beam related to the horizontal and vertical axis.

Zoom the video camera

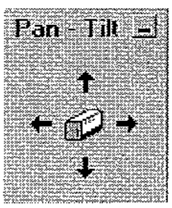


You zoom the video camera with the slider Zoom. Using the mouse you can roughly set the slider. If the slider is active, you can fine-tune it with the arrow keys ↑ and ↓. (To activate the slider, click it.)

Focus the video camera

You focus the video camera with the slider Focus. Using the mouse you can roughly set the slider. If the slider is active, you can fine-tune it with the arrow keys ↑ and ↓. (To activate the slider, click it.)
You can also focus automatically. To do so, click Autofocus. Automatic focusing can take several seconds during which the software is inactive.

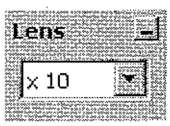
Pan-tilt stage (as an option)



You control the motorized pan-tilt stage with the icons Pan-Tilt. If you can not see the icons in the scanning head control, then first of all activate the pan-tilt stage for the software. See section 3.3 on this.

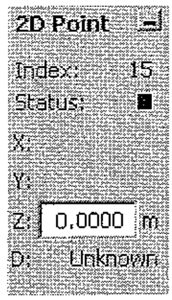
To pan the scanning head, click or . To tilt the scanning head, click or .

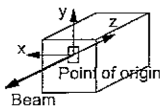
Set the zoom factor for the microscope



If you are using the scanning head MSA-I-400 or MSV, here you select the zoom factor set on the microscope. The software uses the zoom factor set to calculate the position of the laser on the measurement object and displays this in µm under the icons Position.

Enter coordinates of axes

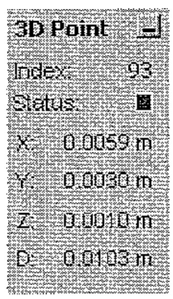




The element 2D Point is displayed if there is a 2D geometry.
Right at the top the Index of the selected scan point is shown, below that its Status (refer to section 8.1 as well).
Enter the distance between the scanning head and the measurement object in the empty field and press Enter. Of the three axes, the one for which you can define the distance depends on the direction of the vibrometer channel in the dialog Acquisition Settings (refer to section 7.2.2). The figures next to this apply to the direction +Z.
As the axis which shows the distance of the measurement object from the scanning head is in the opposite direction to the laser beam, the coordinate for the object always has the inverse sign. If you enter the distance between the measurement object and the scanning head as z-coordinate, the software calculates the x and y coordinates of the respective scan point under the assumption that the object is flat and is positioned vertically to the 0° direction of the laser beam. The z coordinate is thus the same for every scan point.
The origin of the coordinate system is the point at which the laser beam is emitted in 0° direction from the front panel of the scanning head.

☞ The coordinate which shows the distance of the object from the scanning head is used as a preset for the object distance when exporting the geometry in Universal File Format and ME'Scope-Format.
For measurements with the close-up unit PSV-A-410 or OFV-056-C, you have to add 41 mm to the stand-off distance. This corresponds to the optical path length inside the close-up unit (see also section 10.2.3 and section 10.2.4).

3D Point



The element 3D Point is displayed if there is 3D geometry.
Right at the top, the Index of the selected scan point is displayed. Below that, the coordinates (X, Y, Z) of the scan point are displayed. The coordinate system used here is the one which you determined with the 3D alignment (refer to section 4.2.4).
The software calculates the distance D, i.e. the distance between the selected scan point and the point at which the laser beam in 0° direction intersects the plane of the front of the scanning head. For the PSV-3D, the distance to the scanning head Top is always given.

4.1.2 Controlling the Optics with the PSV-A-PDA

To control the optics with the optional PDA, start the PDA as described in section 2.4. The user interface of the PDA software appears.

Position the laser beam

Move the laser beam with the icons ↓, ↑, ← and →. To do so, touch the icon for the direction required. If you touch ⊚, the laser beam is positioned in such a way that it is emitted at a right angle to the front panel of the scanning head (position 0; 0).

Focus the laser beam manually (PSV-1D)

Focus the laser beam manually with the icons ◀N (close-up) and F▶ (infinity). Below the icons you will see the optical signal level shown as a bar. This makes manual focusing easier. The signal level displayed is identical to that in the software and on the scanning head. The LED next to the icons shows when the set measurement range is exceeded. In this case it lights up red. If it lights up permanently, then you have to select the next highest measurement range.

Automatically focus the laser beam

With the PSV 400 you can also focus the laser beam automatically with the icon AF. See section 4.4 on this.

4.2 Aligning Coordinates

To define scan points on the live video image and to move the laser beam using the mouse, you have to align the coordinates on the live video image to the measurement plane. As you are aligning two-dimensional coordinate systems, you have to align at least two points with different x- and y-coordinates.

How?

You can align the coordinates with the software as described in the following sections. However you can also use the optional PDA to help you. See section 4.2.2 on this.

When?

You have to realign when you

- are working at a different stand-off distance
- have zoomed the video camera.

Tips

The following tips make it easier to align:

- The more points you align, the more precisely the software positions the laser beam.
- Distribute the alignment points evenly over the whole measurement surface. If, for example, you want to scan a rectangular surface, it would make sense to choose four alignment points near the corners.
- Align those points which you want to position precisely when scanning.
- To increase the precision, you can zoom in on sections of the image. Read section 2.8 on this.

PSV-3D

If you are using the PSV-3D, then you are making a measurement with three independent scanning heads. This means that you have to start by carrying out a standard alignment for every single scanning head as described in section 4.2.1.

After that, you have to carry out a 3D alignment to position the three laser beams on one geometry point and have to transmit the vibration data into the coordinate system of the object under investigation. 3D alignment is described in section 4.2.3.

☞ A 3D alignment without previous standard alignment is possible. To make a measurement however, you will need both.

4.2.1 Carrying out Standard Alignment with the Software

You always have to carry out this alignment for the PSV. It is only necessary for the PSV-3D if you want to make a measurement.

☞ If you want to import geometry data in 3D point mode, you also have to carry out a standard alignment first.
You will find detailed information on geometry import in section 5.4.

Alignment with the scanning head control

For standard alignment, proceed as follows:

1. Click or select Setup > Align Coordinates. The software maximizes the video window and displays the scanning head control.
2. Move the laser beam with the icons Position in the scanning head control to an alignment point on the object, refer also to section 4.1.
3. In the live video image, point the mouse precisely at the laser beam and click. You can now see a target there.
4. If the laser beam is not precisely in the middle of the target, repeat step 3.
5. Repeat steps 2 and 4 for at least one other alignment point.

☞ When you select a new scanning head for alignment, the alignment points of the other scanning heads which have already been defined are saved.

6. Once you have aligned all points, click again or select Setup > Align Coordinates.

Special features for PSV-3D

If you are carrying out standard alignment with PSV-3D, please also pay attention to the following points:

1. For the PSV-3D define at least four alignment points for each scanning head. When doing so, the following applies:
   - In the case of simple level surfaces, it often already suffices to use four to six alignment points to get good results.
   - The larger the surface, the greater the deviations, particularly in the areas close to the edge.
   - If the results of the alignment are not satisfactory (see below: section Test, step 3), then define at least ten alignment points per scanning head.
2. To select the individual scanning heads, use the list in the scanning head control or click the right mouse button on the video image and select one of the scanning heads (Top, Left or Right) in the pop-up menu.
3. Once you have defined all alignment points for one scanning head, then select the other two scanning heads one after the other as described in step 2 and define the alignment points for these scanning heads in the same way.

Alignment using the mouse

With a bit of practice, you can position the laser beam more quickly for alignment by using the mouse to move it to approximately the right place first. If necessary, you can then use the scanning head control for fine-tuning as described above.

1. Hold the middle mouse button (mouse wheel) pressed and drag across the video image with it. The laser beam follows the mouse pointer, although not very precisely yet, as the alignment has not yet been carried out.

☞ If you have allocated a special function to the middle mouse button (e.g. double-click), then this method of alignment is not available.

2. If necessary, move the laser beam using the icons Position in the scanning head control to the right position and proceed with the alignment as described above in step 3.

Alignment with auto-alignment

If you are using one of the graphics cards ATI Radeon® 9000 Pro, 9600 Pro or 9600 XT, you can carry out automatic alignment. To do this, proceed as follows:

1. Click in the video image with the right mouse button and select Auto Align in the pop-up menu.
2. In the video image, click the point on the object at which you want to define the alignment point. The software will automatically position the laser beam there and define an alignment point.

☞ This function is not available for the MSV.

Delete alignment points

To delete an individual alignment point, click it with the right mouse button and select Delete in the pop-up menu.

To delete all the alignment points for one scanning head, click with the right mouse button in the video image and select Delete All in the pop-up menu.

Abort the alignment

You can abort the alignment at any time. To do so, click or select Setup > Align Coordinates. You will be given a message that the alignment was not finished correctly and you can now decide whether you want to repeat it or not.

Test

Now test the alignment as follows:

1. If the scan points are shown in the live video image, click to hide them.
2. Point at the live video image and click a point on the measurement plane. The laser beam moves to this point on the object.
3. Check if the position of the laser beam corresponds to that of the point clicked. If this is not the case, repeat the alignment.

☞ The live video image shows a two-dimensional image of the three-dimensional object. For this reason, the laser beam does not precisely hit points which are not on the measurement plane.
Only PSV-3D: If you want to define scan points in Scan Point Definition mode, then it is necessary for the laser beam and the point clicked on the screen to match as accurately as possible (refer above to Alignment with the scanning head control, step 3). If you import via UFF or teach-in the scan points, then an approximate match is good enough.

4. Repeat steps 2 and 3 for a few more alignment points.

4.2.2 Carrying out Standard Alignment with the PSV-A-PDA (as an Option)

To carry out a standard alignment with the optional PDA, you essentially proceed as described in section 4.2.1. Use the PDA to position the laser beam and to define the alignment points. To do this, proceed as follows:

1. Click or select Setup > Align Coordinates. The software maximizes the video window and displays the scanning head control.
2. Start the PDA as described in section 2.4. The user interface of the PDA software appears.

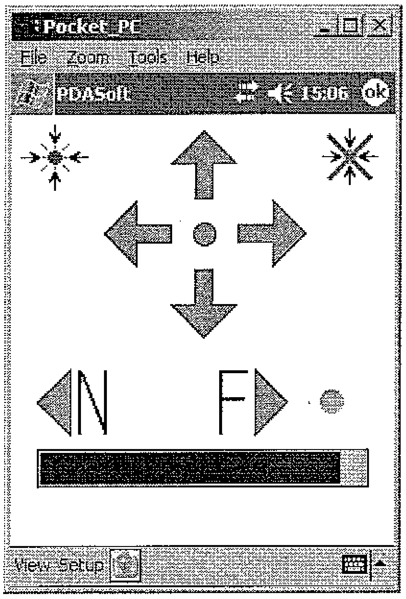


Figure 4.1: User interface of the PDA software

Position the laser beam

3. Center the laser beam by touching the icon with the stylus.
4. Position the laser beam by touching the corresponding icon for the direction , , or .

☞ If you touch an arrow icon for more than approx. one second, the PDA switches to fast forward.
For fine adjustment you can always briefly touch the icon again.

Define alignment points

5. You define an alignment point by touching the icon .

Delete alignment points

6. You can delete an alignment point by positioning the laser beam on the alignment point and touching the icon .

Directly head for alignment points

You can use the optional PDA to directly head for the defined alignment points with the laser beam.To do this, proceed as follows:

1. Select View > Toggle Points in the PDA menu bar.

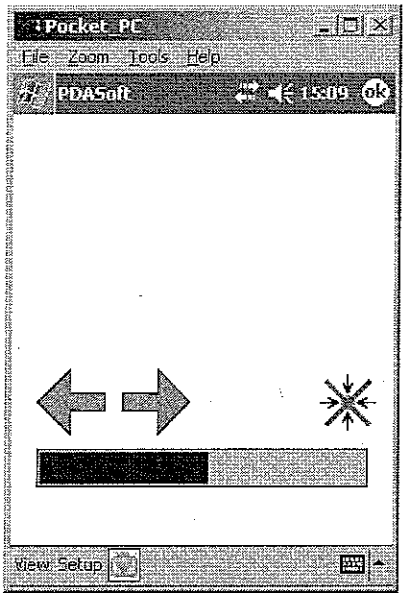


Figure 4.2: Directly head for alignment points

2. Touch the icons or . The laser will directly head for the defined alignment points backwards or forwards.

Select the scanning head (PSV 3D)

If you are using the PSV-3D, you can also select the scanning heads with the PDA software.

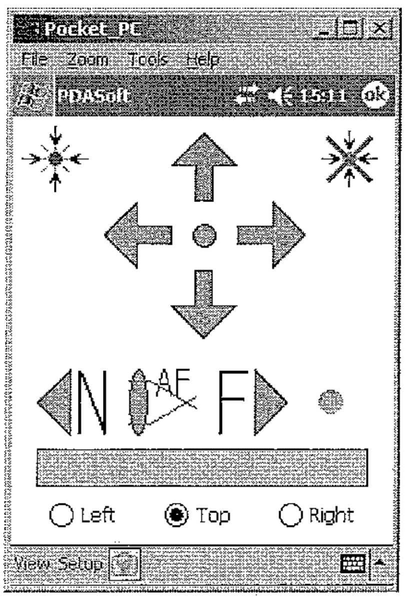


Figure 4.3: User interface of the PDA software for the PSV-3D

To select one of the three scanning heads, touch the corresponding icon
Left Top Right.

You can define, delete and directly control the alignment points for every scanning head as described above.

4.2.3 3D Alignment

This alignment must be carried out for the PSV-3D. It is only necessary for the PSV if you want to import geometry data in 3D point mode (as an option) or want to acquire geometries with the geometry scan unit PSV-A-420 (as an option). It determines the position and the alignment of the scanning heads in the coordinate system of the object under investigation.

☞ With the micro scanning lenses PSV-A-CL80, PSV-A-CL150 and PSV-A-CL300 it is not possible to carry out 3D alignment! The close-up unit without micro-scanning lenses does not affect 3D-alignment.

You need the coordinate description of at least four points on the object in a cartesian coordinate system. Ideally you import these points as a Universal File directly from an external program (e.g. CAD or modal analysis). You can also enter the coordinates manually after measuring your object. You can directly determine the coordinates with the optional geometry scan unit PSV-A-420. Then you will also only need at least 3 points for the 3D alignment.

Careful alignment is an important prerequisite for an optimal measurement result. For this reason, please pay attention to the following points:

- Pay attention to the position of the coordinates on the object!
  If all the coordinates are in one plane, then this can lead to inaccurate results, even on a flat object. If necessary, use an object with several spatial planes for the alignment.
- Pay attention to the number of alignment points on the object!
  In principle for an alignment, it is enough to define four alignment points. For the best possible results however, you should align at least five points.

☞ Ideally, the selected alignment points should cover the whole volume of the object. For this reason they should not all be in one plane.

- It is best if two people position the laser beam. One person operates the software, the other watches the movements of the laser beam directly on the object.
  Alternatively you can use the hand set PSV-Z-051 or the optional PDA. See the respective hardware manual on this.
  The more precisely the alignment is carried out, the better the measurement result will be. **So please take your time defining the alignment points!**

For 3D alignment, in principle you proceed as described in the following. You will find detailed information on the individual steps in section 4.2.4.

Select the unit

1. Open the dialog 3D Alignment and select the unit of length (mm or m).

Set the coordinates

2. Put the coordinates of the alignment points in the table. You can enter the coordinates manually or import them.

Define alignment points

3. Choose a scanning head, position the laser beam to point at the required points on the object one after the other and define the alignment points.

Assign the coordinates

4. Assign the coordinates to the alignment points.
5. Repeat step 3 for both the other scanning heads.

Specify quality

6. Then enter the accuracy with which the alignment points on the object and the coordinates in the table approximately correspond to each other.

Calculate the alignment

7. Calculate the alignment and if necessary, correct the alignment points.

If you are using the optional geometry scan unit, you proceed slightly differently than described here. Refer to section 4.2.6 or section 4.2.7.

4.2.4 Carrying Out 3D Alignment Using the Software

☞ If you are using the PSV-3D in 1D mode, you only have to carry out the 3D alignment for the scanning heads which are not marked as reference.

For 3D alignment, proceed as follows:

1. Click or select Setup > Align 3D Coordinates.
2. Click or select Setup > Dialog 3D Alignment.

   You can also click the video image with the right mouse button and select Dialog 3D Alignment in the pop-up menu. The dialog 3D Alignment appears. Depending on the system you are making the measurement with (PSV-3D or PSV with the option Data Import: Geometry), either all three scanning heads are shown in the dialog or only one.

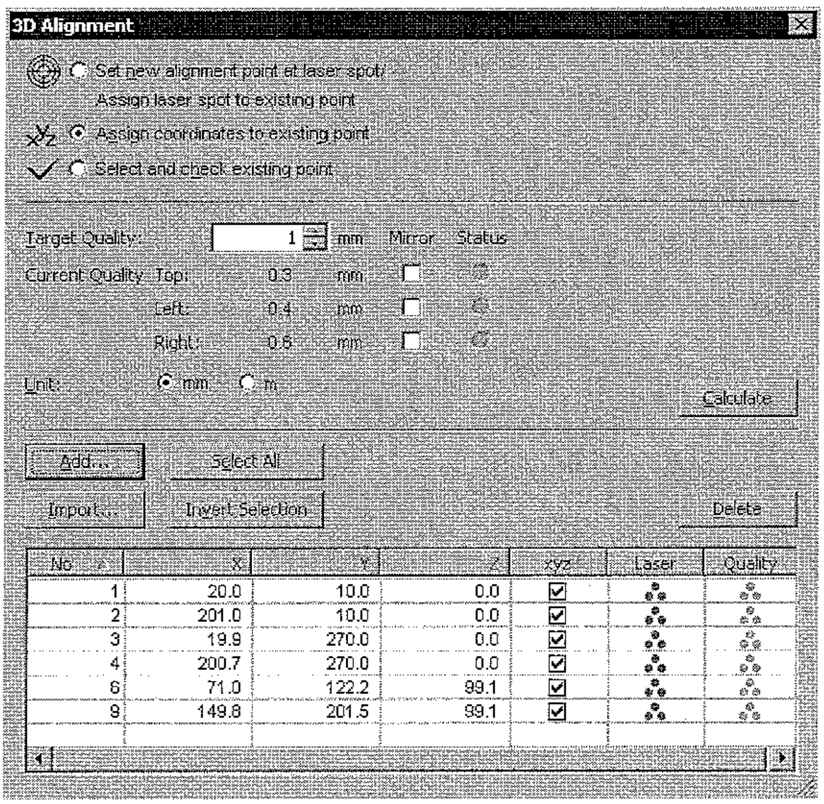


Figure 4.4: Dialog 3D Alignment for the PSV-3D

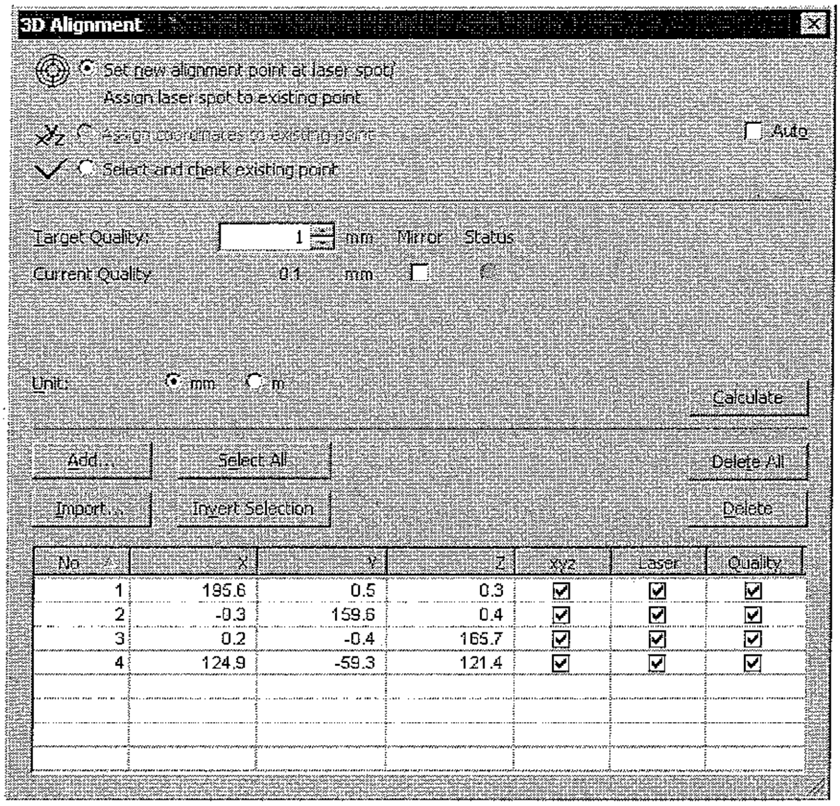


Figure 4.5: Dialog 3D Alignment for the PSV with the option Data Import: Geometry

☞ You can sort the entries in the table in ascending or descending order in every column. To do so, click the head of the respective column.

Select the unit

3. Select the unit for the coordinates (mm or m).

Set the coordinates

4. Enter at least four object coordinates for every scanning head. These coordinates can be the same for all three scanning heads, but this is not necessary.

   If you want to import the coordinates e.g. from a CAD program, then click Import. Then enter the file which you want to import the values from.

☞ When importing, all the coordinates which already exist will be deleted!

☞ If you are importing geometry from a file in Universal File format which does not contain data set 164 with the units of the coordinates, you have to enter a scaling factor in the dialog 3D Alignment, refer to figure 4.6. The factor 1 stands for the unit m, the factor 0.01 for the unit cm etc.

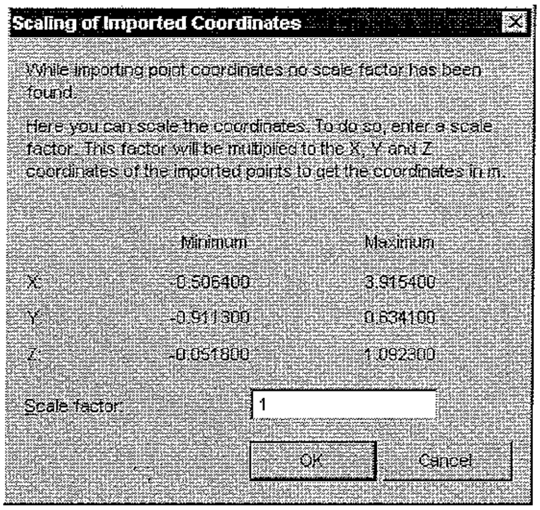


Figure 4.6: Dialog Scaling of Imported Coordinates

If you enter the coordinates manually, click Add. The dialog Add Point Coordinates appears.

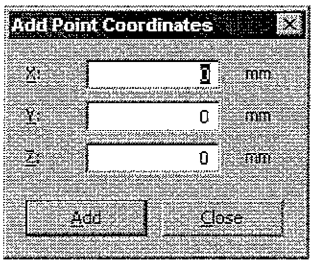


Figure 4.7: Dialog Add Point Coordinates

Enter the values in the fields X, Y and Z and click Add. Once you have entered all the coordinates, click Close or press the Escape key to leave the dialog.

Delete individual coordinates

If the table contains too many coordinates, you can delete individual coordinates. To do so, mark one or more coordinates and click Delete.

Or:

Mark the coordinates you want to keep, click Invert Selection and then Delete. This way you will delete all the undesired coordinates at once.

Delete all coordinates

If you want to delete all coordinates, click Select All and then Delete.

☞ If alignment points on the video image are already linked with the coordinates in the table, then the coordinates assigned to the points are deleted, the alignment points themselves however remain.

Select the scanning head

5. In the scanning head control, select a scanning head, or with the right mouse button, click in the video image and select one of the scanning heads (Top, Left or Right) in the pop-up menu.

6. Now you can move the laser beam using the icons Position in the scanning head control.

   Alternatively you can also use the mouse directly. Using the middle mouse button (mouse wheel), click in the video image. This will make the laser beam jump to your mouse pointer. To position the beam, press the middle mouse buttonand drag with the mouse until the laser beam is positioned on the required point on the object.

☞ To increase the accuracy when hitting the required point, zoom the video image. See section 2.8 on this.
If you have assigned a special function to the middle mouse button (e.g. double-click), position the laser beam using the icons Position in the scanning head control.

Defining alignment points

7. Once you have found the precise position, in the dialog 3D Alignment, select Set new alignment point at laser spot/Assign laser spot to existing point. Now in the video image, click the point which the laser beam is currently at. An alignment point will now be defined there.

   The alignment point is marked using a black circle. This icon shows you which scanning head you are currently aligning:

   designates the left, the right and the top scanning head.

☞ If you define alignment points with identical coordinates for two or all three scanning heads, the respective circular icons will be superimposed on each other while you align the scanning heads one after the other. If for example you give the same coordinates to one alignment point for the left and right scanning head and have aligned both scanning heads, you will be shown .

8. In this manner define all alignment points.

☞ On the PSV the icon appears immediately

Delete alignment points

To delete an alignment point, click it in the video image with the right mouse button and select Delete in the pop-up menu.

To delete all the alignment points for the selected scanning head, click in the video image with the right mouse button and select Delete All in the pop-up menu.

Assign coordinates

9. Then in the dialog 3D Alignment, select Assign coordinates to existing point.

10. In the dialog 3D Alignment, mark the first coordinate in the table and click the relevant alignment point in the video image. In the column xyz a tick will appear which shows that the coordinates in this line are now assigned to an alignment point. The circle in the video image is now shown in bold and the marker in the table moves on one line.

☞ In the dialog 3D Alignment in the table column Laser, you will see which scanning heads you have already assigned to the respective alignment point. The three dots in the icon stand for the three laser beams Top, Left and Right. Once the first scanning head has been aligned, the respective dot in the icon is marked red.

11. Now assign the other coordinates in the table to the alignment points.

12. Define the alignment points for the other two scanning heads as described above.

☞ As soon as all three scanning heads have been aligned, a tick will appear in the column Laser instead of the icon.

Use mirrors

If you make the measurement with the aid of mirrors, e.g. to scan sides of the object which you can not reach directly with the laser beam, you have to define all scan points for the respective scanning head on the reflection of the object and also align the coordinates on the mirror. Apart from that, tick the corresponding box in the dialog 3D Alignment in the column Mirror.

Specify quality

13. In the field Target Quality enter the value by which the alignment points deviate from the given coordinates (e.g. 1 mm).

Calculate the alignment

Once you have defined the alignment points for all three scanning heads and have assigned coordinates to them, you can calculate the alignment.

14. Click Calculate. The software will now carry out an alignment for each scanning head. The quality of this alignment is displayed in the dialog for every scanning head. If none of the quality values calculated is greater than the value in the field Target Quality, then the alignment was successful.

    You can check the quality for the scanning heads and also for the individual alignment points. In the column Quality the points are marked green for which the quality value for the respective scanning head is lower than the value in the field Target Quality. The LED Status in the dialog 3D Alignment also shows whether the quality of the alignment of individual points is sufficient. If the LED lights up green, then the quality is good. If the LED lights up yellow, then the quality is worse than the target quality but you can use the alignment. If the LED lights up red, then the alignment is not valid.

☞ You can also make a measurement if not all the alignment points are positioned exactly. To increase the quality of the measurement results, you can delete the alignment points or reassign laser positions to them as described in the following.
You can also initially increase the tolerance limit in the field Target Quality to find out what the deviation between the alignment point and the object coordinate is.

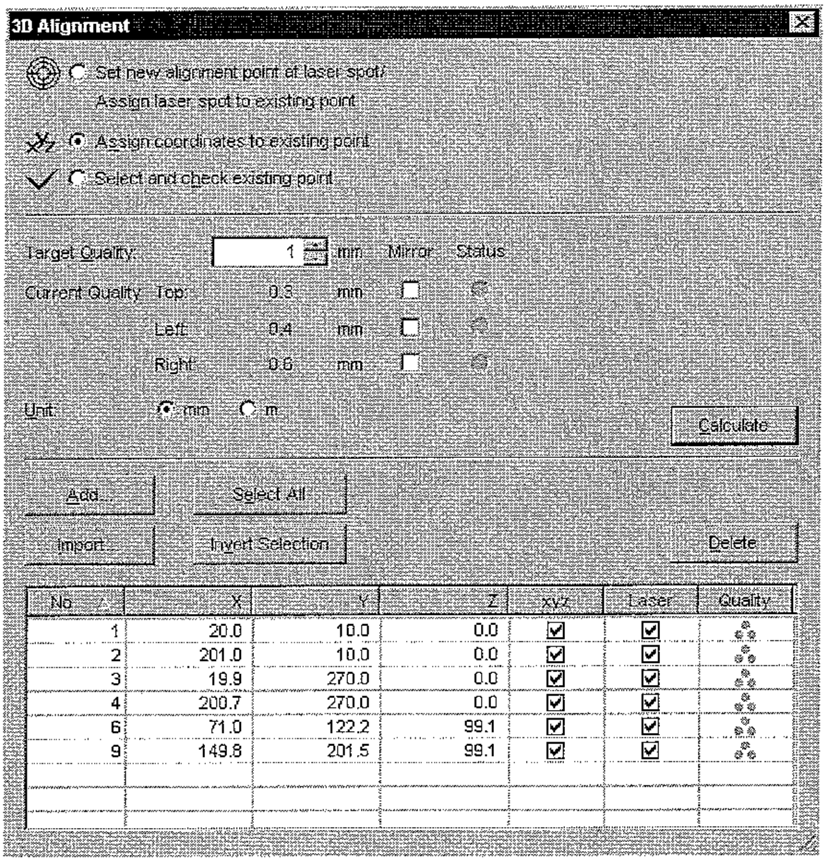


Figure 4.8: Successfully calculated 3D Alignment

Reassign the laser position

You can also reassign a new laser position to existing alignment points to increase the quality of the measurement results.

15. To do so, in the dialog 3D Alignment, select Set new alignment point at laser spot/Assign laser spot to existing point. Then move the relevant laser beam to the alignment point and click the point with the left mouse button. The new laser position is used to calculate the alignment again.

Abort the alignment

You can abort the alignment at any time. To do so, click or select Setup > 3D Alignment. You will be given a message that the alignment was not finished correctly and you can now decide whether you want to repeat it or not.

Check alignment points

You can also retrospectively compare the assignment of the alignment points on the video image to the points in the table in the dialog 3D Alignment.

16. To do so, in the dialog 3D Alignment, select Select and check existing point.

17. Then click an alignment point in the video image. If this point already has coordinates assigned to it, then the corresponding line in the table is marked blue.

    Or:
    Click a line in the table. The corresponding alignment point is displayed blue in the video image. If there is a valid 3D alignment for all scanning heads, then the laser beams are moved to the positions calculated for the x, y and z coordinates. You can visually control the quality of the alignment at the respective point. The more precisely the beams are superimposed, the greater the quality of the alignment will be.

18. Click to leave the dialog 3D Alignment.

Clear assignment

If you have already assigned coordinates to an alignment point, delete the respective table lines in the dialog 3D Alignment. The assignment of the alignment point to the coordinates is removed.

4.2.5 Carrying Out 3D Alignment with the PSV-A-PDA

To carry out a 3D alignment with the optional PDA, you essentially proceed as described in section 4.2.4. You use the PDA to select the scanning heads, to position the laser beam and to define the alignment points. To do so, proceed as follows:

1. Click or select Setup > Align 3D Coordinates.

2. Click or select Setup > Dialog 3D Alignment.

Select the unit and define coordinates

3. Select the unit and define the coordinates as described in section 4.2.4.

4. Start the PDA as described in section 2.4. The user interface of the PDA software appears.

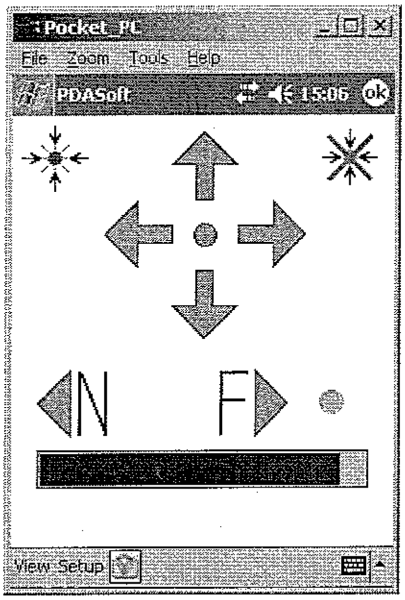


Figure 4.9: User interface of the PDA software

Position the laser beam

5. Center the laser beam by touching the icon with the stylus.

6. Position the laser beam by touching the corresponding icon for the direction , , or .

☞ If you touch an arrow icon for more than approx. one second, the PDA switches to fast forward. For fine adjustment you can always briefly touch the icon again.

Define alignment points

7. You define an alignment point by touching the icon .

Delete alignment points

8. You can delete an alignment point by positioning the laser beam on an alignment point and touching the icon .

Select the scanning head (PSV 3D)

If you are using the PSV-3D, you can also select the scanning heads with the PDA software.

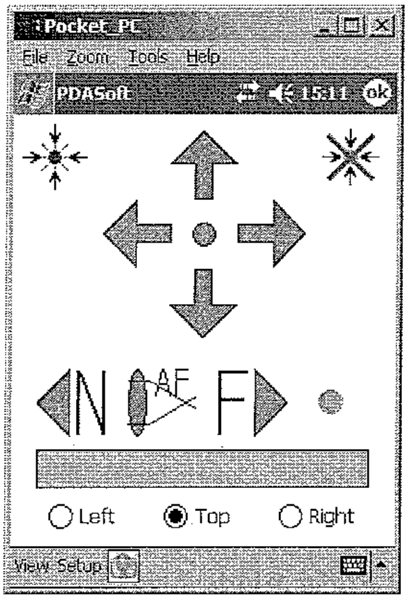


Figure 4.10: User interface of the PDA software for the PSV-3D

9. To select one of the three scanning heads, touch the corresponding icon ◯ Left ◉ Top ◯ Right.

You can define and delete the alignment points for every scanning head as described above.

Assign coordinates and calculate alignment

10. Now proceed as described in section 4.2.4, i.e. assign coordinates to all alignment points, specify the quality and calculate the alignment.

Directly head for alignment points

If there is a calculated 3D alignment, you can directly head for the defined alignment points with the laser beam. To do this, proceed as follows:

1. In the dialog 3D Alignment, select Select and check existing point.

2. Select View > Toggle Points in the PDA menu bar.

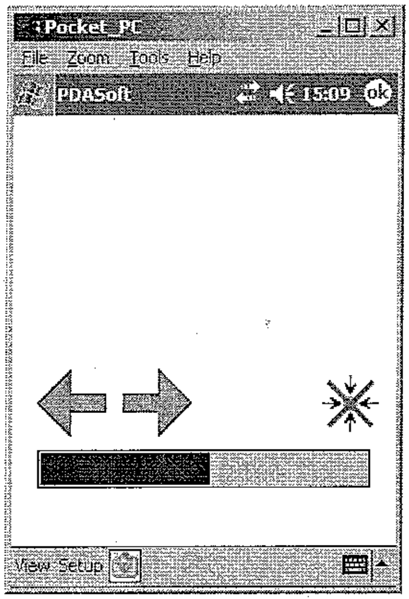


Figure 4.11: Directly head for alignment points

3. Touch the icons or . The laser directly controls the defined alignment points backwards or forwards.

☞ If you delete an alignment point, there is no valid 3D alignment any more and you can no longer directly head for the alignment points.

4.2.6 3D Alignment for the PSV with the Geometry Scan Unit (as an Option)

You can use the geometry scan unit to carry out a simplified 3D alignment as an alternative to section 4.2.4.

1. If you have not carried out a standard alignment yet, do it now as described in section 4.2.1or section 4.2.2.

2. Click or select Setup > Align 3D Coordinates. You can also click in the video image with the right mouse button and select Dialog 3D Alignment in the pop-up menu. The dialog 3D Alignment appears.

3. Tick the box Auto. In place of the buttons above the table, the list Coordinate Definition Mode is displayed, instead of the column xyz, the column Distance.

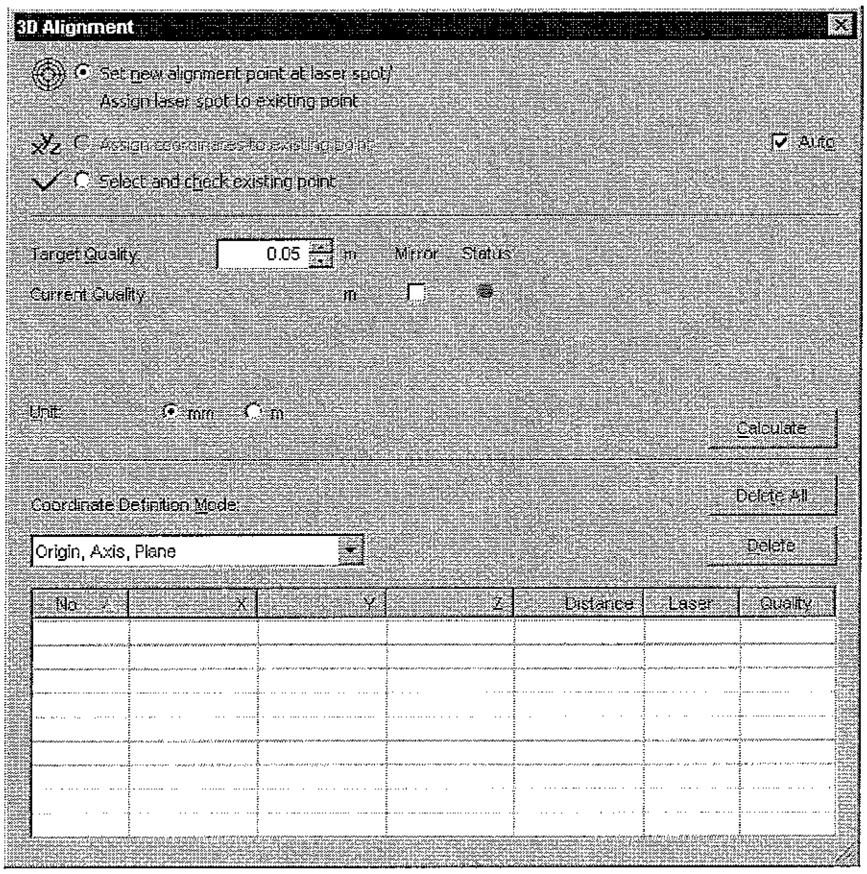


Figure 4.12: Dialog 3D Alignment for alignment with the geometry scan unit

You have the following ways of defining the coordinate system:

- Mark the origin, any point on the positive x, y or z axis and any point on a positive half plane limited by the selected axis.
  Example: 0, +x, x/+y
- Mark any point respectively on the positive x, y and z axis.
- Mark any three points and enter all the coordinates of these points.

These possibilities are described in detail in the following.

☞ When defining every alignment point, the software automatically switches over to the geometry laser and carries out a distance measurement to the alignment point. When defining the alignment points, you can save time by activating the geometry laser first to avoid having to switch over. To do so, select Scan > Geometry Laser.

Specify Origin, Axis, Plane

To set the coordinate system in this way, proceed as follows:

1. Select Origin, Axis, Plane from the list Coordinate Definition Mode.
2. Position the laser at the origin of the coordinate system.
3. Define an alignment point as also described in section 4.2.4. The alignment point is automatically displayed in the list in the dialog 3D Alignment. In the column Distance the distance measured to this alignment point is entered. In the column Laser it shows that the point has been defined.
4. Click the alignment point with the right mouse button and select Origin in the pop-up menu. A 0 will appear next to the alignment point. The coordinates of the point at the origin (0/0/0) are shown.
5. Move the laser beam and define a second alignment point on one of the positive axes, e.g. on the positive x-axis. The point and its distance from the scanning head are shown in the list in the dialog 3D Alignment.
6. Click the alignment point with the right mouse button and select Point on +x-axis in the pop-up menu. An +X will appear next to the point; an arrow will be drawn through the point. The distance and the coordinates (+x/0/0) of the point are shown.
7. Move the laser beam again and define a third alignment point on one of the half planes limited by the selected axis, e.g. on the x /+y plane. The point and its distance from the scanning head are shown in the list in the dialog 3D Alignment.
8. Click the alignment point with the right mouse button and select Point on x/+y-plane in the pop-up menu. An X/+Y will appear next to the point. The distance and the coordinates (x/+y/0) of the point are shown.
9. Click Calculate. The software will calculate all the coordinates of the alignment points and enter them in the list. At the same time it determines the position of the scanning head in this coordinate system.

Specify Three Points on Axes

To set the coordinate system in this way, proceed as follows:

1. Select Three Points on Axes from the list Coordinate Definition Mode.
2. Position the laser beam at a point in the video image which the x-axis of the coordinate system is to pass through.
3. Click the alignment point with the right mouse button and select Point on +x-axis in the pop-up menu. An +X will appear next to the point; an arrow will be drawn through the point.
4. Repeat steps 2 and 3 for one more alignment point each on the y and z-axis.
5. Click Calculate. The software will calculate all the coordinates of the alignment points and enter them in the list. At the same time it determines the position of the scanning head in this coordinate system.

Specify Points with free Coordinates

To specify the coordinate system in this way, the object coordinates have to be known. Please proceed as follows:

1. Select Points with free Coordinates from the list Coordinate Definition Mode.
2. Position the laser beam at any point on the video image.
3. Click the alignment point with the right mouse button and select Points with Free Coordinates in the pop-up menu. The dialog Assign Coordinates appears.

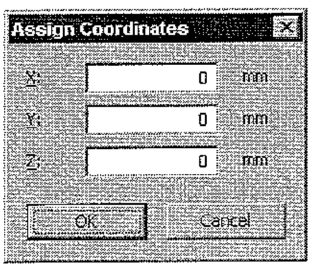


Figure 4.13: Dialog Assign Coordinates

4. Here you enter the coordinates of the alignment point and click OK. XYZ will appear next to the point.
5. Repeat steps 2 to 4 for a total of four to seven alignment points.
6. Click Calculate. The software calculates the position and location of the scanning head in the coordinate system.

4.2.7 3D Alignment for the PSV 3D with the Geometry Scan Unit

1. If you have not carried out a standard alignment yet, do it now as described in section 4.2.1.

2. Select the scanning head Top.

3. If applicable, select Scan > Geometry Laser to activate the geometry laser.

4. Click or select Setup > Align 3D Coordinates. You can also click the video image with the right mouse button and select Dialog 3D Alignment in the pop-up menu. The dialog 3D Alignment appears, refer to figure 4.12.

5. Tick the box Auto. In place of the buttons above the table, the list Coordinate Definition Mode is displayed, instead of the column xyz, the column Distance.

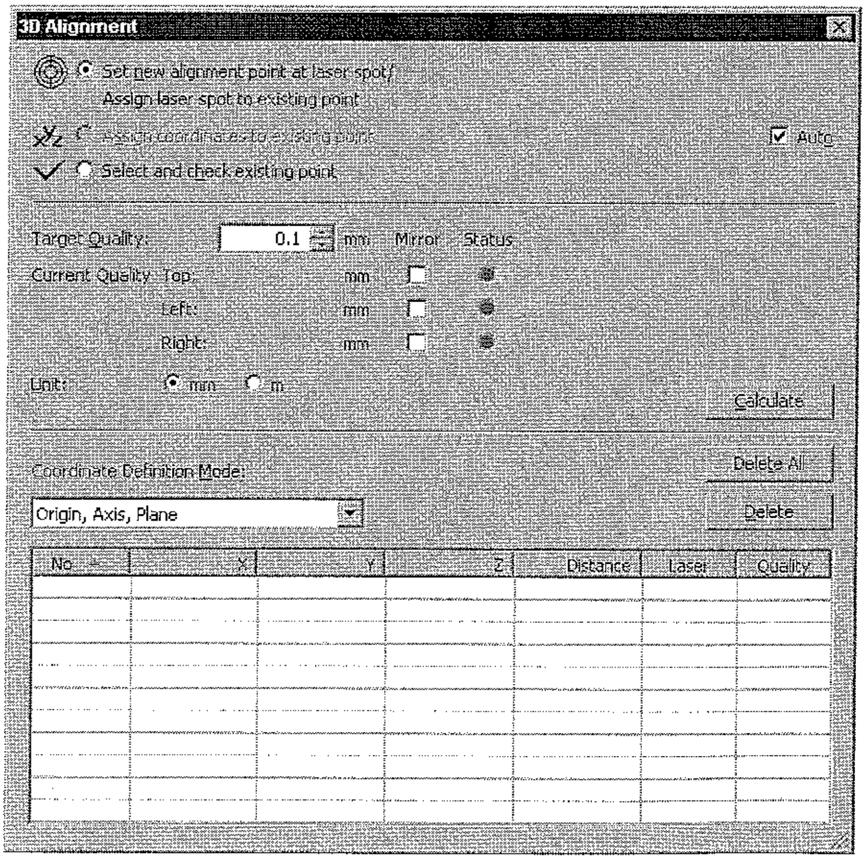


Figure 4.14: Dialog 3D Alignment for alignment with the geometry scan unit

You can define the coordinate system in the following ways:

- Mark the origin, any point on the positive x, y or z axis and any point on a positive half plane limited by the selected axis.
  Example: 0, +x, x/+y
- Mark any point respectively on the positive x, y and z axis.
- Mark any three points and enter all the coordinates of these points.

These possibilities are described in detail in the following.

Specify Origin, Axis, Plane

To set the coordinate system in this way, proceed as follows:

1. Select Origin, Axis, Plane from the list Coordinate Definition Mode.

2. Position the laser at the origin of the coordinate system.

3. Define an alignment point here as also described in section 4.2.4. The alignment point is automatically displayed in the list in the dialog 3D Alignment. In the column Distance the distance measured to this point is entered. The column Laser shows that the alignment point has been set for the scanning head Top.

4. Click the alignment point with the right mouse button and select Origin in the pop-up menu. A 0 will appear next to the point. The coordinates of the point at the origin (0/0/0) are shown.

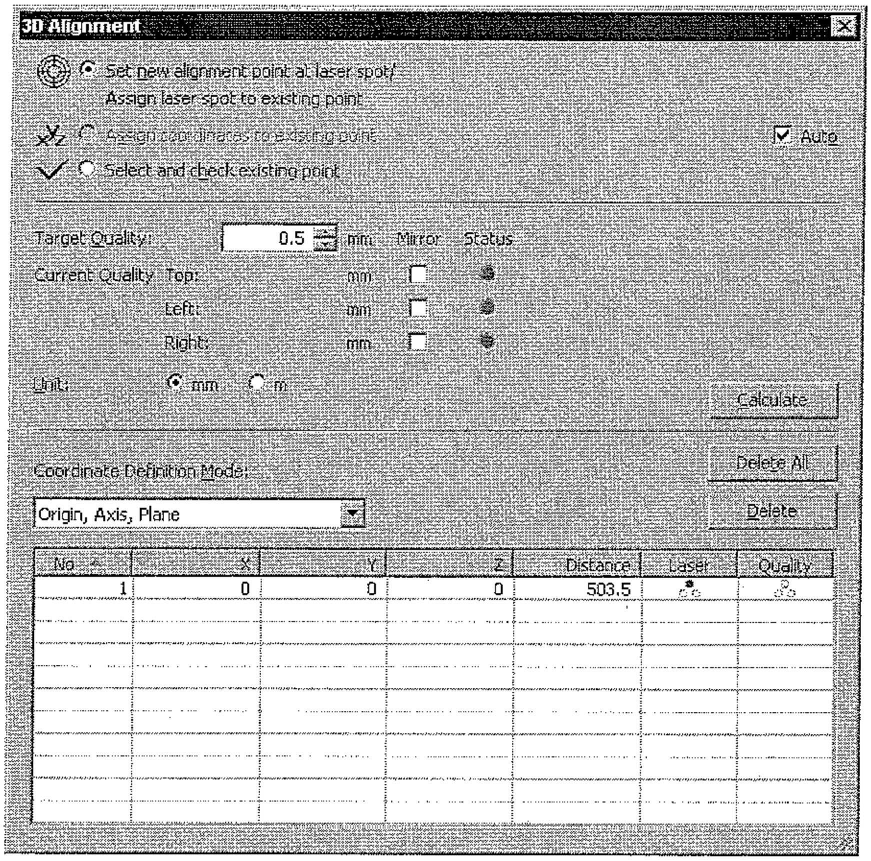


Figure 4.15: Dialog 3D Alignment for alignment with the geometry scan unit

5. Move the laser beam and define a second alignment point on one of the positive axes, e.g. on the positive x-axis. The point and its distance from the scanning head are shown in the list in the dialog 3D Alignment.

6. Click the alignment point with the right mouse button and select Point on +x-axis in the pop-up menu. +X will appear next to the point. The distance and the coordinates (+x/0/0) of the point are shown.

7. Move the laser beam again and define a third alignment point on one of the half planes limited by the selected axis, e.g. on the x /+y plane. The point and its distance from the scanning head are shown in the list in the dialog 3D Alignment.

8. Click the alignment point with the right mouse button and select Point on x/+y-plane in the pop-up menu. An X/+Y will appear next to the point. The distance and the coordinates (x/+y/0) of the point are shown.

Now define four to seven alignment points each for the scanning heads Left and Right as described in the following. The alignment points for the three scanning heads do not have to be coincident. However, the scanning head Top also has to be able to reach the alignment points for the scanning heads Left and Right.

9. First of all, position the scanning head Top at the points at which you want to set alignment points for the scanning heads Left and Right and then define the points. This will enable you to see whether you can reach all required alignment points with the scanning head Top. In addition to that, the distance of every point is already measured.

10. Define the alignment points for the scanning heads Left and Right as described in section 4.2.4.

11. Click Calculate. The software will calculate all the coordinates of the alignment points and enter them in the list. At the same time it determines the position of the scanning heads in this coordinate system, refer to figure 4.17.

Specify Three Points on Axes

To set the coordinate system in this way, proceed as follows:

1. Select Three Points on Axes from the list Coordinate Definition Mode.

2. Position the laser beam at a point in the video image which the x-axis of the coordinate system is to pass through.

3. Click the alignment point with the right mouse button and select Point on x-axis in the pop-up menu. An +X will appear next to the point; an arrow will be drawn through the point.

4. Repeat steps 2 and 3 for one more alignment point each on the y and z-axis.

5. Now define four to seven alignment points each for the scanning heads Left and Right as described in the following. The alignment points for the three scanning heads do not have to be coincident. However, the scanning head Top also has to be able to reach the alignment points for the scanning heads Left and Right.

6. First of all, position the scanning head Top at the points at which you want to set alignment points for the scanning heads Left and Right and then define the points. This will enable you to see whether you can reach all required points with the scanning head Top. In addition to that, the distance of every point is already measured.

7. Define the alignment points for the scanning heads Left and Right as described in section 4.2.4.

8. Click Calculate. The software will calculate all the coordinates of the alignment points and enter them in the list. At the same time it determines the position of the scanning heads in this coordinate system.

Specify Points with free Coordinates

To set the coordinate system in this way, proceed as follows:

1. Select Points with free Coordinates from the list Coordinate Definition Mode.

2. Position the laser beam at any point on the video image.

3. Click the alignment point with the right mouse button and select Point with free coordinates in the pop-up menu. The dialog Assign Coordinates appears.

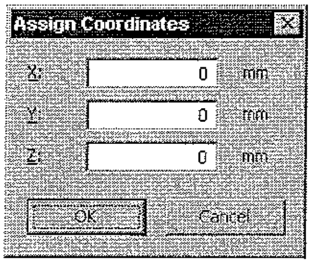


Figure 4.16: Dialog Assign Coordinates

4. Here you enter the coordinates of the point and click OK. XYZ will appear next to the point.

☞ If the coordinates of the alignment points are not precisely known, please also refer to section 4.2.8.

5. Repeat steps 1 to 4 for a total of four to seven alignment points.

Define four to seven alignment points each for the scanning heads Left and Right in the same way as described in the following. The alignment points for the three scanning heads do not have to be coincident. However, the scanning head Top also has to be able to reach the alignment points for the scanning heads Left and Right.

6. First of all, position the scanning head Top at the points at which you want to set alignment points for the scanning heads Left and Right and then define the points. This will enable you to see whether you can reach all required points with the scanning head Top. In addition to that, the distance of every point is already measured.

7. Define the alignment points for the scanning heads Left and Right as described in section 4.2.4.

8. Click Calculate. The software calculates all the coordinates of the alignment points and enters them in the list. At the same time, it determines the position of the scanning heads in this coordinate system.

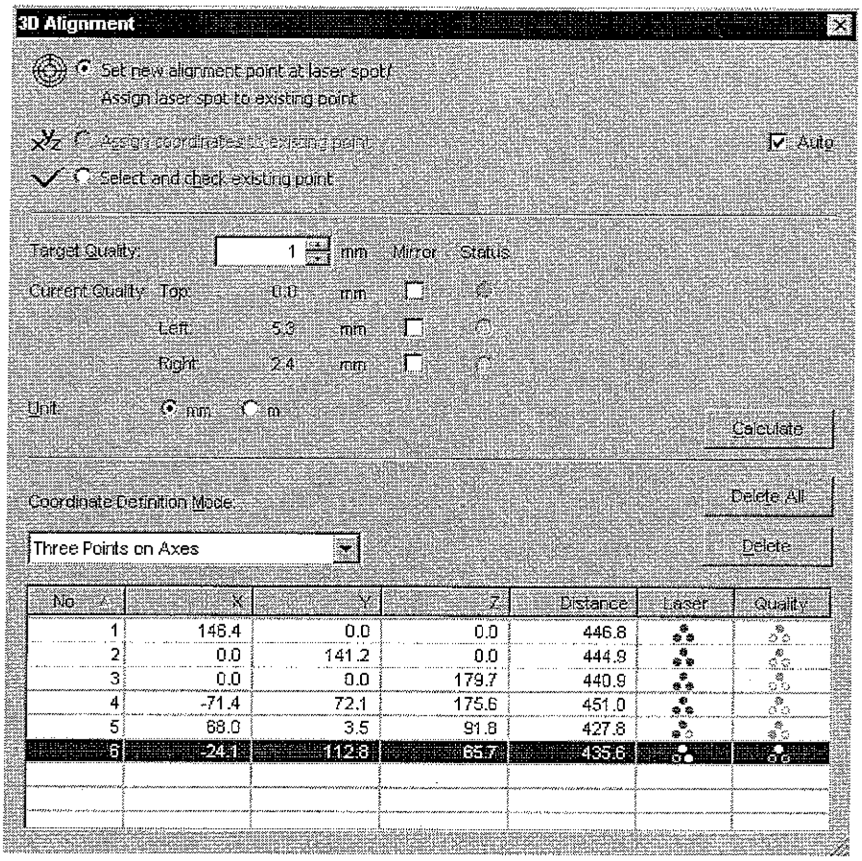


Figure 4.17: Successful 3D Alignment

4.2.8 Editing 3D Alignment Points

You can also edit 3D alignment points which have already been defined, this means for example

- defining object system alignment points as normal alignment points
- retrospectively changing the coordinate definition mode
- editing alignment points in the mode Points with free Coordinates
- defining alignment points for which you do not know the precise coordinates

Object system points as normal alignment points

To define an object system alignment point as a normal alignment point, click it with the right mouse button and select Alignment Point in the pop-up menu. The alignment point remains but it is no longer an object system alignment point, see also section 4.2.6 and section 4.2.7on this. The special identification which identified it as such disappears as well.

Change the coordinate definition mode

Independently of which definition mode you define the alignment points in (Origin, Axis, Plane; Three Points on Axes; Points with free Coordinates), you can still retrospectively change the definition mode. To do this, proceed as follows:

1. In the dialog 3D Alignment, select another definition mode. The object system alignment points become normal alignment points, their identification disappears. If a valid alignment had already been carried out however, the coordinates of the alignment points are retained.

2. Click the alignment point you want to edit with the right mouse button and select the corresponding command in the pop-up menu (refer also to section 4.2.6 andsection 4.2.7).

Retrospectively correct alignment points with free coordinates

To correct free coordinates of alignment points which have already been set, proceed as follows:

1. Click an alignment point with the right mouse button and select Point with free coordinates in the pop-up menu. The dialog Assign Coordinates appears (refer also to figure 4.16).

2. Here you enter the correct values and click OK.

Define alignment points with coordinates which are not precisely known (PSV 3D)

If you have defined alignment points in the definition mode Points with free Coordinates without knowing the precise coordinates of these alignment points, or if you have not been able to precisely localize the alignment points on the object, proceed as follows:

☞ Prerequisite: You have defined 3 to 7 alignment points with the scanning head Top in the definition mode Points with free Coordinates as described in section 4.2.6 or section 4.2.7.

1. Use the scanning head Top to define 4 to 7 additional alignment points at position which you can also reach with the scanning heads Left and Right. The software thereby measures the distance between each point and the scanning head Top. The alignment points are displayed in the dialog 3D Alignment.

☞ Do not define these alignment points as object system alignment points!

2. Now define these alignment points one after the other also with the scanning head Left and the scanning head Right.

3. Click Calculate. The software initially calculates a 3D alignment for the scanning head Top using the alignment points with free coordinates. This then means that the position and alignment of the scanning head Top are known approximately in this coordinate system. The actual quality for the scanning head Top is not optimal because the coordinates of the alignment points can not be given exactly.

Then the software calculates the coordinates of the other alignment points for the scanning heads Left and Right. To do this, it uses the mirror angles from the scanning head Top at these alignment points, the distances these points are from the scanning head Top and the position and alignment of the scanning head Top. The coordinates of these alignment points are displayed in the dialog 3D Alignment.

With the aid of these coordinates, the alignment for the scanning heads Left and Right is now calculated, i.e. their position and alignment is determined within the coordinate system of their alignment points. (The alignment points of the type Point with free Coordinates do not play any part in this as they have only been defined for the scanning head Top.) The actual quality for the scanning heads Left and Right is significantly better than that for the scanning head Top, because the coordinates of the alignment points used have been determined directly on the object under investigation.

4. Select Select and check existing point in the dialog 3D Alignment.

5. Click the entries in the list of coordinates one after the other. The three laser beams are thereby positioned with the aid of the calculated 3D alignment and the 3D coordinates of the selected alignment point.

6. Use the object under investigation to check how far the three individual laser beams are apart from each other. The distance should be in the range of the actual qualities of the scanning heads Left and Right.

This means that the software has determined the relative position of the scanning heads to each other with greater precision than the relative position of the scanning heads to the coordinate system of the alignment points with free coordinates. Therefore the laser beams generally intersect well at sample points, the coordinates of which have been determined for example with a geometry scan. However, please note that importing geometries can still lead to inaccuracies. This is because the imported alignment points are in the coordinate system of the Points with free Coordinates and the relative position of the scanning heads to the coordinate system thus determined is only inaccurately known. If necessary, you can carry out a geometry scan after the geometry import to improve the results.

4.3 Carrying out a Geometry Scan (as an Option)

If you are using the scanning head PSV-I-400 with the optional geometry scan unit PSV-A-420, you can also determine the distance between the scanning head and the object even if you do not know the object geometry.

☞ If you are using the PSV-3D, then the geometry scan unit is on the scanning head Top.

You can use the geometry scan unit to assign 3D coordinates to scan points. To do so, first of all define the scan points as described in chapter 5 and then determine the 3D coordinates of the scan points.

The geometry scan unit provides the scanning head with a second laser apart from the vibrometer laser to determine the object geometry. In contrast to the vibrometer laser, the geometry laser can not be focused. This means that in general it generates a larger spot of light than the vibrometer laser. To check whether the laser is also hitting the required points at the edges or periphery of the object under investigation, you can switch over to the geometry laser at any time. If the spot of light from the geometry laser only partially hits the object, it is not possible to make a distance measurement and you have to correct the laser position again. Apart from that, with the aid of the geometry laser you can check and see if your scanning head is still adjusted correctly. If both laser beams with the same setting do not hit the same point on the object, then the scanning head is probably misaligned.

Geometry laser To switch between the vibrometer laser and the geometry laser, select Scan > Geometry Laser.

Geometry point To make a distance measurement between the scanning head and the object, position the laser beam at any point on the object and select Scan > Geometry Point. The software will make a distance measurement to this point, calculate the x-, y- and z-coordinates of this point from the results of this measurement and the current mirror angles and will display these coordinates.

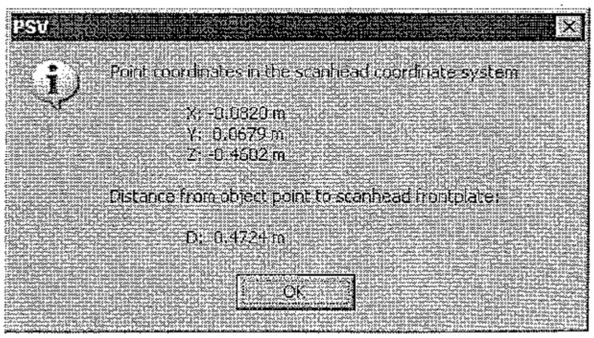


Figure 4.18: Display of the coordinates

If there is a valid 3D alignment, then the coordinates are given in the object coordinate system that you defined through the 3D alignment. Otherwise the coordinates are given in the scanning head system which you can define as described in section 4.1under Enter Coordinates of Axes.

Geometry scan

To scan an object, the 3D geometry of which is not yet known by the software, select Scan > Geometry Scan. If applicable, the software switches over to the geometry laser automatically. The geometry laser is positioned at every scan point, measures the distance from the scanning head and determines every x-, y- and z-coordinate as described above under Geometry Point. The coordinates of the scan points are displayed in the scanning head control in the element 3D Point. Once the software has determined the coordinates of all the scan points, you can start a scan. On starting, it automatically switches over to the vibrometer laser.

☞ Prerequisite for a geometry scan is a valid 3D alignment.

The geometry scan unit is equipped with a filter which you can use to weaken the intensity of the laser beam. As a general rule you initially carry out a geometry scan without this filter. If the scanning head is receiving too much light, you will be given the advice to use the filter. In this case switch the filter on. See your hardware manual on this.

☞ If the geometry scan has not been carried out correctly or you have canceled it, you will get a status report (see figure 4.19). You can decide whether to finally abort the geometry scan or whether to remeasure the remaining scan points or to have them interpolated. Refer to section 6.2 or section 9.1 and your theory manual on this. Independently of whether you have carried out the geometry scan or have aborted it, you can subsequently check the status of the scan points and if necessary take further measures. See section 5.6.1 and section 8.1 on this.

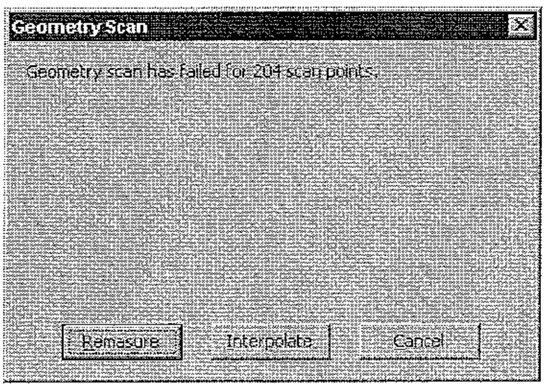


Figure 4.19: Status report if geometry scan is incomplete

The 3D coordinates of the geometry points are determined in the coordinate system of the alignment points (object system). The coordinates are displayed in the element 3D Point.

Transform 2D geometry to 3D geometry

You can transform the 2D geometry of a three-dimensional object into 3D geometry. Prerequisite is that you have previously carried out a 3D alignment. To transform 2D geometry into 3D geometry, start a geometry scan. This makes the three-dimensional geometry of the object known to the software.

4.4 Automatically Focusing the Laser Beam

With the PSV 400 you can automatically focus the laser beam. There are two ways to do so:

- with the software
- with the optional PDA.

4.4.1 Focusing with the Software

PSV

To focus the laser beam with the software, click in the scanning head control.

☞ Automatic focusing can take several seconds during which the software is inactive.

PSV-3D

If you are making a measurement with the PSV-3D, hold the shift key pressed while clicking . This allows all three laser beams to be focused at the same time.

4.4.2 Focusing with the PSV-A-PDA (as an Option)

PSV

Focus the laser beam with the PDA by touching the icon .

☞ Automatic focusing can take several seconds during which the software is inactive.

PSV-3D

If you are making a measurement with the PSV-3D, you can select the scanning heads and focus them individually automatically.

4.5 Teaching-in Focus Values (as an Option)

You have the option of assigning focus values to the scan points. This makes it easier to focus if several objects are to be scanned which are at different distances from the scanning head, or if the object has three-dimensional geometry. When focusing automatically (Auto Focus) a focus value is determined. You have the possibility to save the focus values determined in this way with the object geometry. They can then be used for any number of measurements, providing the object geometry remains the same. Teaching-in the focus values is only available if you have the option APS Professional Extended.

You have different options how to allocate focus values to the scan points:

- Manually, to single scan points or figures
- Fast or Best, to all scan points

4.5.1 Assigning Focus Values Manually

You can assign focus values manually to single scan points or figures. This is particularly useful if the object under investigation is made up of one or more planes which are equidistant from the scanning head, i.e. the object is not at an angle to the scanning head.

☞ If you are using the PSV-3D and are making measurements with all three scanning heads, the command Assign Focus Manually is not available.

Assign a focus value

To assign a focus value manually, proceed as follows:

1. Select Scan > Assign Focus Manually. The software changes over to scan point definition (APS). All single scan points or figures are marked which have not yet had a focus value assigned.

2. Use the middle mouse button to position the laser beam at the point at which you want to determine the focus value and then click .

   ☞ If you have assigned a special function to the middle mouse button (e.g. double-click), position the laser beam using the icons Position in the scanning head control.

   Or:
   Click with the right mouse button and select Auto Focus in the pop-up menu.

3. Select the scan points or figures which you want to assign a focus value to, as described in section 5.5.1 and section 5.6.1.

4. Click with the right mouse button and select Set Focus in the pop-up menu. The previously determined focus value is assigned to all selected scan points or figures respectively.

5. End scan point definition.
6. You can now check the focus settings as described in section 4.6.
7. Then you can start a scan.

☞ If you have not assigned focus values to all scan points, when the scan starts you will be given the message that there not all scan points have a valid focus value. You can repeat Assign Focus Manually or start the scan anyway.

Reset focus value

To reset a manually assigned focus value, change back to scan point definition. Click the scan point with the right mouse button and select Clear Focus in the pop-up menu.

Retrospectively correct focus values

You can retrospectively correct the focus values of single scan points within a figure. To do so, undo the figure into individual points as described in section 5.3 and assign the correct focus values to the affected scan points manually.

4.5.2 Assign Focus Values Automatically

Fast

Select Scan > Assign Focus Fast to assign a focus value to all scan points quickly. While doing so, using one scanning head (PSV) or all three scanning heads (PSV-3D), scan points at different distances from the scanning head are approached and automatically focused. For the PSV, you have to enter the correct coordinates for the distance in the element 2D Point in the scanning head control before you use Assign Focus Fast (refer also to section 4.1).

☞ This method is only suitable for level surfaces which are positioned at a right angle to the laser beam.

In contrast, for the PSV-3D and for 3D geometries in the PSV which have been imported or determined by a geometry scan, the precise position of the scan points is used. The focus values for all other scan points are then calculated by the software.

Best

Select Scan > Assign Focus Best to automatically focus all scan points respectively and to assign them a focus value. This can take up to 10 seconds per scan point. For the PSV-3D focusing is done with all three scanning heads at the same time.

☞ If you cancel Assign Focus Best, the focus values determined until then are saved and used for the subsequent scan. For all scan points which have not had a focus value determined, the focus value last set is used for a scan. The function Focusing during Scan is not activated.

Assign focus values

To automatically assign focus values to all scan points, proceed as follows:

1. Select Scan > Assign Focus Fast or Scan > Assign Focus Best. The scan points are focused automatically as described above and the focus values are saved with the object geometry.
2. In the menu Scan, Focusing during Scan is activated by the software. This has the effect that during a scan, the focus values are set for every scan point using the optics.
3. You can now check the focus settings as described in section 4.6.
4. Then you can start a scan.

☞ If you have canceled Assign Best Focus, when the scan starts, you will be given the message that not all scan points have a valid focus value. You can repeat Assign Best Focus or start the scan anyway.

4.6 Checking the Focus Settings

If you click a scan point and leave the mouse cursor there, then the focus values of this scan point are displayed on a yellow background next to the cursor. The current focus position is shown as a percentage and as an absolute value. The value 0% (0) means that the optics in the scanning head has been moved right to the end in the direction close-up (N). The value 100% (3300) means that the optics in the scanning head has been moved right to the end in the direction infinity (F).

At the same time the optics is set to the focus value of this scan point.

If the focus values are not to be taken into consideration during scanning, select Scan > Focusing during Scan to deactivate focusing during a scan.

4.7 Image Settings of the Live Video Image (2D View)

You adjust the settings of the live video image in the dialog Display Properties. To open the dialog, double-click the live video image. You can also activate the video window (to do so, click it) and then select Scan > Properties.

4.7.1 General

On the page general you set up the display of the video window on the screen.

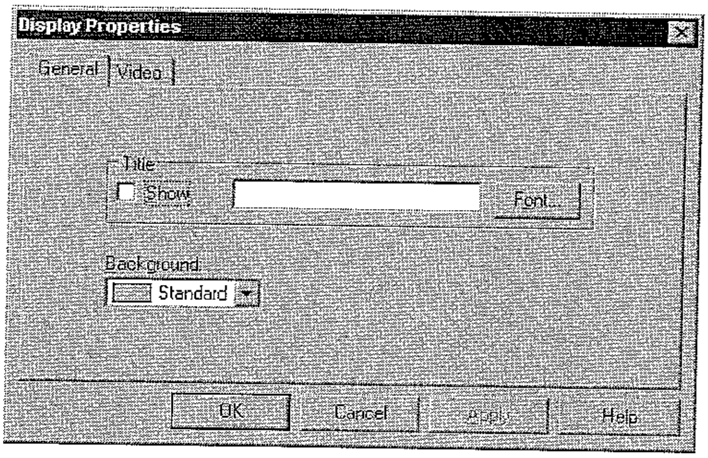


Figure 4.20: Page General

Title

Show: If you would like to display a title above the video window, tick the box. You enter the title on the right.

Font: Click here to format the title. The dialog Font appears.

Background

Here you select the background color for the video window.

4.7.2 Video

On the page Video you adjust the camera settings.

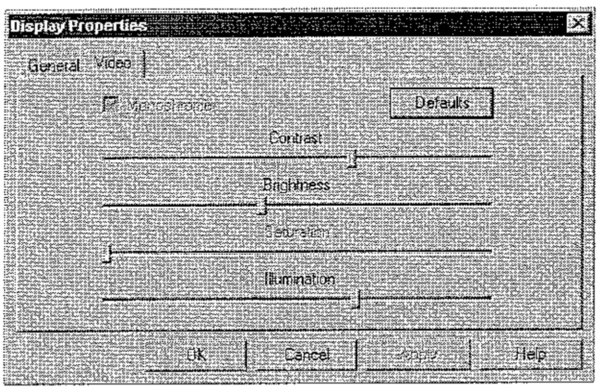


Figure 4.21: Page Video

Monochrome: Here you can change color images to black and white. This is recommended for measurements with the optional close-up unit PSV-A-410 or OFV-056-C, as it is equipped with a red filter.

Standard: Click here to load the default settings for the live video image.

Contrast: Here you set the contrast of the live video image.

Brightness: Here you set the brightness of the live video image.

Saturation: For color images you set the color saturation here.

Illumination: This slider only appears for MSA/MMA systems. If you want to use the strobe illumination in MSA / MMA operation to illuminate the sample, you can adjust its brightness here. See your hardware manual on this as well.

4.8 Image Settings of the Video Image (3D View)

You can also display the video image in the 3D view. To do so, click 3D. However, you will then no longer see a live video image but a snapshot of the video image at the time at which you changed the view.

You can adjust the image settings of the video image in 3D view in the dialog Display Properties. To open the dialog, double-click the video image. You can also activate the video window (to do so, click it) and then select Scan > Properties.

4.8.1 General

On the page general you set up the display of the video window on the screen.

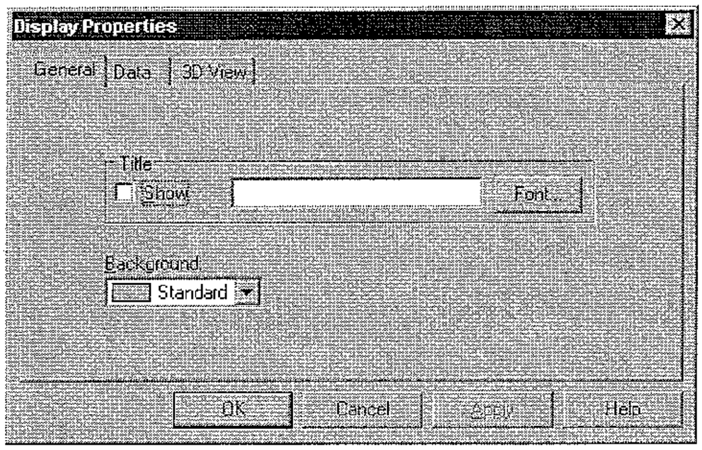


Figure 4.22: Page General

Title

Show: If you would like to display a title above the video window, tick the box. You enter the title on the right.

Font: Click here to format the title. The dialog Font appears.

Background

Here you select the background color for the video window.

4.8.2 Data

On the page Data you set up the display of the data on the screen.

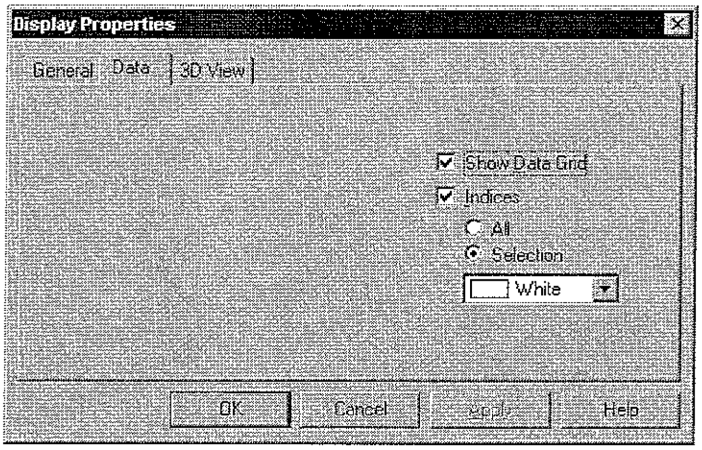


Figure 4.23: Page Data

Show Data Grid: Tick the box if you want to see the grid that the scan points are on.

Indices: Tick the box to show the index of scan points. Select whether the indices of all scan points are to be shown or only the indices of selected scan points. In the list below select the color which is to be used to show the indices.

4.8.3 3D View

On the page 3D View set up the presentation of the 3D view on the screen.

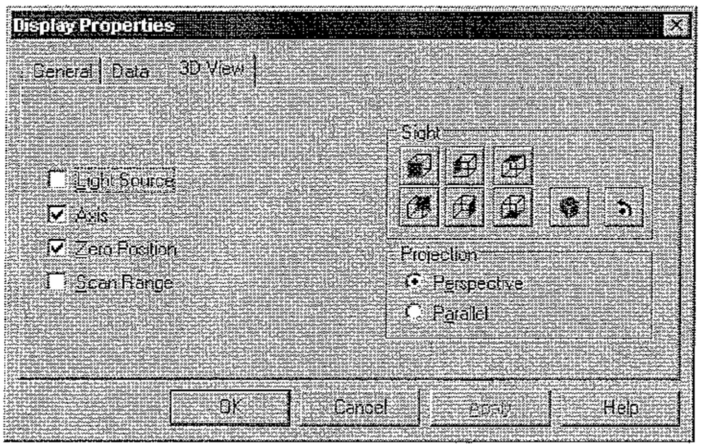


Figure 4.24: Page 3DView

Changes made to the representation or the sight are immediately effective, i.e. without clicking Apply or closing the dialog.

Light Source: Tick the box to switch on the illumination model. It simulates illuminating the object from the direction of the observer.

☞ Depending on the shape of the object, the display of light and shadow has a detrimental effect on the quality of the presentation. In this case, deactivate the box to switch off the illumination model.

Axes: Tick the box to display a coordinate system top left in the presentation window next to the object.

Zero Position: Tick the box to view the object in its original position in addition to viewing the measurement results.

Scan Range: Tick the box to show lines to help you display the position of the scanning heads in front of the object. In this way you can see whether the 3D alignment has provided a useful result.

☞ For combined files (refer to section 8.5), the box is not displayed.

Sight

The icons in the field Sight show the line of sight of the object. You can move the object more precisely by clicking these icons than by dragging with the mouse.

 Sight on the object from the front

 Sight on the object from the back

 Sight on the object from the left

 Sight on the object from the right

 Sight on the object from the above

 Sight on the object from the below

 Sight of the video camera (only for 3D geometry)

 Sight on the object at an angle from front, left and above

 Rotating the object around the line of sight

You can show (hide) a coordinate system which shows you the resulting orientation of the object (see above, Axes).

☞ You can also set the line of sight directly in the presentation window using the mouse. To do so, click the object and using the mouse drag it into the direction you require.

Projection

Here you select the type of projection of the object.

Perspective: The object is shown in perspective, i.e. parts in the front of the image become larger, parts in the background of the picture are shown smaller.

Parallel: All parts of the object are shown the same size regardless of their distance from the observer.

☞ Parallel projection makes it easier to differentiate between in-plane and out-of-plane vibrations. Particularly with out-of-plane vibrations, the perspective layout viewed from the top can give the impression that the object is being stretched and contracted again.

Click here to next page.....

5 Defining Scan Points (APS)

Before a scan you first of all have to define the scan points. To do so, you draw geometrical figures on the live video image as you would in graphics software. For this purpose, the software offers a standard mode and two further modes as an option. If you want to make a measurement with 3D coordinates, you can also use 3D point mode.

Standard mode

In standard mode you can draw rectangles, ellipses and polygons. The scan points in all figures are on a global right-angled grid.

Professional mode (as an option)

In professional mode, apart from rectangles, ellipses and polygons, you can also draw lines. You can set up the grid for every figure individually and it can also be polar or hexagonal. Professional mode is only available if you have the option APS Professional.

Point mode (as an option)

In point mode you do not draw figures but define and edit single scan points and their connections. You can take over scan point definitions from the other modes and fine-tune them. Point mode is only available if you have the option APS Professional. In point mode you can define scan points with both the PSV software and also the optional PDA. Refer to section 5.3.1 or section 5.3.2.

3D point mode (PSV-3D)

In 3D point mode, in addition to the above mentioned modes, you can also import the scan points from an external file or teach-in them with the aid of the three scanning heads.

☞ With the PSV or the PSV-3D (1D)[1], 2D geometries occur in standard, professional and point mode. With a valid 3D alignment and the corresponding software option, it is possible to change to 3D point mode. However geometries which have already been generated in other modes are not taken over, they are deleted!

[1] refer also to section 3.1

With the optional geometry scan unit in contrast you can proceed as follows:

1. Define the scan points in standard, professional or point mode as described in section 5.1, section 5.2 or section 5.3 respectively.
2. Exit scan point definition and carry out a geometry scan as described in section 4.3.
3. Go to 3D point mode (refer to section 5.4). When you do so, the scan points and the measured coordinates are retained.

3D point mode (PSV, as an option)

In 3D point mode for the PSV you can import 3D geometry and then edit it. You can only define new scan points with the optional geometry scan unit.

The following table contains an overview of the geometries which you can define in the individual modes with the PSV and the PSV-3D.

System	Standard	Professional	Point	3D Point
PSV	2D	2D	2D	3D
PSV-3D (3D)	3D	3D	3D	3D
PSV-3D (1D)	2D	2D	2D	3D

Define To define scan points, proceed as follows:

1. Go to acquisition mode. To do so, click .
2. If necessary, align the coordinates of the live video image to the measurement plane. See section 4.2 on this.
3. In the toolbar of the application window, click or select Setup > Define Scan Points. The software maximizes the video window and displays a graphics toolbar. Areas of the live video image can be crosshatched. These areas are outside the range you can scan.

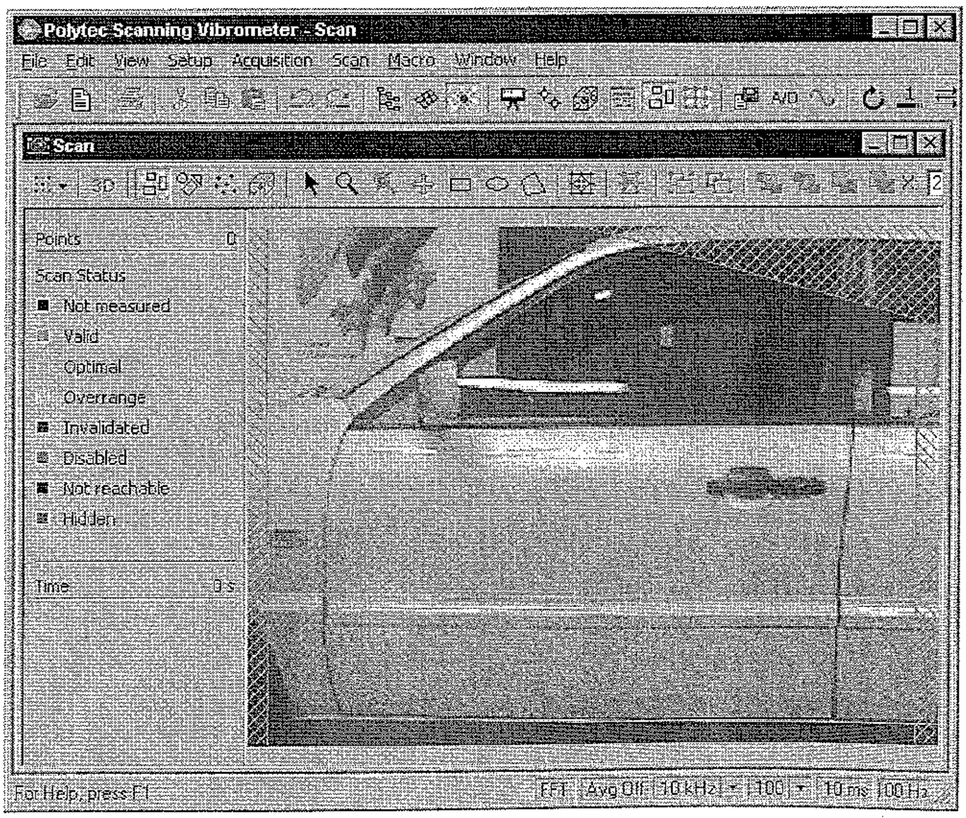


Figure 5.1: Available range for defining the scan points

☞ The possible scan area depends on the scanning head, zoom of the camera and correct alignment.

4. Go to the required mode.

   To scan a flat object, click , or in the graphics toolbar. The icons and are only active if you have the option APS Professional. To use 3D point mode, click .

5. Define scan points as described in section 5.1, section 5.2, section 5.3 and section 5.4. You can see how many scan points you have defined in the legend of the live video image. Below that you see the estimated time needed for the scan. The estimation is based on the time for data acquisition at all scan points and the settling time of the scanner mirrors.

☞ You can also define scan points in the crosshatched area of the live video image. However, when scanning, these scan points themselves are not hit, but the next attainable point respectively.

6. When you have defined all scan points, in the toolbar of the application window, click again.

Zoom

To position the scan points exactly, you can zoom in the video image. Read section 2.8 on this.

☞ If you change into one of the four scan point definition modes, the icons for the zoom function in the toolbar of the video window become inactive. Instead they appear in the toolbar for point definition.

Test

As the live video image shows a two-dimensional image of the three-dimensional object, it is possible that the laser beam does not hit some of the scan points exactly. So check the scan points as follows:

7. Point at the live video image and click a scan point. The laser beam moves to this point on the object.

   Only PSV 400 and PSV 300: You can also approach the scan points with the optional PSV-A-PDA or the hand set PSV-Z-051. Refer to section 5.3.2 and your theory manual on this.
   Only PSV 300: You can also position the laser beam on scan points using the hand set PSV-Z-051. See your hardware manual on this.

8. Check if the position of the laser beam on the object corresponds to that on the live video image.

9. Repeat steps 7 and 8 for a few more scan points.

5.1 Standard Mode

In standard mode you draw geometric figures on a global, right-angled grid. You can

- draw rectangles, ellipses and polygons
- determine the density of the grid points
- move the grid.

To go into standard mode, in the graphics toolbar, click .

☞ If you define scan points with the PSV-3D in standard mode, then these points have already have 3D coordinates assigned to them. These coordinates have been calculated from the prior 3D alignment of the three scanning heads and their mirror angles. It is not possible to make a calculation of this kind with the PSV or PSV-3D (1D). To be able to obtain 3D data with the PSV or PSV-3D (1D) despite this, you have to import the data into 3D point mode.

5.1.1 Drawing Rectangles and Squares

To draw a rectangle or a square, proceed as follows:

1. Click .
2. Point at the live video image. The cursor becomes a cross.

Rectangle

There are two ways of drawing a rectangle:

3. Point at a corner of the rectangle.
4. Press the mouse button and drag to the diagonally opposite corner.

or

5. Point at the center of the rectangle.
6. Press the control key and the mouse button simultaneously and drag across to a corner point.

Square

There are two ways of drawing a square:

7. Point at a corner of the square.
8. Press the shift key and the mouse button simultaneously and drag to the diagonally opposite corner.

or

9. Point at the center of the square.
10. Press the control key, shift key and the mouse button simultaneously and drag across to a corner point.

5.1.2 Drawing Ellipses and Circles

To draw an ellipse or a circle, proceed as follows:

1. Click .
2. Point at the live video image. The cursor becomes a cross.

Ellipse

There are two ways of drawing an ellipse:

3. Point at a corner of the rectangle enclosing the ellipse.
4. Press the mouse button and drag to the diagonally opposite corner.

or

5. Point at the center of the ellipse.
6. First press and hold the control key and then the mouse button and drag across to a corner point of the rectangle enclosing the ellipse.

Circle

There are two ways of drawing a circle:

7. Point at a corner of the square enclosing the circle.
8. First press and hold the shift key and then the mouse button and drag to the diagonally opposite corner.

or

9. Point at the center of the circle.
10. Press the control key, shift key and the mouse button simultaneously and drag across to a corner point of the square enclosing the circle.

5.1.3 Drawing Polygons

To draw a polygon, proceed as follows:

1. Click .
2. Point at the live video image. The cursor becomes a cross.
3. Click at least three corners of the polygon.
4. Double-click the last corner. The software connects it to the first corner.

5.1.4 Deleting Scan Points within a Figure

You can delete all scan points within a figure. You can use this to hide areas which you do not want to scan or which the laser beam can not reach. This could be the case for example with objects which have a complicated three-dimensional geometry. Scan points which the laser beam can not reach must be deleted before the start of the measurement. Otherwise the sensor head hits the wrong scan points on the object when trying to hit the points, giving you an incorrect result.

☞ With the PSV-3D, it is practically impossible to see on the screen which laser beams reach which scan points, or which ones they can not reach, as only one of the three scanning heads is equipped with a video camera. So in the CAD program you should already delete those parts of the object which are covered by other parts. Then import the object geometry from the CAD as UFF or ME'Scope in PSV (refer to section 5.4).

To delete the scan points, proceed as follows:

1. Select the figures as described in section 5.5.1.
2. Click .

5.1.5 Setting up the Grid

In standard mode there is a global grid over the whole live video image.

Show and hide the grid

To show (hide) the grid in the live video image, click .

Density of grid points

The density of the grid points $d_{x,y}$ determines the distance between the grid points $a_{x,y}$ on the live video image as follows:

$$a_{x,y} = \frac{h_y}{d_{x,y}} \qquad \text{Equation 5.1}$$

h_y... Height of the live video image.

You can enter the density of the grid points in the fields X: 10.5 and Y: 17. You can also enter decimals.

Another way of increasing the density of the scan points is to make the grid finer. See section 5.6.1 on this.

You can also scale the grid at the same time as all the figures. To do so, proceed as follows:

1. If you can not see the grid on the live video image, it would be useful to display it. To do so, click .

2. Click . All figures are selected.
3. Point at one of the white handles which mark the edge of the figures. The cursor becomes a double arrow.

There are now three ways of scaling:

4. Press the mouse button and drag in one of the directions the double arrow is pointing in. The anchor point is opposite the point you are dragging.

or

5. Press the control key and the mouse button and drag in one of the directions the double arrow is pointing in. The anchor point is the center of the figures.

or

6. Press the shift key and the mouse button and drag across to a corner point. The figures and the grid are scaled in proportion horizontally and vertically.

Moving the grid

You can move the grid on the live video image. To do so, proceed as follows:

1. Click .
2. Point at the live video image.

To move the grid without the figures:

3. Point at a dot outside the figures.
4. Press the mouse button and drag in the direction required.

To move the grid at the same time as all the figures:

5. Point at a dot within a figure.
6. Press the mouse button and drag in the direction required. (You can also use the arrow keys.)

5.2 Professional Mode (as an Option)

Professional mode is only available if you have the option APS Professional. In professional mode you can draw rectangles, ellipses and polygons as described in section 5.1.1, section 5.1.2 and section 5.1.3. Apart from that you can

- set up the grid for every figure individually and it can also be polar or hexagonal
- draw polylines
- rotate figures
- edit figures.

To go into professional mode, in the graphics toolbar, click . The dialog Object Properties appears.

5.2.1 Drawing Polylines

To draw a polyline, proceed as follows:

1. Click .
2. Point at the live video image. The cursor becomes a cross.
3. Click the corners of the polyline.
4. Double-click the last corner.

5.2.2 Rotating Figures

To rotate figures, proceed as follows:

1. Select the figures as described in section 5.5.1.

There are now two ways of rotating figures:

2. Enter the absolute angle of rotation in the dialog Object Properties, group Object in the field Rotation.

or

3. Click .
4. Point at one of the white handles which mark the edge of the figures. The cursor becomes a .
5. Press the mouse button and drag in the direction you want to rotate in. The anchor point is the center of the figures.

5.2.3 Changing the Shape of a Figure

You can retrospectively insert corners in figures and move corners individually. To do so, proceed as follows:

1. Select the figures as described in section 5.5.1.
2. Click .

To insert a corner:

3. Point at the edge of the figure. The cursor becomes a .
4. Click the edge of the figure. The software inserts a corner at this point.

To move a corner:

5. Point at the corner. The cursor becomes a .
6. Press the mouse button and drag in the direction required.

5.2.4 Distributing Scan Points Among Figures

Using the icons , , and in the dialog Object Properties you can distribute scan points on figures. To do so, first select the figures as described in section 5.5.1. Then click

: You are defining scan points inside and on the edges of the figures (not active for polylines).

: You are defining scan points only within the figures (not active for polylines).

: You are only defining scan points on the edges of the figures.

: You are deleting the scan points inside and on the edges of the figures.

5.2.5 Setting up the Grid

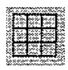
In professional mode, every figure has got its own grid. To set up the grid, first of all select the figure as described in section 5.5.1. In the dialog Object Properties you can then

- select the type of grid
- set the density of the grid points
- rotate the grid.

You can not set up a grid for polylines and figures which only have scan points on the edge (refer to section 5.2.4).

Type of grid

To select the type of grid, click

: You select a right-angled grid.

: You select a polar grid.

: You select a hexagonal grid.

Density of grid points

You enter the density of the grid point in the dialog Object Properties in the respective field Density. You can also enter decimals. The density is independent of the dimensions of the figure, it always refers to the height of the live video image.

For a figure with a right-angled grid, in the dialog the fields Density X and Density Y appear. The density of the grid points $d_{x,y}$ determines the distance between the grid points $a_{x,y}$ as follows:

$$a_{x,y} = \frac{h_y}{d_{x,y}} \qquad \text{Equation 5.2}$$

h_y... Height of the live video image.

For a figure with a polar grid, the fields Density radial and Density tang appear. The radial density d_{radial} determines the distance between the grid points on the beams a_{radial} as follows:

$$a_{radial} = \frac{h_y}{d_{radial}} \qquad \text{Equation 5.3}$$

h_y... Height of the live video image.

The tangential density d_{tang} is equal to the number of grid points on the circles.

For a figure with a hexagonal grid, the field Density appears. The density of the grid points d determines the distance between neighboring grid points as follows:

$$a = \frac{h_y}{d} \qquad \text{Equation 5.4}$$

h_y... Height of the live video image.

Rotate grids You can rotate a grid relatively to its figure. To do so, enter the angle of rotation in the field Rotation, group Grid.

5.2.6 Vertex Points of Ellipses

The software approximates ellipses by using polygons (at least quadrangles). You can set the number of vertex points. To do so, first select the ellipse as described in section 5.5.1. In the dialog Object Properties, the field Vertex Points then appears, in which you can enter the required number of vertex points. The number of vertex points then also applies for all ellipses which you subsequently draw.

☞ If you define scan points on the edge of an ellipse (refer to section 5.2.4), every vertex point becomes a scan point.

5.2.7 Properties of Lines

Polylines and figures which only have scan points on the edge (refer to section 5.2.4) do not have a grid. However, you can set the density of the scan points on the lines. To do so, first select the figure as described in section 5.5.1.

Resolution In the dialog Object Properties, the field Resolution appears. The resolution is inversely proportional to the distance between the scan points on the line.

Width For polylines, the field Width also appears. The width determines the size of a shadow around the polyline. Within the shadow, the scan points which are behind the polyline are hidden. This means, for example, you can delete scan points on cables which obscure the view of the object.

5.3 Point Mode (as an Option)

Point mode is only available if you have the option APS Professional. In point mode you do not draw figures but edit single scan points and their connections. You can take over scan point definitions from the other modes and fine-tune them. To do so, proceed as follows:

1. Draw figures in standard or professional mode as described in section 5.1and section 5.2.

2. Go to point mode. To do so, in the graphics toolbar, click . A message window appears. To separately save the scan points which have already been defined and to then define new ones, click Save. To add more to those which already exist, click Continue.

☞ If you have displayed the project browser (refer to section 2.7.4), you will then automatically be shown the directory marked there as saving location.

3. Click Continue. The software groups all scan points which have already been defined and selects the group.

4. Undo grouping. To do so, click . The software selects all scan points.

5. Undo the selection. To do so, click the live video image outside the scan points.

6. You can now edit scan points as described in section 5.3.7. Apart from that, you can define single scan points as described in section 5.3.1 and section 5.3.2.

   Only PSV 400 and PSV 300: You can also approach the scan points with the optional PSV-A-PDA or the hand set PSV-Z-051. Refer to section 5.3.2 and your theory manual on this.
   Only PSV 300: You can also position the laser beam on scan points using the hand set PSV-Z-051. See your hardware manual on this.

7. You can edit connections of scan points as described in section 5.3.3 and section 5.3.4.

5.3.1 Defining Single Scan Points Using the Software

There are two ways of defining a scan point:

1. Click .
2. Point at the live video image and click. A scan point is defined at this point.

Or:

1. Move the laser beam on the object to the point at which you want to define a scan point. See section 4.1 on this.
2. Click .

5.3.2 Defining Individual Scan Points with the PSV-A-PDA (as an Option)

You can use the optional PDA to help you define individual scan points. To do so, proceed as follows:

1. Go to point mode as described in section 5.3.
2. Start the PDA as described in section 2.4. The user interface of the PDA software appears.

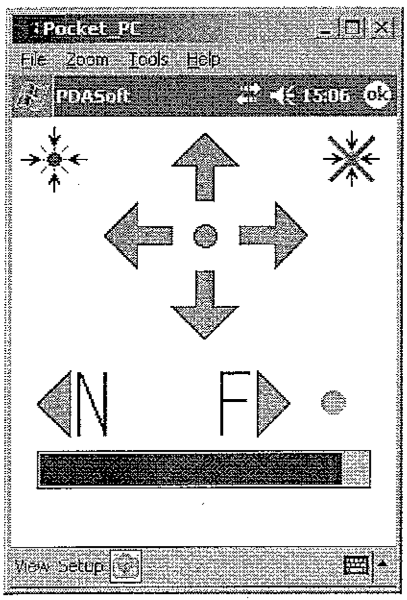


Figure 5.2: User interface of the PDA software

Position the laser beam

3. Center the laser beam by touching the icon ◎ with the pen.
4. Position the laser beam by touching the icons ⇧, ⇩, ⇦ or ⇨.

☞ If you touch an arrow icon for more than approx. one second, the PDA switches to fast forward. For fine adjustment you can always briefly touch the icon again.

Define scan points

5. You define a scan point by touching the icon ⌖.

Delete scan points

6. You can delete a scan point by positioning the laser beam on a scan point and touching the icon ✳.

Head for scan points directly

You can use the optional PDA to directly head for the defined scan points with the laser beam. To do so, proceed as follows:

1. Select View > Toggle Points in the PDA menu bar.
2. Touch the icons ⇦ or ⇨. The laser will directly head for the defined alignment points backwards or forwards.

5.3.3 Defining Connections

There are several ways of connecting scan points.

- connect two scan points and thus define a line,
- connect three scan points and thus define a triangle,
- automatically connected selected scan points to each other.

☞ In point mode it is useful to select the view (refer also to section 5.5.1). You can then see which areas are enclosed by scan points.

Connect two scan points

To connect two scan points, proceed as follows:

1. Click .
2. Point at the first scan point. The cursor becomes a cross.
3. Click the scan point.
4. Point at the second scan point.
5. Double-click.

Connect three scan points

To connect three scan points, proceed as follows:

1. Click .
2. Point at the first scan point. The cursor becomes a cross.
3. Click the scan point.
4. Point at the second scan point and click.
5. Point at the third scan point and click. The software connects this scan point to the first one.

Connect selected scan points

To automatically connect scan points, proceed as follows:

1. Select the points you want to connect as described in section 5.6.1.
2. Click . The software will connect all the selected points with each other.

5.3.4 Deleting Connections

To delete connections, proceed as follows:

1. Click .
2. Point at a connection. The cursor becomes a .
3. Select the connection. To do so, click it.
4. To select further connections, click them while holding the shift key pressed.
5. To remove a connection from the selection, click the connection while holding the shift key pressed.
6. To select all connections, press the key combination Ctrl+A or select Edit > Select All.
7. To delete the selected connections, press the Delete key or select Edit > Delete.

☞ To delete a triangle, you only have to delete one of the connections. The software automatically deletes the other connections.

5.3.5 Refining the Grid

If you have defined individual scan points and connections in point mode, you can then refine the resulting grid. This means you increase the number of scan points in the grid and thus their density. To do so, proceed as follows:

1. Select several connected scan points as described in section 5.6.1.
2. Click or select Scan > Refine Grid. The software will insert more scan points between the selected scan points.

5.3.6 Merging Scan Points in the Grid

If you have defined individual scan points and connections in point mode, you can then merge neighboring scan points. This means you decrease the number of scan points in the grid and thus reduce their density. In doing so, the software first calculates the distances between the selected scan points. Then, starting from the minimum distance found, it merges two points into one point if their distance is less than the minimum distance + 50%. In doing so, the positions of the scan points in the video image and, if existing, the 3D coordinates of the scan points are being calculated by averaging the values of the two points that have been merged.

To merge scan points, proceed as follows:

1. Select several connected scan points as described in section 5.6.1.
2. Click or select Scan > Merge Points. The software will merge neighboring scan points as described above.

5.3.7 Editing Scan Points

If you have defined individual scan points in point mode, you can select scan points and modify them.

Select scan points You can select points as also described in section 5.6.1 and modify the selected points as described in the following.

Disable If the selected scan points are not to be measured, you can disable them. To do so, select Disable. The scan points are then disabled for measurements, geometry scans and for the function Assign Focus Best.

Enable To undo disabling, select Enable.

Modify 3D Coordinates

You can modify the 3D coordinates of individual scan points. See section 5.6.2 on this.

With the PSV you can only modify the 3D coordinates of individual scan points if there is 3D geometry, i.e. after importing geometry or after a geometry scan. Refer to section 5.4 or section 4.3.

Triangulate 3D Coordinates (only PSV-3D)

To triangulate the 3D coordinates of the selected scan points, select Triangulate 3D Coordinates. Using the standard and 3D alignment of all three scanning heads, the software calculates the 3D coordinates of the scan points. You will find more information on this in your theory manual.

Interpolate 3D Coordinates

To interpolate the 3D coordinates of the selected scan points, select Interpolate 3D Coordinates. To do so, the software calculates the average distance of the neighboring points to the scanning head Top. From this distance and taking into consideration the position of the selected scan points on the video image, the 3D coordinates are determined.

With the PSV you can only interpolate the 3D coordinates of individual scan points if there is 3D geometry, i.e. after importing geometry or after a geometry scan. Refer to section 5.4 or section 4.3.

5.4 3D Point Mode

3D point mode () is only available if you previously carried out a 3D alignment (refer to section 4.2.3, section 4.2.4 and section 4.2.6 or section 4.2.7 respectively). In 3D point mode, there are the following ways of defining the scan points:

- Importing scan points (only PSV-3D or as an option for the PSV)
  If you know the geometry of the object and it is saved in an external program, you can simply import the required scan points as a Universal File. You can also import Vibrant ME'Scope structural data. For this purpose, an additional file filter is available in the dialog Open.
- Teaching-in scan points with the geometry scan unit PSV-A-420 (only PSV-3D or as an option for the PSV)
  If there is no data available on the object, you can define the points yourself.

☞ If you are using the PSV-3D and change from standard, professional or point mode into 3D point mode, scan points which have already been defined are retained. However, with the PSV or PSV-3D (1D) respectively, the scan points are only retained if you have previously carried out a geometry scan!

- Defining scan points with auto-alignment

5.4.1 Importing Scan Points

The icon and the command for geometry import are only available for the

- PSV with the option Data Import: Geometry
- PSV-3D.

To import scan points, proceed as follows:

1. Click or in the menu select Scan > Import Geometry. The dialog Open appears.

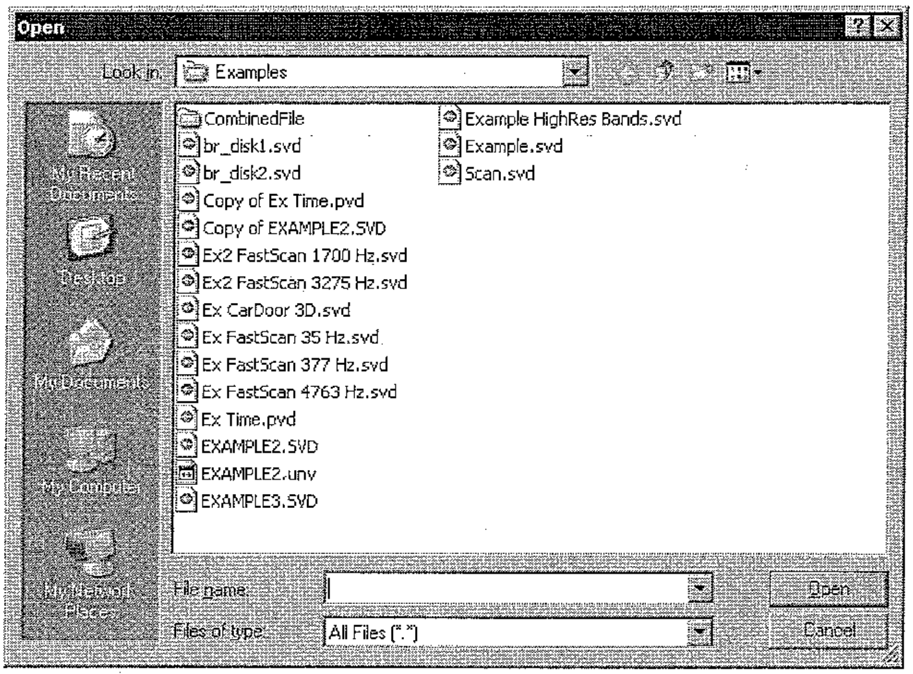


Figure 5.3: Dialog Open

2. Select the required file type.

3. Navigate to the saving location and select the required file.

4. Click Open. The scan points from the selected file are taken over in the video image. The indices of the scan points are also taken over.

☞ If you are importing geometry from a file in Universal File format which does not contain data set 164 with the units of the coordinates, you have to enter a scaling factor in the dialog Scaling of Imported Coordinates, refer to figure 5.4. The factor 1 stands for the unit m, the factor 0.01 for the unit cm etc.

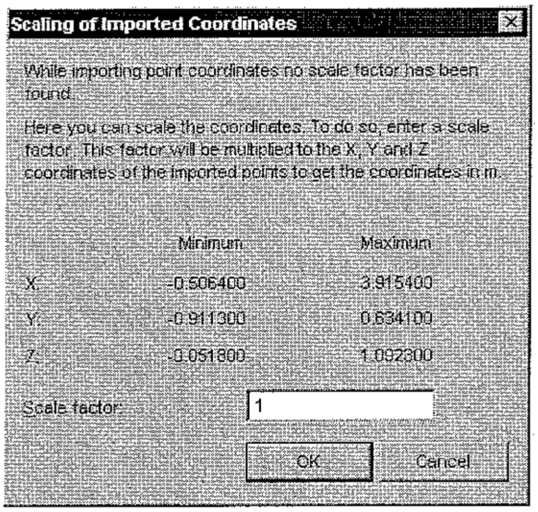


Figure 5.4: Dialog Scaling of Imported Coordinates

☞ If the object is deep, the imported points are not precisely on the object in the display on the screen. However despite this, during scanning, the laser beams hit the scan points precisely. If you want to correct the display on the screen, you can move the individual points in the video image to the right position. This, however, does not have any effect on the measurement result.

Work with geometries which are too large

If the imported geometry is larger than the image section of the object in the video window, the video window is reduced correspondingly and the geometry is shown completely in both the 2D view as well as the 3D view.

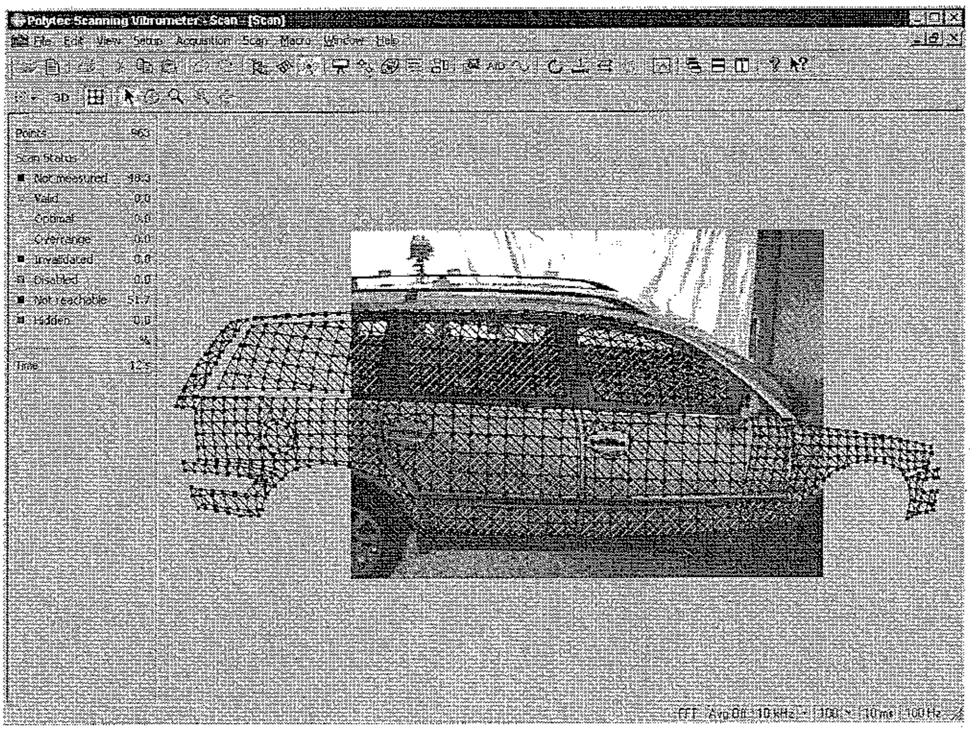


Figure 5.5: Example of geometry which is too large

Generally several scan points will then be given the status Not reachable or Hidden (refer to section 8.1). These points are not measured during a scan.

To acquire the entire geometry of the object, proceed as follows:

1. Select the scan points which are not to be measured with the current measurement setup. See section 5.6.1 on this.
2. Assign the status Disabled to these scan points. See section 5.6.2 on this.
3. Start a scan as described in section 6.2.
4. Change the position of the measurement setup so that you can scan another part of the object. To do so, carry out a new alignment as described in section 4.2 and disable the scan points which are not to be measured.
5. Start another scan.
6. Repeat the steps 4 and 5 until you have acquired the whole geometry.

☞ If you are using PSV-3D, you can then group the individual measurements to a combined file as described in section 8.5.

Import scan points with auto-alignment

If you are using one of the graphics cards ATI Radeon® 9000 Pro, 9600 Pro or 9600 XT, then after the geometry import you can have the position of the scan points on the video image corrected. To do so, click the video image with the right mouse button and select Auto Align from the pop-up menu. Then import the scan points as described above.

As soon as the import is finished, a message window is displayed with the query whether the scan points in the video image are to be repositioned. Click Yes. The software moves the laser beam of the scanning head Top to the points, determines the position of the laser beam on the screen and positions the scan point precisely at this point.

☞ This process can take quite some time!

5.4.2 Teaching-in Scan Points with the Geometry Scan Unit

If the object you are making measurements on does not have a continuous surface on which you can define a grid of scan points (e.g. a sheet of glass which has only been covered with reflective film in certain places), you can define single scan points with the aid of the optional geometry scan unit.

PSV, PSV-3D (1D)

1. Only PSV-3D: Select the scanning head Top.
2. Position the laser beam at the point at which you want to define a scan point.

☞ You can also use the hand set PSV-Z-051 for this or the optional PDA. Position the laser beam with the arrow keys on the hand set. Once the laser beam has reached the correct position on the object, press the button TEACH on the hand set. See your hardware manual on this as well.
You can read section 5.3.2 to find out how to define scan points with the PDA.

3. Click . If the geometry laser is not active yet, the software will now switch over to it. The software makes a distance measurement. At the same time, the coordinates of the point on the object are automatically determined, as is the position of the point on the video image.

☞ You can accelerate the speed at which new points are taught-in by switching over to the geometry laser first. To do so, click Scan > Geometry Laser. In this case the software does not keep on switching back and forwards between the vibrometer and the geometry laser for every individual point.

Once you have taught-in all the scan points, you can link them together to become a surface as described in section 5.3.3.

PSV-3D (3D)

If the positions of the scanning heads are known, you can acquire the geometry of the object by manually teaching-in the scan points.

1. Point all three laser beams at a point which you want to define as the scan point.

☞ The more precisely you define the scan points, the better the measurement result will be. **So please take your time defining the scan points!**

2. Click . This then automatically determines the coordinates of the point on the object and the position of the point on the video image. You can use the mouse to move this blue point. However this does not have any effect on the calculated 3D coordinates; it only affects the display in the video image.

☞ In the scanning head control, additional information is displayed in the element 3D Point. X, Y and Z describe the coordinates of the selected scan point. D is information on the plausibility control. This value shows the distance between the scan point and the front panel of the scanning head Top.

3. Once you have defined all scan points, you can connect them with each other. See section 5.3.3 on this.

4. Click [icon] to finish scan point definition. You can now start scanning.

5.4.3 Defining Scan Points with Auto-alignment, only PSV-3D (3D)

If you are using one of the graphics cards ATI Radeon® 9000 Pro, 9600 Pro or 9600 XT, you can also define individual scan points. To do so, proceed as follows:

1. Click in the video image with the right mouse button and select Auto Align in the pop-up menu.

2. Hold the control key pressed and in the video image click the place on the object at which you want to define the scan point. Depending on the lighting conditions, the surface of the object etc., the software positions the three laser beams precisely at this point and defines a scan point.

Correct 3D coordinates If the three laser beams jump to other positions after clicking [icon], then you have not carried out the 2D alignment precisely enough. The 3D-coordinates were only determined approximately via the video image. If the three laser beams do not meet at one point, then you could change the distance between the coordinates and the sensor heads. You can use this to minimize the distances of the laser points. The minimal attainable distance is limited by the accuracy of the 3D alignment. To correct the coordinates, proceed as described in section 5.6.2 under Modify 3D Coordinates.

5.4.4 Editing Scan Points

If you have defined individual scan points in 3D point mode, you can select scan points and modify them.

Select scan points You can select points as also described in section 5.6.1 and modify the selected points as described in the following.

Disable If the selected scan points are not to be measured, you can disable them. To do so, select Disable. The scan points are then blocked for measurements, geometry scans and for the function Assign Focus Best.

Remove block To undo disabling, select Enable.

Modify 3D Coordinates If 3D geometry data is available, you can modify the 3D coordinates of individual scan points. Refer also to section 5.6.2 under Modify 3D coordinates.

Triangulate 3D Coordinates (only PSV-3D) To triangulate the 3D coordinates of the selected scan points, select Triangulate 3D Coordinates. Using the standard and 3D alignment of all three scanning heads, the software calculates the 3D coordinates of the scan points. You will find more information on this in your theory manual.

Interpolate 3D Coordinates If 3D geometry is available for the selected scan points, you can interpolate the 3D coordinates of the selected scan points. To do so, select Interpolate 3D Coordinates. The software will then calculate the average distance of the neighboring points to the scanning head (Top with PSV-3D). From this distance and taking into consideration the position of the selected scan points on the video image, the 3D coordinates are determined.

5.5 Common Functions in All Modes

Several functions are available to you in all modes. They are described in the following sections. Show and Hide Scan Points

To show and hide the scan points in the live video image, in the toolbar of the application window, click  or select View > Scan Points. You see the scan points as blue squares. You see the connections between the scan points as lines.

5.5.1 Editing Figures

Present figures Using the icons , ,  and , you can present figures in different ways. To do so, first select the figures as described below. Then click

: You can see the scan points and their connections.

: You can see the scan points, their connections and cross-hatching of the areas enclosed by the scan points. As a general rule, these areas are different from the geometric figures you have drawn.

☞ In presentation mode, areas which are enclosed by scan points are shown as enclosed areas.

: You see the connections between the scan points.

: You see cross-hatching of the areas enclosed by scan points.

Select figures

To edit figures, you have to select them first. To do so, proceed as follows:

1. Click .
2. Point at a figure. At the right below the cursor, a cross appears.
3. Click. The software marks the edge of the figure with white handles.
4. To select further figures, click them while holding the control key pressed. The software marks every selected figure with white handles.
5. To select all figures, press the key combination Ctrl+A or select Edit > Select All.
6. To remove a figure from the selection, click the figure holding the control key pressed. The white handles disappear.

Move figures

To move figures, select them as described above and then use the mouse to drag them in the direction required. You can also use the arrow keys.

Scan points which you have defined in point mode or 3D point mode can be moved individually or in groups. You move individual scan points, whether connected or freestanding, in exactly the same way as you move figures (see above). If you want to move several scan points at the same time, then you first have to select them. To do so, you have the following possibilities:

- Hold the control key pressed and click the individual points. Then release the control key.
- Mark the scan points you would like to move. To do so, use the mouse to draw a rectangle which encloses these scan points.

☞ If you want to add even more scan points to this selection, hold the shift key pressed and draw another rectangle.

Move the scan points with the mouse.

Scale figures

To scale figures, proceed as follows:

1. Select the figures as described above. If you want to scale scan points which you defined in point mode or in 3D point mode, then first of all select them as described above under Move figures. Then click to group the selected scan points.
2. Point at one of the white handles which mark the edge of the figures. The cursor becomes a double arrow.

There are now different ways to scale:

3. Press the mouse button and drag in one of the directions the double arrow is pointing in. The anchor point is opposite the scan point you are dragging.

or

Press the control key and the mouse button and drag in one of the directions the double arrow is pointing in. The anchor point is the center of the figures.

or

Press the shift key and the mouse button and drag across to a corner point. The figures are resized in proportion horizontally and vertically.

Duplicate figures

To duplicate figures, proceed as follows:

1. Select the figures as described above.
2. Click or select Edit > Copy. The figures are copied onto the clipboard.
3. Click or select Edit > Paste.

Delete figures

To delete figures, proceed as follows:

1. Select the figures as described above.
2. Press the Delete key or select Edit > Delete.

Group figures

To group figures, proceed as follows:

1. Select the figures as described above.
2. Click .
3. To undo grouping, click .

Arrange figures

Using the four icons , , and , you can arrange figures behind each other (not in point mode and 3D point mode). To do so, first of all, select one of the figures as described above. Then click

or : The figure moves into the foreground or background.

or : The figure moves one layer forwards or backwards.

Undo and Redo

You can undo up to 20 operations and then redo them. To do so, click and or select Edit > Undo and Edit > Redo.

5.6 Editing Scan Points

You can also edit scan points if you have already finished scan point definition.

To do so, you have to start by selecting the scan points. See section 5.6.1 on this.

You can see how to modify the scan points in section 5.6.2.

5.6.1 Selecting Scan Points

Select scan points with the mouse

To select scan points with the mouse you have the following options:

1. To select several scan points adjacent to each other, hold the shift key and the left mouse button pressed and draw one or more rectangles across the required scan points.

   Or:

   To select several scan points that are not adjacent to each other, hold the control key pressed and click the required scan points.

Select all scan points

2. To select all scan points, press the key combination Ctrl+A.

   Or:

   Select Edit > Select All.

   Or:

   Click the object with the right mouse button and select Select Points from the pop-up menu. The dialog Select Scan Points appears.

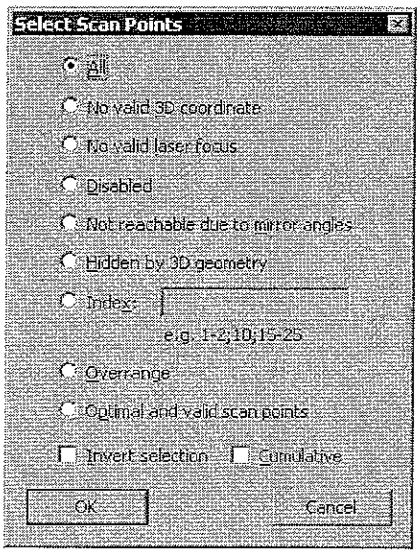


Figure 5.6: Dialog Select Scan Points

Select All and click OK.

Select scan points with certain properties

To select scan points which have certain properties, proceed as follows:

1. Click or select Edit > Select Points.
2. Click the object with the right mouse button and select Select Points from the pop-up menu. The dialog Select Scan Points appears (refer to figure 5.6).
3. Here you select the criteria according to which you want to select the points and click OK.

☞ If you want to select the scan points on the basis of their index, you can display the indices. See section 4.8.2 on this.

4. If you want to select points with different properties, then also tick the box Cumulative and repeat steps 2 and 3 as often as necessary.
5. To undo the selection, click again.

5.6.2 Modifying Scan Points

To retrospectively modify the selected scan points, select Edit > Modify Selected Points or click one of the selected scan points with the right mouse button and select Modify Selected Points and then the required command in the pop-up menu.

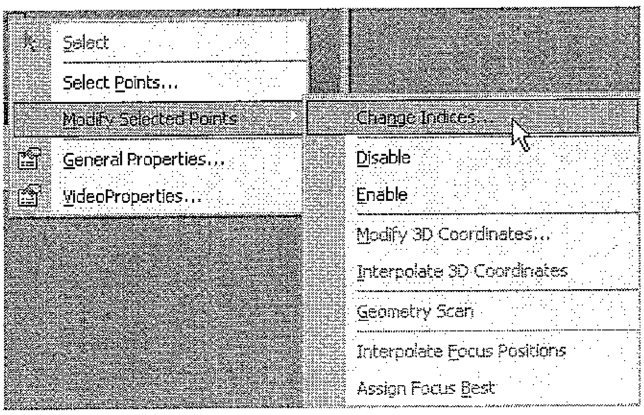


Figure 5.7: Command selection to modify scan points

You have the option of the following functions:

- Change Indices
- Disable/Enable
- Modify 3D Coordinates (only with 3D geometries)
- Triangulate 3D Coordinates (only for PSV-3D)
- Interpolate 3D Coordinates (only with 3D geometries)
- Geometry Scan
- Interpolate Focus Positions (only with option PSV-S-APS Ex)
- Assign Focus Best (only with option PSV-S-APS Ex)

Display indices

You set up the display of scan point indices in the dialog Display Properties in the 3D view. To open the dialog, display the 3D view. To do so, click 3D. Double-click the video image and display the page Data or click the video image with the right mouse button and select Data Properties in the pop-up menu. You will also find a detailed description of the dialog in section 4.8.

Change Indices

To change the indices of selected scan points, select Change Indices. The dialog Change Indices appears.

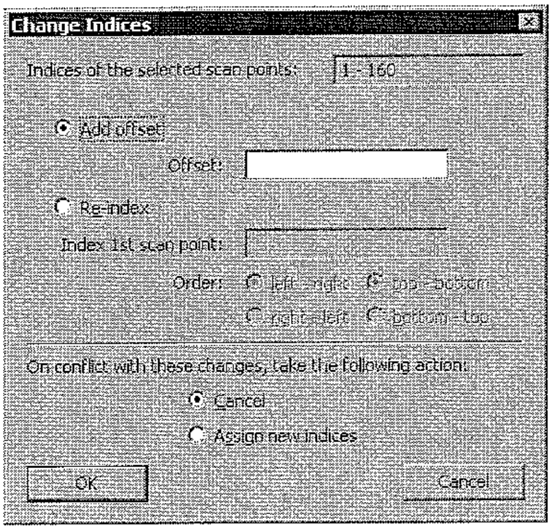


Figure 5.8: Dialog Change Indices

At the top you are shown the indices for selected scan points.

Add offset: Click here if you want to add a certain amount to the indices of the selected scan points or want to subtract it from them. In the field Offset enter the required value. For a negative offset you have to enter an additional minus sign (–).

Example:
The selected scan points have the indices 1 - 21.
Offset: 10
The new indices will be 11 - 31.

Re-index: Click here if you want to renumber the selected scan points. In the field Index 1st scan point enter the value at which the new numbering is to start.

In addition to that, select the direction of the numbering, starting with the first scan point.

Example:
The selected scan points have the indices 27 - 52.
Index 1st scan point: 30
Direction: left - right, top - bottom
The new indices will be 30, 31, 32, ... They are assigned to the selected scan points from left to right and from top to bottom.

☞ The numbering of the indices only affects the display on the screen. It has no influence on the order in which the points are scanned.

On conflict with these changes, take the following action: Here you select how the software is to react if there is a conflict after changing the indices, i.e. numbers are assigned twice. If you select Assign new indices, then the selected scan points are assigned the required indices. Indices for other scan points which already exist are then counted up, starting with the highest index +1.

Example:
You have defined 2500 scan points and want to newly assign the indices 1 - 200 to the scan points 200 - 400.
Index 1st point: 1
On conflict with these changes, take the following action: Assign new indices
The selected scan points are given the indices 1 - 200. The scan points which originally had the indices 1 - 200 will be given the indices 2501 - 2701.

☞ Independently of whether you abort assignment of new indices or carry it out anyway, you will see a message as to whether a conflict occurred.

Disable

If the selected scan points are not to be measured, you can disable them. To do so, select Disable. The scan points are then disabled for measurements, geometry scans and for the function Assign Focus Best.

Enable

To undo disabling, select Enable.

Modify 3D Coordinates

You can modify the 3D coordinates of individual scan points. To do so, for the respective selected scan point, select Modify 3D Coordinates. The dialog Modify 3D Coordinates appears.

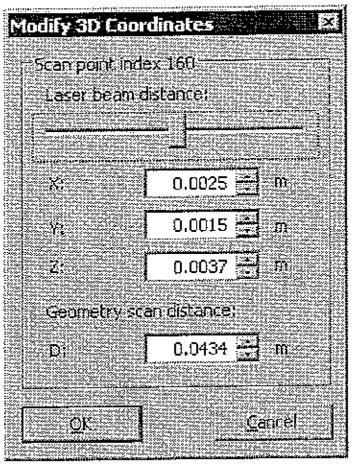


Figure 5.9: Dialog Modify 3D Coordinates

Here you can correct the values of the X, Y and Z coordinates and also the distance determined by the geometry scan unit. If you move the laser beams with the aid of the slider Laser beam distance, the values in the fields are automatically updated. If however you correct the values in the fields, the slider remains in the set position.

You can also modify the 3D coordinates of several scan points at the same time. To do so, proceed as follows:

1. Select several scan points as described in section 5.6.1.
2. Click one of the scan points with the right mouse button and select Modify 3D Coordinates in the pop-up menu.
3. Modify the 3D coordinates as described above and click OK. The change to the 3D coordinates of that scan point is added to the 3D coordinates of all selected scan points. This allows you to move the position of several scan points in the same direction.

Triangulate 3D Coordinates (only PSV-3D)

To triangulate the 3D coordinates of the selected scan points, select Triangulate 3D Coordinates. Using the standard and 3D alignment of all three scanning heads, the software calculates the 3D coordinates of the scan points. You will find more information on this in your theory manual.

Interpolate 3D Coordinates

If 3D geometry data is available for the selected scan points, you can interpolate the 3D coordinates of the selected scan points. To do so, select Interpolate 3D Coordinates. The software will then calculate the average distance of the neighboring points to the scanning head (Top with PSV-3D). From this distance and taking into consideration the position of the selected scan points on the video image, the 3D coordinates are determined.

Geometry Scan If you want to correct the 3D coordinates of the selected scan points with the aid of the geometry scan unit, select Geometry Scan. The software will carry out a geometry scan as described in section 4.3.

Interpolate Focus Positions To interpolate the focus positions of the selected scan points, select Interpolate Focus Positions. The focus positions of the selected scan points are interpolated linearly from the focus positions of the adjacent points.

Assign Focus Best Select Assign Focus Best to automatically focus the selected scan points respectively and to assign them a focus value. See also section 4.5.2 on this.

6 Making Measurements

You can make single point measurements and scan using the software. In section 6.1 and section 6.2 the different measurements are described. There you will also find an explanation of the respective procedure.

When a measurement is running, the status bar can display messages on it. See section 6.4 on this.

In section 6.5 you will find information on what you have to pay attention to if you stop a measurement.

Only with option VDD: You must run the test mode at regular intervals before making measurements. See section 6.6 on this.

In section 6.7 you will find a few example applications which give you detailed instructions on various measurement tasks.

6.1 Single Point Measurement

You can make single point measurements as single shots or as a continuous measurement.

Single shot

With a single shot, the software makes a single measurement and then ends data acquisition. You can also stop single shots manually.

Continuous measurement

With a continuous measurement, the software repeats single shots until you manually stop data acquisition. You can only save the last single shot.

To make a single point measurement, proceed as follows:

Preparation

1. Go to acquisition mode. To do so, click or select View > Acquisition.
2. Set the software up for data acquisition as described in chapter 3.
3. Set the optics and position the laser beam to point at the place where you want to make a measurement. See chapter 4 on this.
4. Focus the laser beam (manually or automatically in the scanning head control). See section 4.1 and section 4.4 on this.
5. Only with option VDD: You must run the test mode at regular intervals before making measurements. See section 6.6 on this.
6. Set the parameters for data acquisition. See chapter 7 on this.

Start

7. Start a single shot or a continuous measurement. To do so, click or . You can also select Acquisition > Single Shot or Acquisition > Continuous.

☞ If you have selected the 3D view in acquisition mode, the software will change over to the 2D view on starting the scan. Thus you can follow the movement of the laser beam on the object in the live video image.

Follow the measurement

8. During the measurement, you can display data in analyzers as described in section 8.2 and section 8.4.

9. During the measurement, the status bar and scanning head control can display messages on data acquisition. See section 6.4 on this.

Stop

10. To stop the measurement, click or select Acquisition > Stop. Please see section 6.5 on this as well.

6.2 Scanning

A scan is a sequence of single point measurements. The order in which the software approaches the scan points is determined by an internal algorithm. For every scan point, the software carries out the following steps:

- position the laser beam at the scan point,
- set the optics of the scanning head to the focus value of the scan point (only with option APS Extended, refer to section 4.5),
- wait for the end of the settling time of the scanner mirrors,
- make a single shot,
- assign scan point status,
- save measurement data.

After a scan, the software can automatically remeasure certain scan points or you can start remeasuring manually. You can also mark single scan points in presentation mode to be remeasured and then remeasure this file in acquisition mode.

To scan, proceed as follows:

Preparation

1. Go to acquisition mode. To do so, click or select View > Acquisition.

2. Set the software up for data acquisition as described in chapter 3.

3. Set the optics. See chapter 4 on this.

4. Define the scan points as described in chapter 5.

5. Set the parameters for data acquisition. See chapter 7 on this.

Start

6. Start the scan. To do so, click or select Acquisition > Scan. If the function generator is active (refer to section 7.2.9), signal output starts. The software creates a file for the scan. The dialog Save As appears.

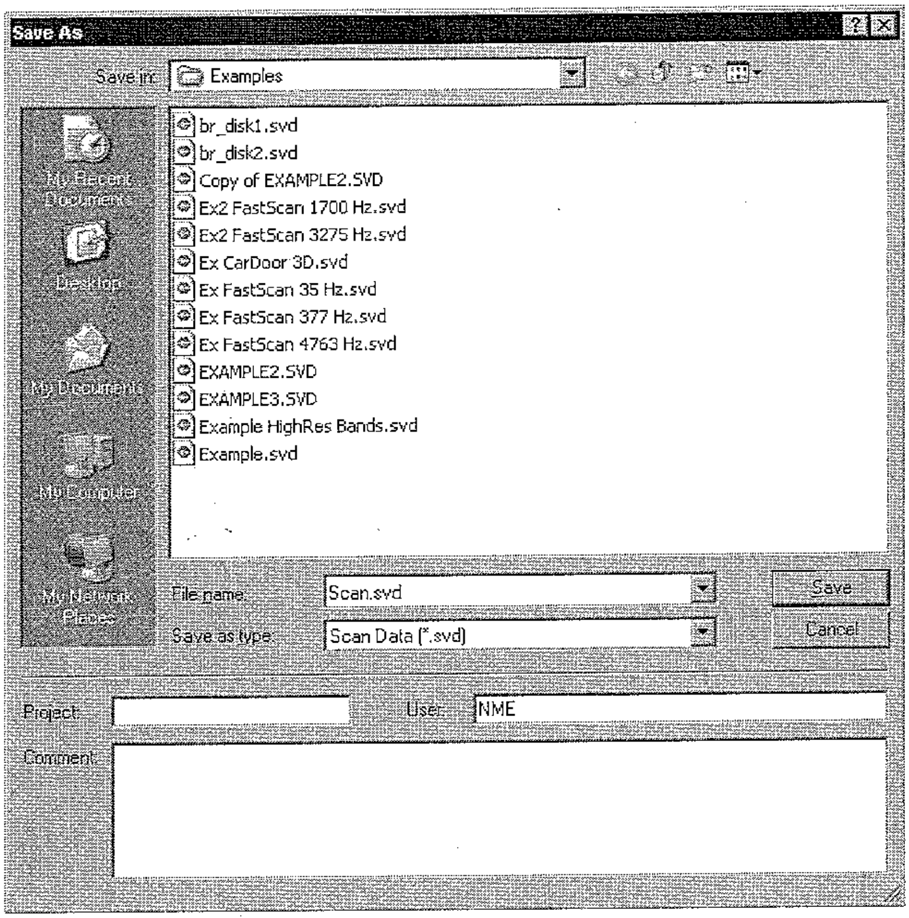


Figure 6.1: Dialog Save As

Save

7. Navigate to the saving location and enter the file name.

☞ If you have displayed the project browser (refer to section 2.7.4), you will then automatically be shown the directory marked there as saving location.

8. At the bottom in the dialog you can enter additional information to give the file more precise properties. This information is part of the file properties which you can also view and edit in the Explorer. It will be displayed to you when you open a file in presentation and also in the dialog File Information. (refer to section 2.7.4 on this as well).

9. Click Save. The scan starts. The software immediately saves every scan point measured.

☞ In measurement mode Time, a high number of samples can mean that very large files are generated which can only be saved and read using Windows® 2000 or Windows® XP! See also section 7.2.12 on this.

Follow the scan

10. You can follow the progress of the scan in the video window as described in section 8.1. During the scan, you can display data in analyzers as described in section 8.2 and section 8.4.

11. During the scan, the status bar and scanning head control can display messages on the data acquisition. See section 6.4 on this.

Stop the scan and continue

12. Once the total sample time has expired, the software ends data acquisition and displays a message. However, you can also stop the scan manually. You will find more details on this in section 6.5.

13. You can continue a stopped scan. To do so, select Acquisition > Continue.

Remeasure

14. After the scan you can remeasure the scan points with the status Overrange, Invalidated and Not Measured at a slightly different position. To do so, select Acquisition > Remeasure. If Signal Enhancement is active for at least one channel (refer to section 7.2.7), then other scan points with the status Valid are also remeasured.

Remeasure File

15. If you have marked individual scan points in presentation mode to be remeasured (refer to section 9.1), you can remeasure them. To do so, select Acquisition > Remeasure File. The dialog Open appears. Navigate to the saving location, select the file and click Open.

☞ In addition to that, the software can also remeasure the points automatically, see section 7.2.1 on this.

6.3 Using the PSV-3D for Making 1D Measurements

If you are using the PSV-3D with just one scanning head, then you have to activate it first. section 3.1) and then change the settings as follows:

1. Click A/D or select Acquisition > Settings.

2. Go to the page Channels and deactivate Vibrometer Left and Vibrometer Right. In this case only the scanning head Top makes a measurement. So you only have to carry out the alignment for this scanning head as described in section 4.2.1.

   You can ignore any error messages about the other two scanning heads not having been aligned.

☞ You can also use Vibrometer Left and Vibrometer Right as a reference. To do so, activate the corresponding vibrometer on the page Channels and mark it as reference.

6.4 Messages while Measuring

During a measurement, the status bar and scanning head control can display messages on data acquisition. A list of messages, their causes and information on prevention can be found in table 6.1.

Table 6.1: Messages on data acquisition

Message	Cause	If the message appears permanently:	See
OVERRANGE VIB (status bar)	The voltage on the vibrometer channel exceeds the input range set.	Click A/D, display the page Channels and set to the next highest input range of the vibrometer channel. Increase the input range on the page Channels step by step up to 10V. Then display the page Vibrometer and increase the measurement range for the velocity step by step.	section 7.2.2
☞ The message OVERRANGE VIB can also appear briefly which is caused by noise peaks due to dropouts. In this case, do not reset the input range.			
OVERRANGE REF (status bar)	The voltage on the reference channel exceeds the input range set.	Click A/D, display the page Channels and set the next highest input range of this reference channel.	section 7.2.2
NO TRIGGER (status bar)	Triggering is set but the software can not detect a trigger signal.	Click A/D, display the page Trigger and check the trigger settings. Also check the cabling.	section 7.2.6, hardware manual
Display OVER is red (scanning head control)	The measurement range for the velocity has been exceeded.	Click A/D, display the page Vibrometer and set the next highest measurement range for the velocity.	section 7.2.8
☞ Even if you are only measuring and evaluating the displacement signal, the measurement range for the velocity must not be exceeded.			

6.5 Stopping a Measurement

With single shots and with scanning, the software ends data acquisition once the total sample time has expired. You can also stop measurements manually. Continuous measurements have to be stopped manually.

To stop a measurement, click or select Acquisition > Stop.

Single point measurement

If you stop a single point measurement, the following applies:

- If there are less than three seconds to the end of the sample time, the software carries out the measurement completely and then ends data acquisition.
- If there are more than three seconds to the end of the sample time, the software aborts the measurement. In the measurement modes FFT and Zoom-FFT, you can always display and save the time signal for aborted measurements, but may not be able to save a spectrum. For long sample times, single shot is recommended if you want to evaluate and save spectra.

Scan

If you stop a scan, the following applies:

All completely measured scan points are already saved. You can evaluate the scan the same as you can a completed one.

6.6 Test Mode (as an Option)

In the test mode, the software calculates the errors which are caused by the analog components during signal processing. Prior to demodulation, the software corrects these errors using special algorithms. To do this, you need the option VDD.

You have to run test mode after having installed both the option VDD and the hardware, and having set up the software, and then repeat it regularly. In doing so, the following applies:

- If you only want to measure to 10 nanometers accuracy or less, you should run the test mode again every three months.
- If you want to measure more accurately than 10 nanometers or if the ambient temperature has changed by ±5°C or more, repeat the test mode every day.

☞ Test mode can be carried out automatically for the controller OFV-5000 if the controller is controlled remotely via the RS-232-interface. Test mode is then run every time the software is started.

To run the test mode, you will need

- a test object which is vibrating – for example, a loudspeaker. The displacement amplitude should be at least 1 µm.
- a piece of reflective film.

To run test mode, proceed as follows:

1. Switch the PSV or MSV on and wait for 30 minutes. The components are then in thermal equilibrium.
2. **Only PSV:** Attach a piece of reflective film to the test object and point the scanning head at it.
3. Let the test object vibrate.
4. **Only PSV:** Open the beam shutter on the scanning head, fine-position and focus the laser beam on the reflective film. The signal level display should light up completely.

   Only MSV: Open the beam shutter on the scanning head, fine-position and focus the laser beam on the test object. The signal level display should light up completely.
5. In the software, select Setup > VDD Test.

☞ If the command is not active, select Setup > Preferences, display the page Devices and in the list Junction Box select the junction box VDD-Z-01x, or MSA-E-400 (VDD), refer also to section 3.1.

The software records the vibration and calculates the correction factors for the errors caused by analog components.

Should test mode fail, then first of all check the cabling and the test assembly. If cabling and the test assembly are correct, then it is possible that the displacement amplitude of the test object is too small.

If test mode is successful, you can now start a measurement as described in section 6.1 or section 6.2.

6.7 Example Measurements

Here you will find a few example applications which give you detailed instructions on various measurement tasks.

6.7.1 Optimizing Input Signals with Signal Enhancement and Speckle Tracking

When scanning with Signal Enhancement and Speckle Tracking, you get an approximately even noise level for all scan points.

☞ Speckles occur when laser light is scattered back from optically rough surfaces. The light scattered back from a certain point can cause constructive or destructive interference. Correspondingly, the detector sees a bright or a dark speckle. Dark speckles lead to dropouts in the vibrometer signal. Dropouts increase the noise level significantly.

With Signal Enhancement and Speckle Tracking, you suppress dropouts in averaged spectra. In addition, the software evaluates the noise level of the single scan points. You will find more information on this in your theory manual.

To activate Signal Enhancement and Speckle Tracking, proceed as follows:

1. Click A/D or select Acquisition > Settings. The dialog Acquisition Settings appears.
2. Display the page SE.
3. On the left you mark the channels which Signal Enhancement is to be active for. You will find information on this in section 7.2.7.
4. If Signal Enhancement is active for the vibrometer channel, then you can activate Speckle Tracking for this channel on the right.
5. Set the parameters on all other pages of the dialog. You will find information on this in section 7.2.
6. Click OK.

You can now start a measurement as described in section 6.1 or section 6.2.

6.7.2 Controlling an External Function Generator (as an Option)

Using the software you can control certain function generators via an IEEE-488/GPIB interface. To do this, you need the option External Signal Generator.

☞ You can set which generator you are using via Setup > Preferences on the dialog page Devices.

The software supports the following function generators:

- HP 33120A
- Agilent 33120A
- Agilent 33250A
- PREMA ARB1000.

To control an external function generator, proceed as follows:

Make a connection

1. Connect your PC to the function generator via an IEEE 488/GPIB or RS-232 interface.
2. Switch the function generator on.
3. Only 33120A: Configure the interface of the function generator as described in its manual. Set HPIB/488 or RS-232 as the interface and as HPIB address 10.
4. Start the software or go into acquisition mode.
5. Select Setup > Preferences and open the page Devices. Here you set the correct connection to the generator (refer also to section 3.1).
6. Click OK. The generator is initialized.

Set the parameters

7. Click or select Acquisition > Settings. The dialog Acquisition Settings appears.
8. Display the page Generator.
9. At the top left, tick the box Active to activate the function generator.
10. Set the parameters for the signal you want to emit. You will find information on this in section 7.2.9.
11. Set the parameters on all other pages of the dialog. You will find information on this in section 7.2.
12. Click OK.

Signal output

13. Start (stop) the signal output of the function generator. To do so, click or select Acquisition > Generator.

☞ When scanning, the signal output starts automatically.

You can now start a measurement as described in section 6.1 or section 6.2.

6.7.3 Controlling the Internal Function Generator (as an Option)

Using the software you can control the internal function generator of the PSV 400, PSV 300 or MSV 300. To do this, you need the option Internal Signal Generator. The output signal of the internal function generator is available at a BNC jack on the junction box (refer to hardware manual).

☞ You can set which generator you are using via Setup > Preferences on the dialog page Devices.

To control the internal function generator, proceed as follows:

Set the parameters

1. Click or select Acquisition > Settings. The dialog Acquisition Settings appears.
2. Display the page Generator.
3. At the top left, tick the box Active to activate the function generator.
4. Set the parameters for the signal you want to emit. You will find information on this in section 7.2.9.
5. Set the parameters on all other pages of the dialog. You will find information on this in section 7.2.
6. Click OK.

Signal output

7. Start (stop) the signal output of the function generator. To do so, click or select Acquisition > Generator.

☞ When scanning, the signal output starts automatically.

You can now start a measurement as described in section 6.1 or section 6.2.

6.7.4 FastScan (as an Option)

You can fast scan at individual frequencies. To do this, you need the option FastScan. The principle of FastScan is a regression in the time domain.

To carry out a FastScan, proceed as follows:

Set the parameters

1. Click A/D or select Acquisition > Settings. The dialog Acquisition Settings appears.
2. Display the page General and select the measurement mode FastScan. In the dialog a page with parameters for FastScan appears. The pages Frequency, Window and Trigger disappear.
3. Display the page FastScan and set the parameters. You will find information on this in section 7.2.11.
4. Set the parameters on all other pages of the dialog. You will find information on this in section 7.2.
5. Click OK.

Measure

6. You start and stop FastScans the same way as normal scans. See section 6.2, section 6.4 and section 6.5 on this.

☞ With a FastScan there is no leakage. Triggers are not active. If you are controlling a function generator with the software, then a sinusoidal signal with the frequency of the FastScan is used for excitation.

Display data

7. You can display data for FastScans as described in chapter 8, but no spectra.

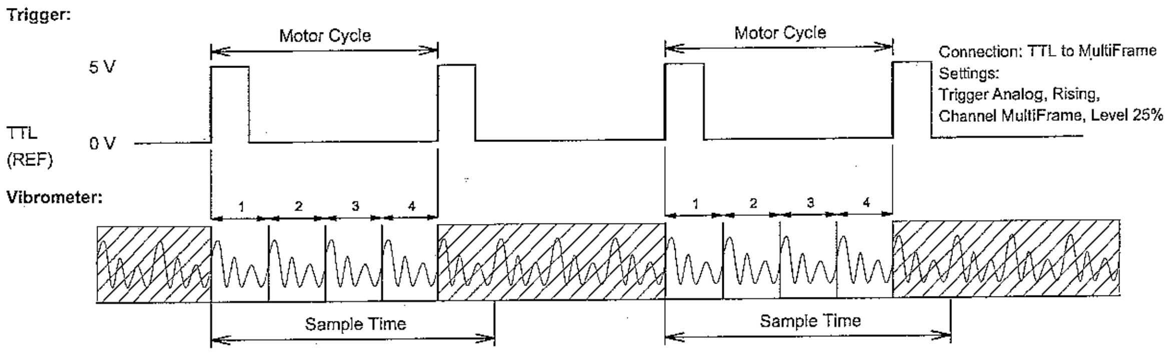
Evaluate

8. You can evaluate FastScans as described in chapter 9, but only at the frequency of the FastScan. You can not define any other frequency bands.

6.7.5 MultiFrame Measurement (as an Option)

Using the software you can divide measurements on combustion engines into frames and analyze the frames individually. To do this, you need the option MultiFrame and a trigger signal (TTL) which determines the start of an engine cycle. For the frame cycle you will need a second trigger signal which determines the end of a frame. You connect this second trigger signal to the channel with the highest number (REF3 or REF24). In the software, this channel will be named MultiFrame.

Motor Cycle (Example: 4 Frames, 1 Pulse per Motor Cycle)



Frame Cycle (Example: 4 Frames, 4 Pulses per Motor Cycle)

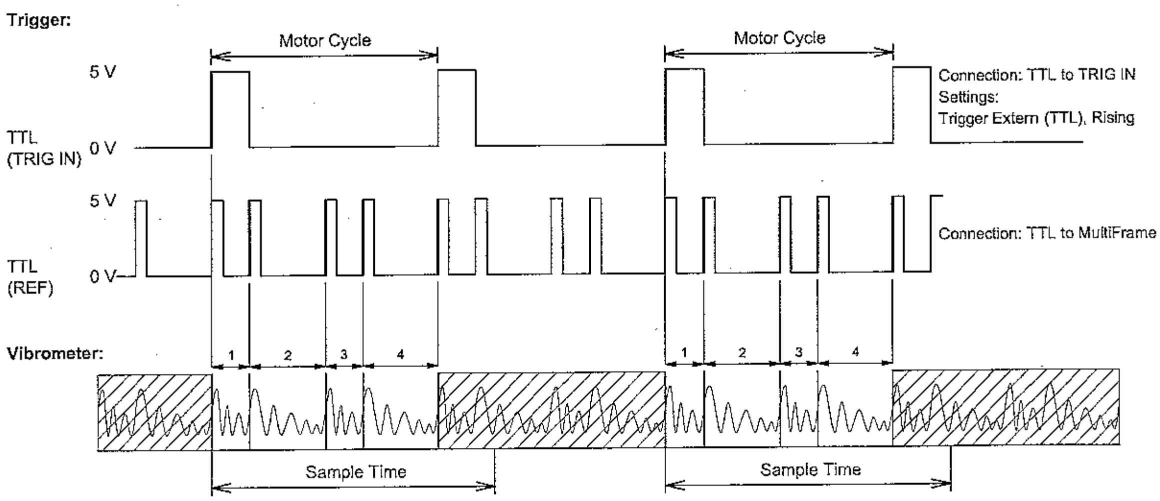


Figure 6.2: Schematic representation of setting frame boundaries

There are three ways of setting the frame boundaries (refer also to section 7.2.13):

- manually
- automatically with the aid of the engine cycle
- automatically with the aid of the frame cycle

Manually If you manually set the frame boundaries in the analyzer, the start of the engine cycle is determined by a trigger signal at TRIG IN (TTL).

Engine cycle If the frame boundaries are set automatically by the engine cycle, the start and the end of the engine cycle are determined by a trigger signal (TTL, rising edge) at MultiFrame. All frames are the same length.

Frame cycle If the frame boundaries are set automatically by the frame cycle, the start of the engine cycle is determined by a trigger signal (TTL, rising edge) at TRIG IN. A second trigger signal (TTL, rising edge) at MultiFrame ends the frame.

To make a MultiFrame measurement, proceed as follows:

Cabling One way of cabling the system and the necessary settings in the software for this is shown in table 6.2. In principle other versions of cabling would be possible.

Table 6.2: Example of connecting up the trigger signals for MultiFrame measurements

Determining the frame boundaries	Cabling	Setting in the software
Manual	Trigger signal for the start of the engine cycle: TRIG IN	Source: External (TTL), Rising Pre-trigger: 0%
Engine cycle	Trigger signal for the start and the end of the engine cycle: MultiFrame	Source: Analog Pre-trigger: 0% Channel: MultiFrame, Rising Source: 25% Pulses per engine cycle: 1
Frame cycle	Trigger signal for the start of the engine cycle: TRIG IN Trigger signal for the end of a frame: MultiFrame	Source: External (TTL), Rising Pre-trigger: 0%

Set the parameters

1. Click  or select Acquisition > Settings. The dialog Acquisition Settings appears.
2. Display the page General and select the measurement mode MultiFrame. A page with parameters for the MultiFrame measurement appears in the dialog.
3. Set all other parameters on the page General. You will find information on this in section 7.2.1.
4. Display the page MultiFrame and set the parameters. You will find information on this in section 7.2.13.
5. Display the page Frequency. Set the parameters as described in steps 6 and 7.
6. At the top left, set the bandwidth.
7. At the bottom right, set the number of samples. Above that, the software shows the lower RPM limit RPM_{min} which it can acquire with the bandwidth and number of samples set. Set the number of samples so that the lower RPM limit is 5 to 40% below the RPM the engine is running at.

8. Display the page Window and set the window functions. As a general rule, the window function Tapered Hanning with a parameter of 10 is suitable for MultiFrame measurements. You will find more information on windowing in section 7.2.5 and in your theory manual.

9. Display the page Trigger and set the parameters according to table 6.2.

10. Set 0% pre-trigger.

11. Set the parameters on all other pages of the dialog. You will find information on this in section 7.2.

12. Click OK.

If you set the boundaries of the frames manually, then now follow steps 13 to 18. If you set the boundaries automatically, you can jump these steps and continue with step 19.

Set frame boundaries manually

13. Start a single point measurement. To do so, click .

14. In the analyzer you will see a MultiFrame toolbar and in the diagram, the boundaries of the frames. In the MultiFrame toolbar, click .

15. Point at a boundary in the diagram. The cursor becomes a ↔.

There are two ways of moving the boundaries:

16. To move a boundary, use the mouse to drag it to the right or left into the required position. You can only move each boundary in a certain range which depends on the neighboring boundaries.

17. To move all boundaries at the same time, press the shift key and drag to the right or left into the required position. All boundaries move at the same time and retain the same respective distances to each other.

18. When you have adjusted all boundaries, click again. Initially the boundaries jump back into their old positions in the analyzer. The new boundaries are not shown until you start a new measurement.

Measure

19. You start and stop MultiFrame measurements as described in section 6.1, section 6.2, section 6.4 and section 6.5.

Display data

20. You can display data for MultiFrame measurements as described in chapter 8.

21. In analyzers you can also display the spectra of the individual frames and the average of all frames. To (de)activate the display of a spectrum, click the corresponding icon in the MultiFrame toolbar.

22. In presentation windows, you can either only display an individual frame or the average respectively. Select the data set you want to display in the list Frame [Frame 4] in the legend for the object.

Exporting Universal File or ME'Scope

23. If you export a MultiFrame measurement as a Universal File or in ME'Scope format (refer to section 10.2.3), the software will create an own file for every single frame and for the average.

6.7.6 Controlling a Second Vibrometer

Apart from the PSV, MSA or MSV, you can control a second Polytec vibrometer at the same time. To do this, you need an IEEE488 /GPIB board or a free RS232 interface in your PC.

Supported controllers

You will find an overview of the controllers and interfaces supported as well as information on cabling in table 6.3.

Table 6.3: Supported controllers and interfaces

Vibrometer	IEEE-488/GPIB	RS-232	RS-232 cable
CLV-1000/2000/3000	-	x	Null modem (cross-wired)
HLV-1000	-	x	Null modem (cross-wired)
NLV-1232	-	x	Null modem (cross-wired)
OFV-3000/3001/3001S	x	x	1:1
OFV-3020/3020S	x	x	1:1
OFV-3300-1/3300-2	x	x	1:1
OFV-3310/3320	x	x	1:1
OFV-4000	x	x	1:1
OFV-5000	-	x	Null modem (cross-wired)
OFV-5000-S	-	x	Null modem (cross-wired)

Supported commands

The connection supports the following commands:

- set the parameters of the controller for data acquisition

Only Vibrometer Controller 1 (refer to section 2.3):

- query overranging
- query the optical signal level
- OFV-5000 with scanning head PSV-I-400: focus the laser beam automatically (Auto Focus)
- OFV-5000 with sensor head OFV-505: focus the laser beam automatically (Autofocus)
- OFV-5000 with sensor head OFV-551/-552: control the beam shutter, dim the laser beam (as an option)
- OFV-3001S with scanning head OFV-056: focus the laser beam
- OFV-3001S and OFV-3001 with the sensor head OFV-303: focus the laser beam

To control a vibrometer, proceed as follows:

Make a connection

1. Connect the PC to the controller via an IEEE-488/GPIB or RS-232 interface, refer also to table 6.3.

☞ If you are using an RS-232 interface, then set 9600 Baud on the controller, on the OFV-5000 controller 115200 Baud.

2. Switch the controller on.
3. Only OFV-3300-1, OFV-3310 and OFV-4000: Use the key ↑ on the front panel of the controller to switch its display to the menu SETTINGS. Then you can monitor the current settings on the display.
4. Start the software or go into acquisition mode.
5. Select Setup > Preferences. The dialog Preferences appears.
6. Display the page Devices. Make the necessary settings here (refer also to section 3.1).
7. Display the page Channels.
8. In the column Vibrometer, connect the controller to the digital channel it is providing the signal for. You will find information on this in section 3.2.
9. Click OK. The controller is initialized.

Set the optics

10. If you can not see the scanning head control in the application window, select View > Scanning Head to display it. At the top you can see the optical signal level as a bar.

☞ If you are using the sensor head OFV-551/-552, you can control the beam shutter and use it to turn the laser on and off. To do so, click the box Laser. Apart from that, as an option, the slider Laser Dimmer is displayed. By moving this slider with the mouse in the direction Max. you can reduce the light intensity of the laser beam.

OFV-505 OFV-551/-552

Figure 6.3: Elements of beam control

11. OFV-5000 with scanning head PSV-I-400 or sensor head OFV-505: You can focus the laser beam automatically with the icon .
12. OFV-3001S with scanning head OFV-056: You focus the laser beam using the icons (close-up) and (infinity).

Set the parameters

13. Click or select Acquisition > Settings. The dialog Acquisition Settings appears.
14. Display the page Vibrometer.
15. Set the parameters of the controller for data acquisition. You will find information on this in section 7.2.8 and in your vibrometer manual.
16. Set the parameters on all other pages of the dialog. You will find information on this in section 7.2.
17. Click OK.

You can now start a measurement as described in section 6.1 or section 6.2.

7 Parameters for Data Acquisition

There are three ways for you to set the parameters for data acquisition. See section 7.1 on this.

You will find a description of all parameters in section 7.2.

7.1 Setting the Parameters

You can set the parameters for data acquisition as follows:

- in the status bar
- in the dialog Acquisition Settings
- by loading the settings from a file.

Status bar

You can set some parameters on the right in the status bar. The parameters which are shown there depend on the measurement mode set. To see which parameters they are, point at a setting and leave the cursor there for a moment. The parameter is then shown on a yellow background next to the cursor and also on the left in the status bar. To set a parameter, click the arrow on the right of it and select the required setting in the pop-up menu.

Dialog

You can set all parameters in the dialog Acquisition Settings. To do this, proceed as follows:

1. Click  or select Acquisition > Settings. The dialog appears. It consists of several pages each with a group of parameters respectively. To display a certain page, click the name of the group.
2. Display the page General and set the parameters. You will find information on this in section 7.2.1. The pages in the dialog can change with the measurement mode selected.
3. Set the parameters on all other pages of the dialog. You will find information on this in section 7.2.
4. When you have set all parameters, click OK.

File

You can load settings from setting files and measurements. See section 10.1.3 on this. You can save the current settings as described in section 10.2.7.

7.2 Description of the Parameters

7.2.1 General

On the page General, you set the measurement mode, averaging and automatic remeasuring.

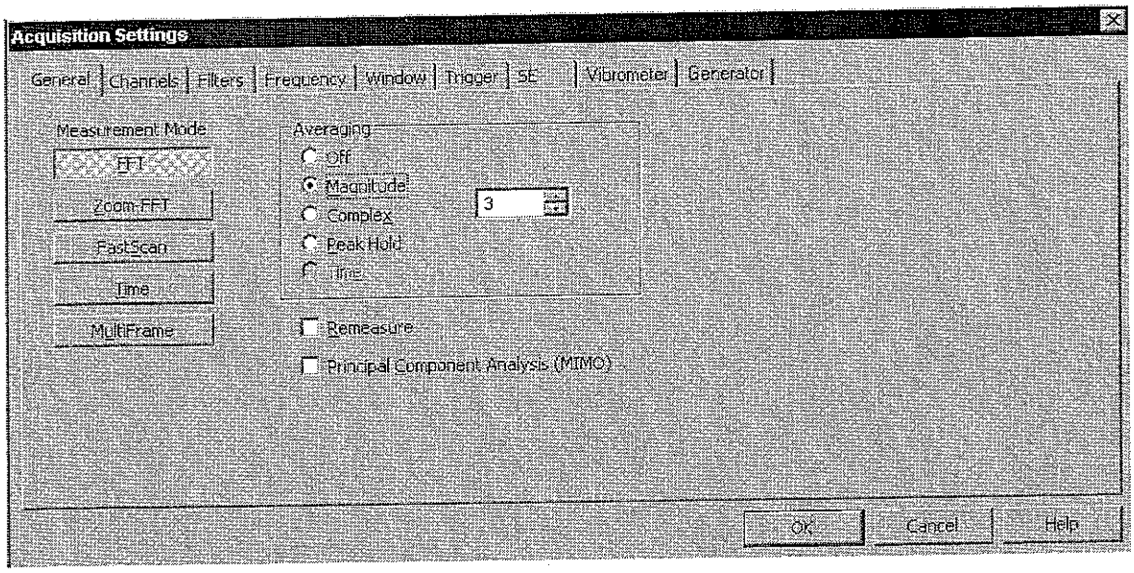


Figure 7.1: Page General

Measurement mode On the left you select the measurement mode. The measurement mode FFT is available as standard, all others are optional. The pages in the dialog can change with the measurement mode selected. If, for example, you select the measurement mode FastScan, then a page appears with parameters for FastScan. Other pages disappear.

Averaging On the right you set the averaging. In measurement mode FastScan you can not average. By averaging you can improve the signal-to-noise ratio of spectra. You will find detailed information on averaging in your theory manual.

Off: You do not average.

Amplitude: Select magnitude averaging if you

- are neither using a reference signal nor a trigger

or

- are using stochastic excitation – for example, in a wind tunnel.

Complex: Select complex averaging if you

- are using a reference signal or a trigger

and

- are using deterministic excitation.

On the right you enter the number of averages. The time needed for a measurement will increase by this factor.

Peak Hold: Select Peak Hold for averaging if you want to calculate and display the respective maximum of the spectra over the set number of averages.

☞ Peak Hold is not available in the measurement mode Time. If you select Peak Hold averaging, you can not make any further quality adjustment for Signal Enhancement (Fast ... Best, refer to section 7.2.7).

You will find more information on the measurement mode Peak Hold in your theory manual.

Time: In the measurement mode Time you can only select Time averaging. A prerequisite of this is that you trigger the measurements.

Remeasure

At the bottom you can activate automatic remeasuring. After a scan all the scan points with the status Overrange, Invalidated and Not Measured are then remeasured at a slightly different position. If Signal Enhancement is active for at least one channel (refer to section 7.2.7), then other scan points with the status Valid are also remeasured.

☞ You can also start remeasuring manually. See section 6.2 on this. After changing from acquisition to presentation mode you can also identify single scan points to be remeasured. See section 9.1 on this.

Principal Component Analysis (MIMO)

With the option PCA (Principal Component Analysis) you can run a MIMO data acquisition. To do this, mark the box Principal Component Analysis (MIMO) in the lower part of the dialog.

☞ So that you can start MIMO data acquisition, you have to have selected Magnitude or Complex as averaging. On the page Channels specify at least two reference channels and on the page Generator tick the box Multiple Channel (refer also to section 7.2.2 and section 7.2.9).

Principal Component Analysis is also available to you if you are also using the optional junction box PSV-E-408 and are measuring 8 channels (refer to section 3.2). You will find more information on MIMO data acquisition in your theory manual.

7.2.2 Channels

On the page Channels you activate the required measurement channels and set their parameters for digital data acquisition. For certain hardware configurations and measurement modes, parameters on the page are not available or are set permanently.

Work in the table

To accelerate adjustment of the settings, you can use the icons (Copy) and (Insert) above the table. To do so, tick the required cell(s), line(s) or column(s) as described in the following. Then click , mark the cell(s), line(s) or column(s) which you want to transfer the settings to and click .

Or:

Click with the right mouse button and select Copy or Insert in the pop-up menu.

- To mark a cell, click it.
- To mark a line, click the first cell of this line.
- To mark a column, click the head of this column.
- To mark several consecutive cells, lines or columns, hold the shift key pressed and mark the first and last cell/start of line/column head with the mouse.
- To mark several cells, lines or columns which are not consecutive, hold the control key pressed and mark the respective cells/starts of line/column heads with the mouse.
- If you want to mark the whole table, click the cell Channel.

In the same way you can copy settings into and out of other applications such as Microsoft® Excel.

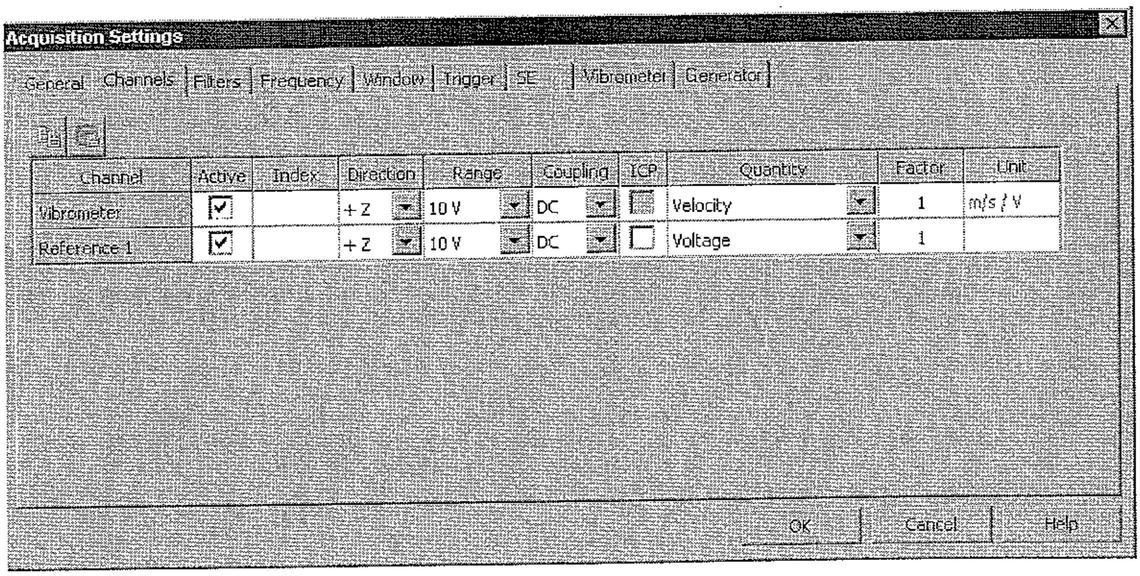


Figure 7.2: Page Channels

Active: Here you mark the channels you want to make measurements on.

Ref: This column only appears if there are more than two input channels available in the software. A channel is either an answer channel or a reference channel. The channel Vibrometer is always an answer channel.

For systems with two channels the channel Reference 1 is always a reference channel. For systems with more than two channels you can select which channel is the reference channel (apart from Vibrometer). To do so, mark it in the column Ref. If the column Ref is not marked for one channel, it is used as the answer channel, even if it is called Reference.

The channel Reference 1 is given special treatment. It serves as a phase reference for the other channels if you

- average magnitudes (refer to section 7.2.1) or
- do not use a trigger (refer to section 7.2.6).

When calculating the frequency response function, all possible combinations of type answer channel/reference channel are formed.

Example:

Vibrometer & Reference 1: answer channels
Reference 2 & Reference 3: reference channels

The following signals are available as frequency response function:

Vibrometer/Reference 2
Vibrometer/Reference 3
Reference 1/Reference 2
Reference 1/Reference 3

When using more than one reference channel, frequencies are respectively formed as a total answer signal/reference signal. This is correct with an excitation signal and several reference signals (e.g. self-excited system, vibrometer and microphone as reference).

☞ When using the measured frequency responses for Experimental Modal Analysis, please note that these can not easily be fed in to a multi-reference procedure in the modal analysis software package. To do this, it is also necessary to determine the transmission function. For these calculations the total answer signal of every individual sample point must be divided up into the individual references (Principal Component Analysis, only with option PCA). This is only possible if the reference signals are uncorrelated (refer also to section 7.2.9). If you are running a principal component analysis, you have to select at least two reference channels. You will find detailed information on this in your theory manual.

Index: Here you enter the index of the scan point at which you are measuring the reference. You can read this index under 2D Point or 3D Point in the scanning head control if you click the scan point with the mouse. Then click the pertinent line in the column Index and enter the displayed value there.

☞ The default setting in the column Index is 0. A reference point index of 0 is however ignored when calculating the reference. In principle the number of scan points is the highest possible value which you can enter in the field Index. However, the software allows you to enter higher values so that you can make several measurements with the same index and then can reunite them in an external program.

Direction: Here you can enter the direction of the vibration. The default setting is +Z. However you can also select another direction (±X/Y/Z) for all channels apart from Vibrometer 3D. With the direction of the vibrometer channel you set the orientation of the scanning head system. Refer to section 4.2.6 and your theory manual on this.

☞ In the presentation window you can also retrospectively change the direction of vibration, refer to section 9.1 on this.

☞ The values from the columns Index and Direction are used when exporting in UFF and ME'Scope. You can change the settings for export again (refer to section 10.2.3 and section 10.2.4).

Range: Here you select the input range of the data acquisition board for every channel.

Coupling: Here you select the input coupling for every channel. For vibrometer channels you have to set DC-coupling, for other sensors DC-coupling is recommended. Only PSV 200-1: For certain hardware configurations, select the input coupling via the cabling of the data acquisition board. See your PSV 200 hardware manual on this.

Impedance: This column is only shown if the Spectrum data acquisition board MI-3025 is installed. In this case you can set the input resistance of the board here (50 Ω or 1 MΩ).

ICP: If you are using one of the junction boxes VIB-Z-012, VIB-Z-016, PSV-E-400 or PSV-E-400-3D and in the list Junction Box on the page Devices you have set it accordingly, you can switch ICP® on and off for the channel REF1 and if applicable, for REF2 and REF3.

☞ If you are using such a junction box and have activated ICP®, then you should select AC coupling. Pay attention to the cutoff frequency when doing so (refer to hardware manual).

Quantity: Here you select the physical quantity which you want to measure on the respective channel.

☞ Using a digital filter, the software can integrate or differentiate the time signal of some measured quantities. See section 7.2.3 on this. If the quantity Displacement, Velocity or Acceleration is selected, then the spectra of both the others are calculated by integration or differentiation. This also applies to the quantities Angle, Angular Velocity and Angular Acceleration.

Factor: Here you enter the calibration factor for every channel, i.e. the measurement value which corresponds to an analog input signal of one volt. If a vibrometer is connected up (refer to section 3.2), the software will enter the calibration factor for this channel corresponding to the measurement range set on the page Vibrometer (refer to section 7.2.8).

Unit: Here, the software enters the SI unit of the set quantity.

Differential Input: If you are using one of the junction boxes VIB-Z-012, VIB-Z-016, PSV-E-400 or PSV-E-400-3D, then here you can activate the differential input for all selected channels. You can thus avoid ground loops and generally improve reliability. All activated channels are switched to ungrounded by the differential input so that distortions through harmonics of the mains frequency (humming) can no longer appear in the spectrum.

7.2.3 Filters

On the page Filters you set digital filters for the input signals

- to limit the bandwidth

and

- for differentiation or integration.

The page Filters is divided into two parts. In the first part you select the filter type to limit the bandwidth – high pass, low pass etc. – and select the integration or differentiation filter. In the second part you set the filter parameters to limit the bandwidth, i.e. cutoff frequency and quality. You can also see the frequency response there.

Work in the table

To accelerate adjustment of the settings, you can use the icons (Copy) and (Insert) above the table. Tick the required cell(s), line(s) or column(s) as described in the following. Then click , mark the cell(s), line(s) or column(s) which you want to transfer the settings to and click .

Or:

Click with the right mouse button and select Copy or Insert in the pop-up menu.

- To mark a cell, click it.
- To mark a line, click the first cell of this line.
- To mark a column, click the head of the column.
- To mark several consecutive cells, lines or columns, hold the shift key pressed and mark the first and last cell/start of line/column head with the mouse.
- To mark several cells, lines or columns which are not consecutive, hold the control key pressed and mark the respective cells/starts of line/column heads with the mouse.
- If you want to mark the whole table, click the cell Channel.

In the same way you can copy settings to and from Microsoft® Excel.

Select

In the first part of the page Filters you select the filter types you want for each channel.

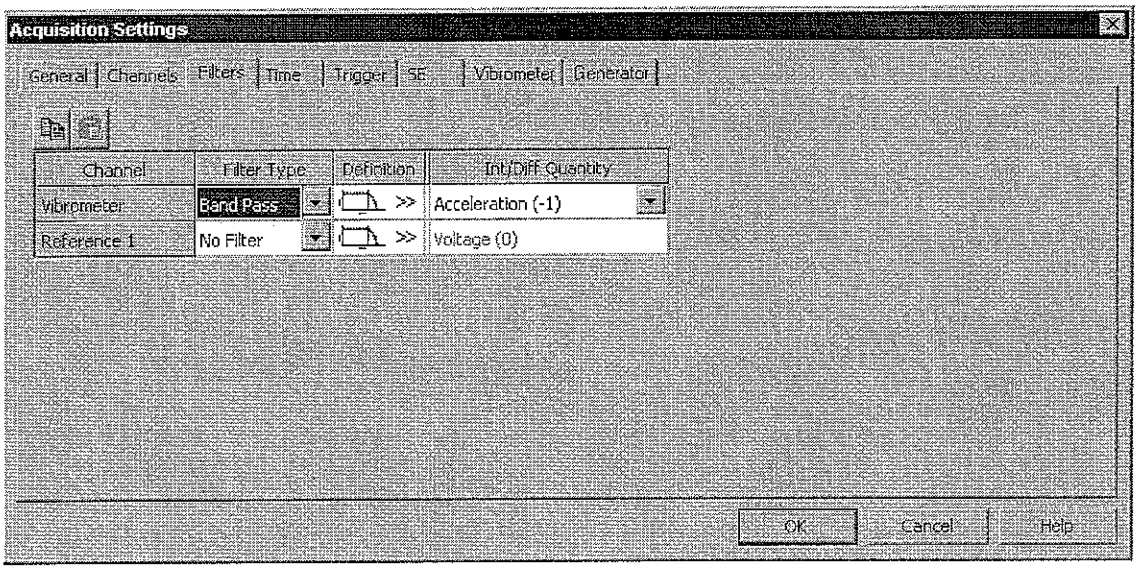


Figure 7.3: Page Filters

Filter Type: Here you select the type of filter to limit the bandwidth.

Definition: You click here to set the filter parameters to limit the bandwidth. The second part of the page Filters appears (see below).

Int/Diff Quantity: Using digital filters, the software can integrate or differentiate the time signal of some measured quantities. Here you select the physical quantity the software is to calculate. The number on the right next to the quantity tells you which arithmetic operation is being carried out, refer to table 7.1.

Table 7.1: Filters for integration/differentiation

Number	Arithmetic operation
1	Integrate once
0	No filter
-1	Differentiate once
-2	Differentiate twice

Set the parameters

In the second part of the page Filters you set the filter parameters to limit the bandwidth. There you can define the filters for several channels one after the other.

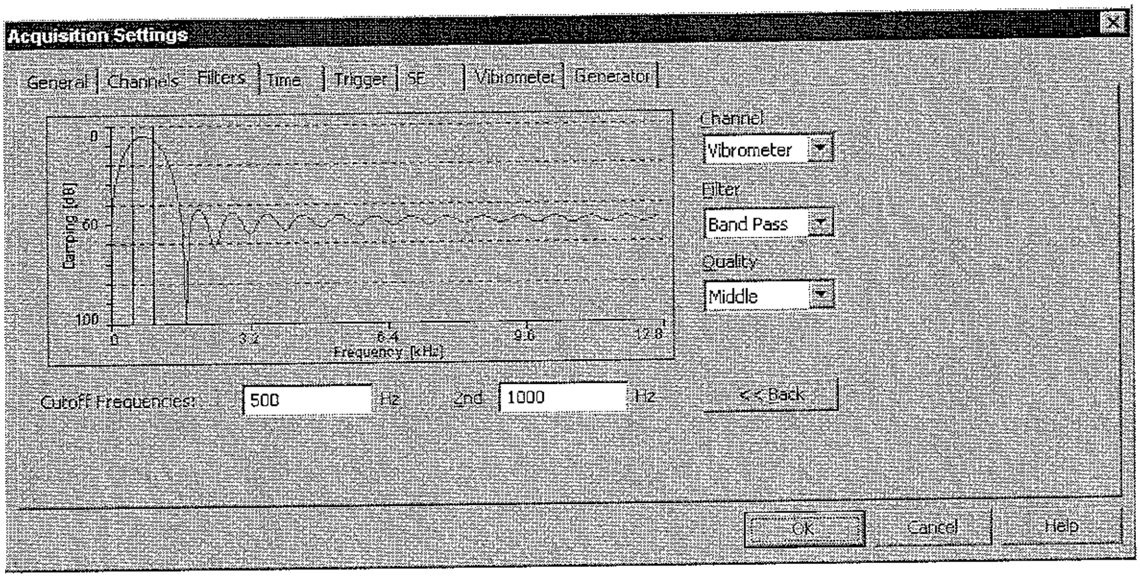


Figure 7.4: Page Filters, part 2 to set the parameters

Channel: Here you select the channel you want to set the filter for.

Filter: Select the type of filter here.

Quality: Here you select the quality of the filter.

Cutoff Frequencies: Enter the cutoff frequency(/ies) of the filter here in Hertz.

The software uses the parameters set to calculate the frequency response and displays it.

To apply all settings, at the bottom right, click Back. The software returns to the first part of the page Filters (see above).

7.2.4 Frequency

You set the parameters for calculating the frequency spectra on the pages Frequency and Window. In the measurement mode Zoom-FFT, the page Frequency is adapted to the Zoom-FFT. See section 7.2.10 on this. In measurement mode MultiFrame, additional parameters appear on the page for the MultiFrame measurement. See section 7.2.14 on this.

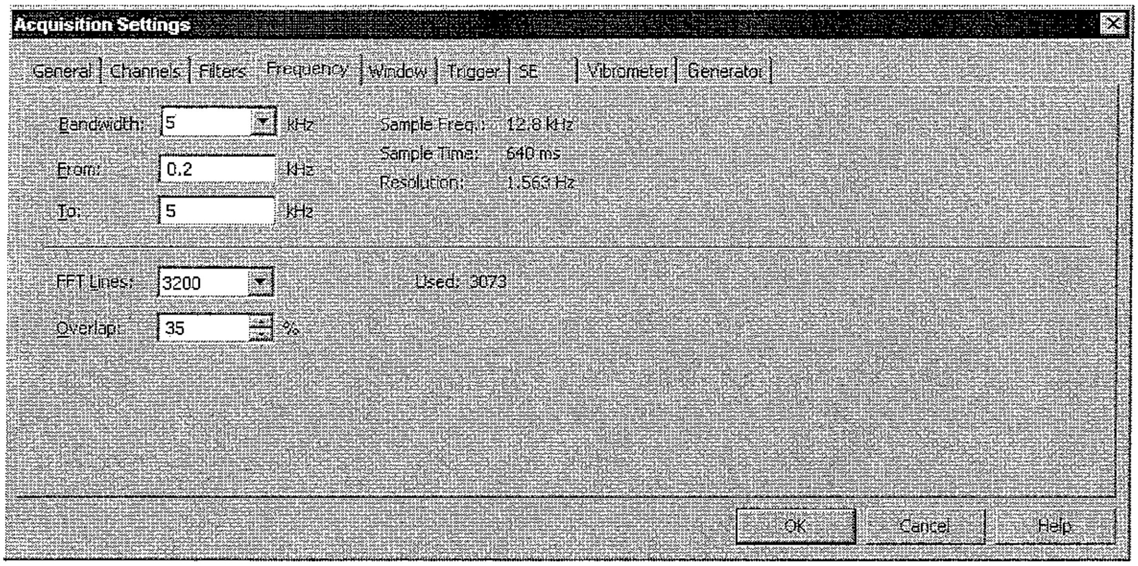


Figure 7.5: Page Frequency in the measurement mode FFT

Frequency range

At the top left you set the frequency range to be measured.

Bandwidth: Here you select the bandwidth in kilohertz.

From and **To:** Here you can limit the frequency range which is displayed and evaluated. If you control a function generator using the software, then with Periodic Chirp and Pseudo Random, excitation only takes place in this frequency range.

FFT

At the bottom you set the parameters for the Fast Fourier Transformation (FFT).

FFT Lines: Here you select the number of FFT lines that you want to analyze.

Used: The number of FFT lines shown here corresponds to the frequency range between From and To (see above).

Overlap: This parameter only appears for certain hardware configurations in the measurement modes FFT and Zoom-FFT. The software only takes the parameter into account for measurements with averaging and without trigger. With overlap you can significantly reduce the time for a measurement, in particular for narrow bandwidths. As a rule of thumb, for a two-channel measurement, the following applies:

- up to 2.5 kHz bandwidth: 75% overlap
- from 2.5 to 5 kHz: 50%
- over 5 kHz: 0%.

You will find more information on overlap in your theory manual.

Sample frequency and resolution

The software calculates the following parameters and shows them at the top right.

Sample Frequency: $f_{Sample} = 2.56 \cdot BW$ Equation 7.1

BW... Bandwidth

Sample Time: $t_{Sample} = \frac{n_{FFT}}{BW}$ Equation 7.2

n_{FFT}... Number of FFT lines
BW... Bandwidth

Resolution: $\Delta f = \frac{1}{t_{Sample}}$ Equation 7.3

t_{Sample}... Sample time

Max. Velocity: This parameter only appears with the option VDD. Due to the processing power of the PC, when using the option VDD only signals up to this maximum vibrational velocity can be acquired. The value depends on the bandwidth and the number of FFT lines (see above).

7.2.5 Window

You set the parameters for calculating the frequency spectra on the pages Frequency and Window. You set windowing of the input signals on the page Window. With suitable windowing you can prevent leakage. You will find information on this in your theory manual.

Work in the table

To accelerate adjustment of the settings, you can use the icons (Copy) and (Insert) above the table. Tick the required cell(s), line(s) or column(s) as described in the following. Then click, mark the cell(s), line(s) or column(s) which you want to transfer the settings to and click.

Or:

Click the analyzer with the right mouse button and select Copy or Insert in the pop-up menu.

- To mark a cell, click it.
- To mark a line, click the first cell of this line.
- To mark a column, click the head of the column.
- To mark several consecutive cells, lines or columns, hold the shift key pressed and mark the first and last cell/start of line/column head with the mouse.
- To mark several cells, lines or columns which are not consecutive, hold the control key pressed and mark the respective cells/starts of line/column heads with the mouse.
- If you want to mark the whole table, click the cell Channel.

In the same way you can copy settings to and from Microsoft® Excel.

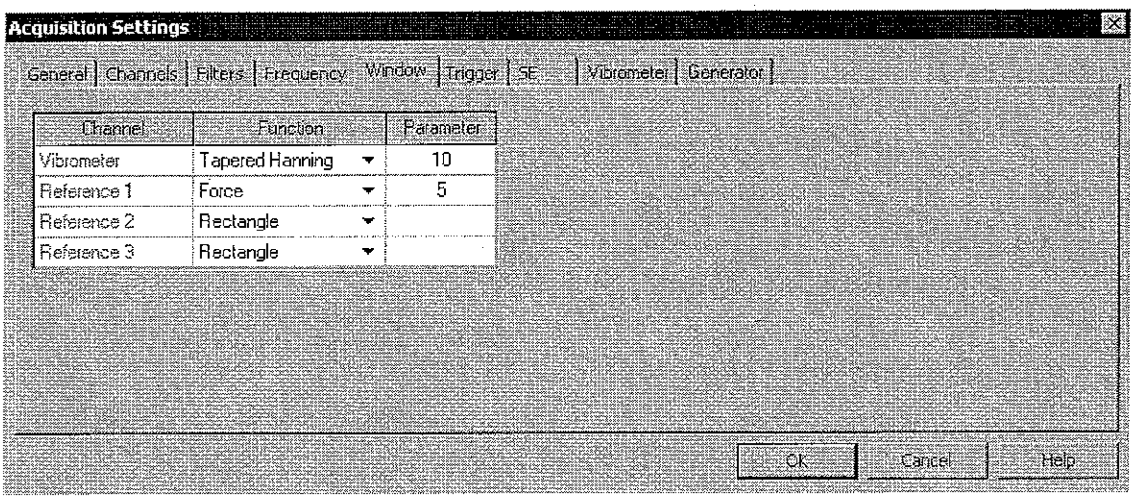


Figure 7.6: Page Windows

Function: Here you select a window function which is suitable for your application. See your theory manual on this.

Parameter: The window functions Tapered Hanning, Force and Exponential can be fine-tuned with a parameter. In table 7.2, the parameters are described.

Table 7.2: Parameters for window functions

Window function	Description of the parameter	Default
Tapered Hanning	Rise and decay time in percent of the sample time	10
Force	Length of the window in percent of the sample time	5
Exponential	Quotient from window length and decay constant	4

7.2.6 Trigger

You set the parameters for triggering on the page Trigger. You will find information on the influence of the trigger in your theory manual.

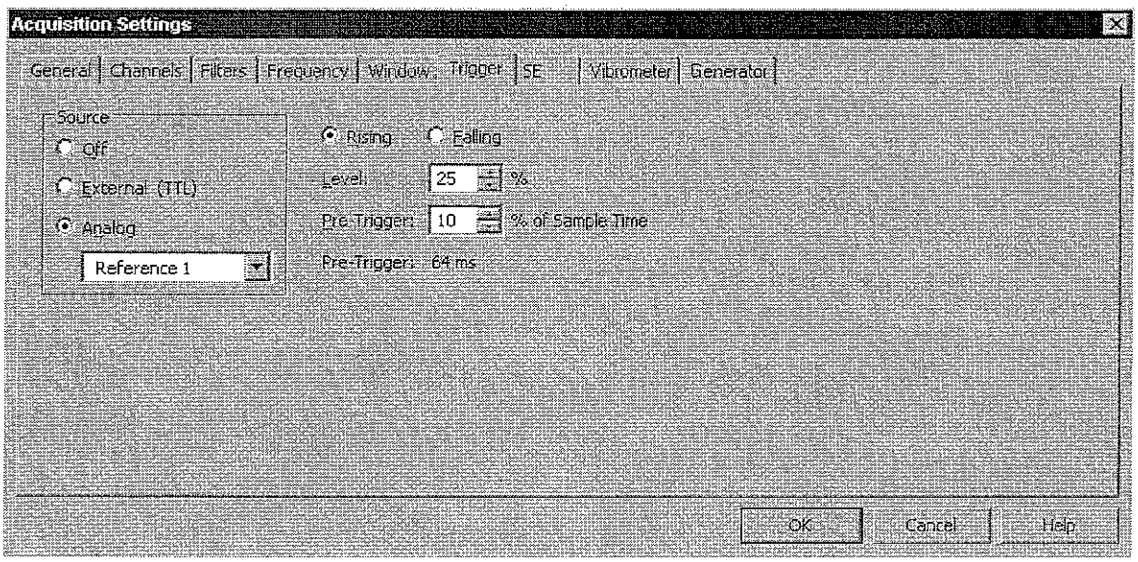


Figure 7.7: Page Trigger

Source On the left you select the trigger source.

Off: You measure without a trigger.

☞ To measure phases you need a trigger or a reference signal.

External (TTL): You trigger using an external trigger signal.

Caution!
Only connect voltages in the range of 0 to 5V to the input for the external trigger! Otherwise you could damage the data acquisition board.

Analog: You trigger using one of the analog input signals. Select the channel the trigger signal is connected to below.

☞ When scanning, do not trigger on the vibrometer signal.

Conditions

On the right you set the trigger conditions.

Rising or **Falling:** Here you select which edge is used to trigger.

Level: If you trigger using one of the analog input signals, you set the trigger threshold here. 100% threshold corresponds to the input range of the channel (refer to section 7.2.2).

Pre-trigger: Here you set the trigger time. If the data acquisition is to start **before** the trigger time, enter a positive value. If data acquisition is to start **after** the trigger time (Post-trigger), enter a negative value. Only PSV 400-M2, PSV 400-M4 and PSV 300-F: You can not set a pre-trigger for an external trigger signal. Only MSV 300-M: with bandwidths ≤ 2 MHz you can not set a pre-trigger for an external trigger signal.

Gate signal (as an option)

As an option, you can control data acquisition with an external gate signal. You will find information on this in your hardware manual. You do not have to set special parameters for this.

7.2.7 Signal Enhancement (SE)

On the page SE you set the parameters for Signal Enhancement (SE) and Speckle Tracking. When scanning, with Signal Enhancement and Speckle Tracking, you get an approximately even noise level for all scan points. You will find information on measuring with Signal Enhancement in section 6.7.1 and in your theory manual.

☞ If you want to mark the whole table, click the cell Channel.

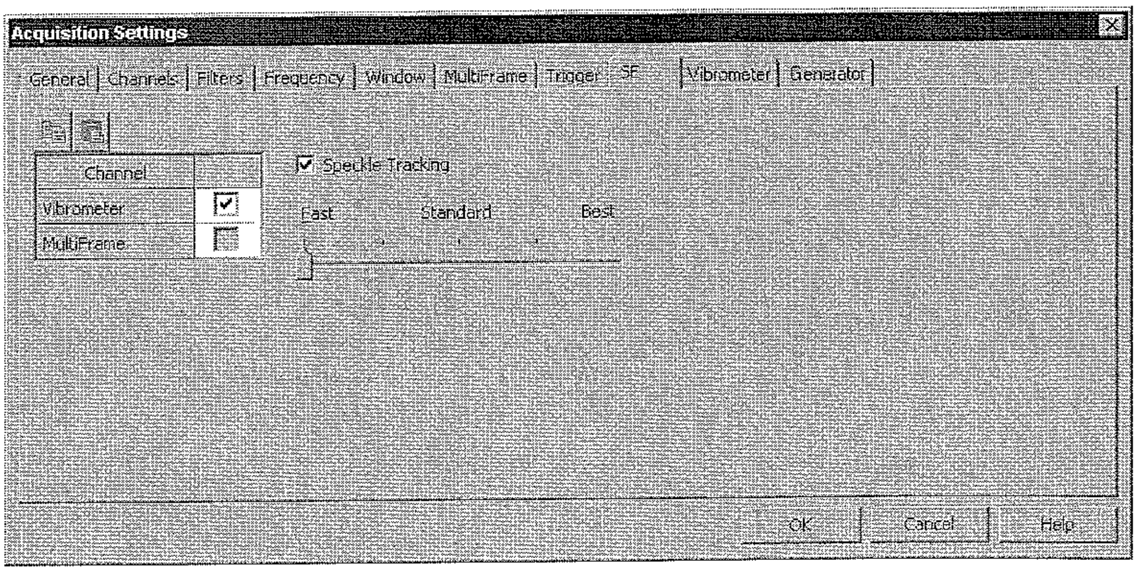


Figure 7.8: Page SE

The measurement mode Time is an exception. The dialog page SE only appears if on the page General you have set Time for Averaging.

Activate

On the left you can activate Signal Enhancement.

Measurement mode Time: With active SE, a median algorithm is used for averaging. This makes higher demands on your PC with regards to memory and calculation speed.

Channel: Here you mark the channels which Signal Enhancement is to be active for.

☞ Activate Signal Enhancement for all channels which may have dropouts. This is generally the case for the vibrometer channel. For reference channels, the following applies: If a vibrometer is connected, measure on treated surfaces if possible and switch Signal Enhancement off. To treat surfaces, stick reflective film on them or apply metallic paint. If you are measuring with the vibrometer, but not on treated surfaces, activate Signal Enhancement.

Speckle Tracking: If Signal Enhancement is active for the vibrometer channel, then you can activate Speckle Tracking for this channel on the right. Without Speckle Tracking, every scan point is measured at the same position when averaging. So it is possible that you will always measure a dark speckle. With Speckle Tracking, the position of every scan point is slightly changed on averaging - at a 1 meter stand-off distance by about 50 μm. You are then also quite likely to measure some bright speckles.

Averaging

At the right you set how often additional averaging is carried out with Signal Enhancement.

Fast: Averaging is only carried out as often as set on the page General (refer to section 7.2.1).

Standard: Depending on the optical signal level, averaging is carried out up to three times as often as set.

Best: Averaging is carried out up to five times as often as set.

In the measurement mode Time, the number of times averaging is carried out always correspond to the figure given on the page General.

7.2.8 Vibrometer

You set the parameters of the controller for data acquisition on the page Vibrometer. You will find information on suitable settings in your hardware manual. If you are controlling a second vibrometer, then you set the parameters for both controllers on the page Vibrometer. You will find information on controlling a second vibrometer in section 6.7.6.

The parameters displayed on the page Vibrometer depend on which controllers are connected (refer to section 3.2). The parameters for the controllers OFV-5000 and also OFV-3001 and OFV-3001S are described below. If you would like any information on other controllers, refer to your vibrometer manual. There you will also find information on suitable settings.

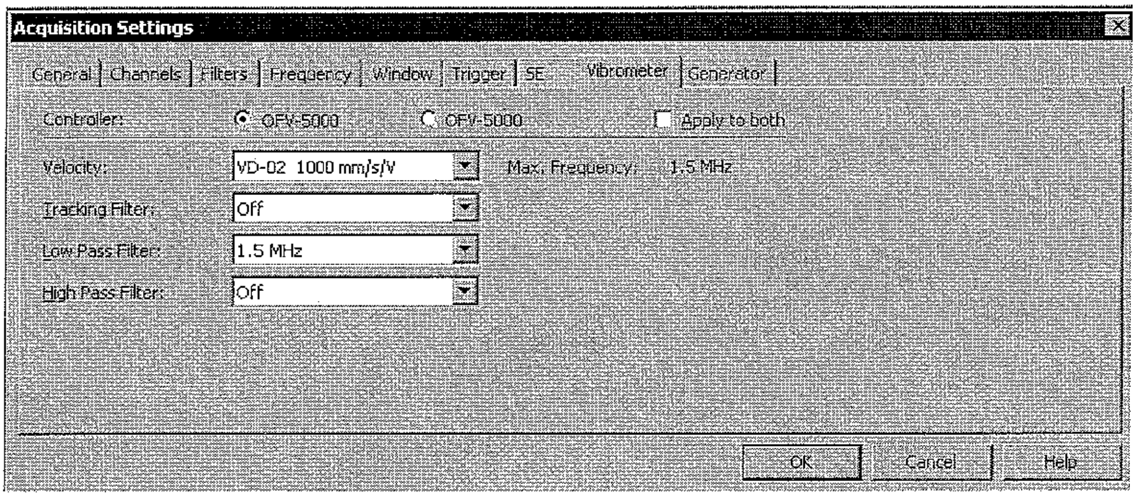


Figure 7.9: Page Vibrometer for the controller OFV-5000S

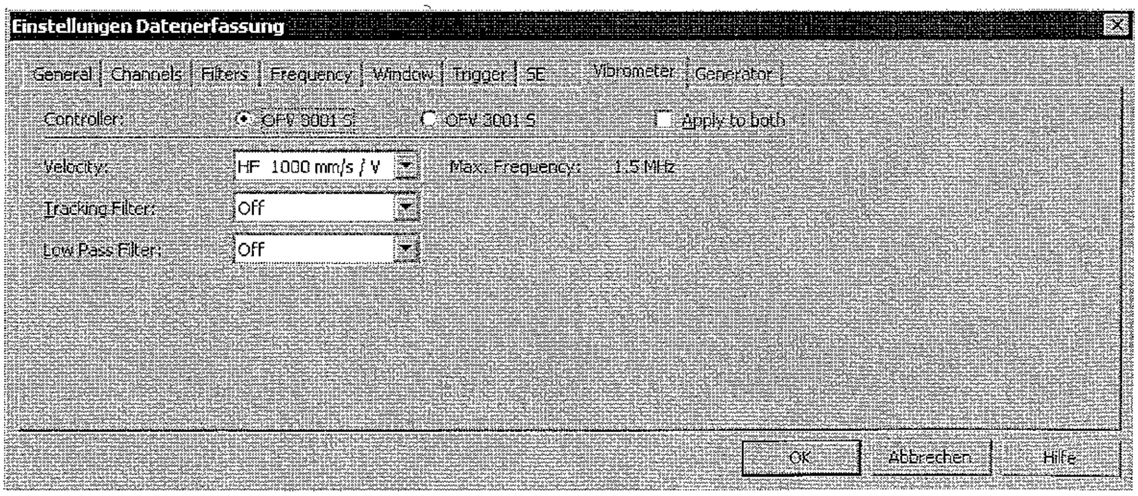


Figure 7.10: Page Vibrometer for the controller OFV-3001S

Controller: Here you can select the controller which the settings are to apply to. If there are two controllers installed, you can switch between the two of them and define the settings for each of them individually.

☞ Only OFV-5000 as of firmware version 2.0:
The software queries the time delay of the measurement range set on the vibrometer controller. The time delay is used to correct the phase of the spectra. The high and low pass filter should be left switched off as their delay times are not being corrected.
The correction can only be made approximately. The remaining phase error in the acoustic area is up to 3° and increases for frequencies above 20kHz with increasing frequency up to 35°.
In the time domain this correction is not active!

Apply to both: If both controllers are identical, i.e. the same type and equipped with identical decoders, then the settings for one can be transferred directly to the other. To do so, mark the box.

Velocity: Here you select the measurement range for the velocity. For the controller OFV-5000, the decoder descriptions are shown in plain text. OFV-3001 and OFV-3001S: If a measurement range is available in several velocity decoders, then to the left of the measurement range you can see an abbreviation for the active velocity decoder. The abbreviations are explained in table 7.3.

Table 7.3: Abbreviations for velocity decoders

Abbreviation	Velocity decoder
HF	OVD-02 OVD-04
LF	OVD-06
DC	PLL-DC
PLL	OVD-01

Displacement: This line only appears if the controller is equipped with an optional displacement decoder. Here you select the measurement range for the displacement.

☞ Even if you are only measuring and evaluating the displacement signal, the measurement range for the velocity must not be exceeded (see above).

Tracking Filter: Here you set the tracking filter.

Low Pass Filter: Here you set the low pass filter. Only PSV 300-H and PSV 200-1: If you select the setting User Defined, then the field Cutoff Frequency appears at the bottom. There you can enter multiples of 0.4 kHz, up to a maximum of 102.4 kHz.

High Pass Filter: Here you set the high pass filter.

☞ If you are using the vibrometer to scan, switch the high pass filter off.

Max. Frequency: Here the respective maximum frequency is shown for the selected measurement range.

7.2.9 Generator (as an Option)

As an option, you can control certain function generators using the software. You will find information on this in section 6.7.2 and section 6.7.3. You set the parameters for signal output on the page Generator.

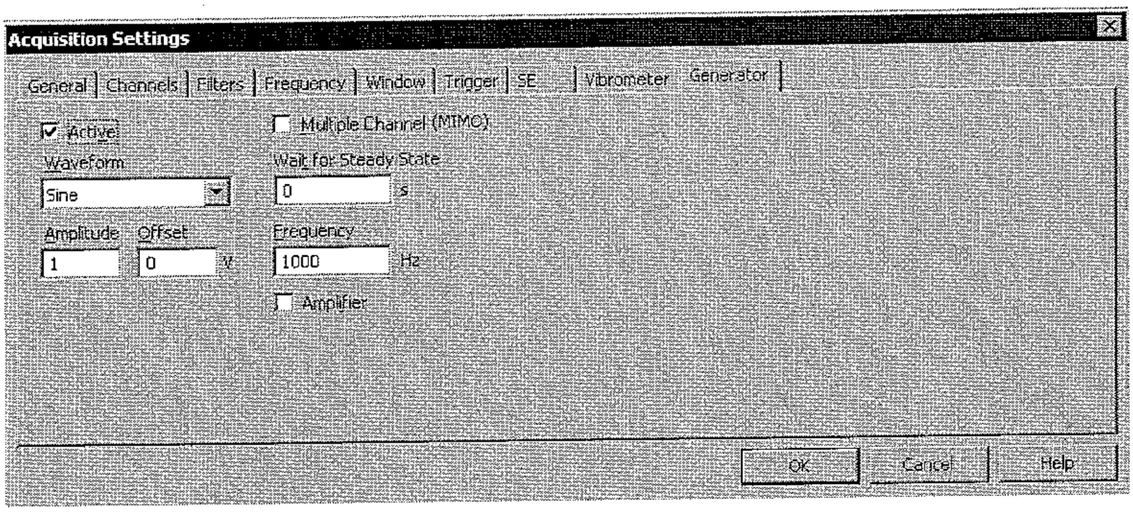


Figure 7.11: Page Generator

General parameters

Active: If sometimes you are not working with the function generator, you can switch it off here for the software. Otherwise signal output starts automatically when scanning. Apart from that, you will suppress corresponding warnings and error messages.

Multiple Channel: Only PSV 400-H4 and PSV300-H: Activate three generator channels here. For signals with randomly generated numbers (Pseudo Random, White Noise, Burst Random), different signals are generated using various random number sequences, otherwise identical signals on all three channels. You will find more information on this in section 7.2.2.

☞ If you want to carry out a principal component analysis, you have to mark the box Multichannel (MIMO) (only with option PCA, refer also to section 7.2.1) and select White Noise or Burst Random. Uncorrelated signals are only emitted with these waveforms.

Waveform: Here you select the waveform you want to emit. Some parameters on the page Generator change with the waveform selected. You will find an explanation of these parameters and information on some of the waveforms in the following. In the measurement mode FastScan, a sinusoidal signal with the frequency of the FastScan is always used for excitation.

Wait for Steady State: Here you enter the time in seconds which the excited object needs to attain steady-state condition. The software delays data acquisition by this time after you have

- started signal output or
- closed the dialog Acquisition Settings with OK.

Amplitude and **Offset:** Here you enter the peak amplitude and DC offset of the signal in volts for high-impedance termination of the function generator. The following conditions must be fulfilled:

$$\text{Amplitude} + |\text{Offset}| \leq 10\,\text{V} \qquad \text{Equation 7.4}$$

Only 33120A and 33250A:

$$|\text{Offset}| \leq \text{Amplitude} \qquad \text{Equation 7.5}$$

If one of the conditions is not fulfilled, the software changes the offset.

☞ Many function generators such as the HP or the internal function generator have an output impedance of 50 Ω. If you terminate such a function generator with 50 Ω, then the output voltages are only half the size set.
This is of particular importance for spectrum generators which have an output impedance of < 1 Ω. The data acquisition board of Spectrum is preset to be terminated with 50 Ω (default setting). To change the setting to 1 MΩ, open the page Channels in the dialog Acquisition Settings (refer to section 7.1).
Only for external function generators: The display of the generator shows peak-to-peak amplitude and offset for the termination with 50 Ω. With high-impedance termination the display shows twice the voltage applied at the output.

Amplifier: This box only appears for PSV/MSV/MSA/MMA-M2-20 systems with the generator board MI.6030 by Spectrum. Mark the box to increase the voltage of the generator output from ±3V to ±10V.

Sine, Rectangle, Triangle, Ramp, User Defined

Frequency: For the waveforms Sine, Rectangle, Triangle, Ramp and User Defined, you enter the repeat frequency of the signal in hertz here.

Sweep

Start Frequency, End Frequency and **Sweep Time:** For a Sweep, you enter the start and end frequency in hertz here. The start frequency can be higher than the end frequency. You also enter the duration of the sweep in seconds.

Periodic Chirp, Pseudo Random

For the waveforms Periodic Chirp and Pseudo Random, sinusoidal signals are emitted to all FFT lines at the same time, but only in the frequency range between From and To on the page Frequency (refer to section 7.2.4).
Only 33250A: The waveforms are not available in the measurement mode Zoom-FFT.
Only 33120A: The waveforms are not available in the measurement mode Zoom-FFT or if 12800 FFT lines are set.

With Periodic Chirp, the phases of the sinusoidal signals are adapted so that the energy of the resulting signal is maximized. With Pseudo Random, the phase of the sinusoidal signals is random.

Amplitude Correction File: As standard, with Periodic Chirp and Pseudo Random all sinusoidal signals have the same amplitude. If you need other amplitudes or frequencies, you can generate a correction file and list it here. To do this, tick the box and then click Browse. The dialog Open appears, in which you can navigate to correction files. You will find a short description of the format required in the file AmplitudeCorrectionSample.txt in the software's installation directory. You can also use this file as a template for your own correction files.

Burst Chirp, Burst Random

The waveforms Burst Chirp and Burst Random are only available for certain hardware configurations. The number of samples for Burst Random is limited to 524288 (1/2 Megasample).

Burst Start and **Burst End:** Here you enter when the burst is to start and when it is to end (input in percent of the sample time).

User Defined

If you need other waveforms, you can generate them yourself. You will find a short description of the format required in the file UserDefSample.txt in the software's installation directory. You can also use this file as a template for waveforms you want to generate. To load a waveform you have generated, select the waveform User Defined and then click Browse. The dialog Open appears, in which you can navigate to files you have generated.

7.2.10 Frequency in the Measurement Mode Zoom-FFT (as an Option)

In the measurement mode Zoom-FFT you can also make high-resolution FFT measurements. To do this, you need the option Zoom-FFT. The page Frequency is then adapted to the Zoom-FFT.

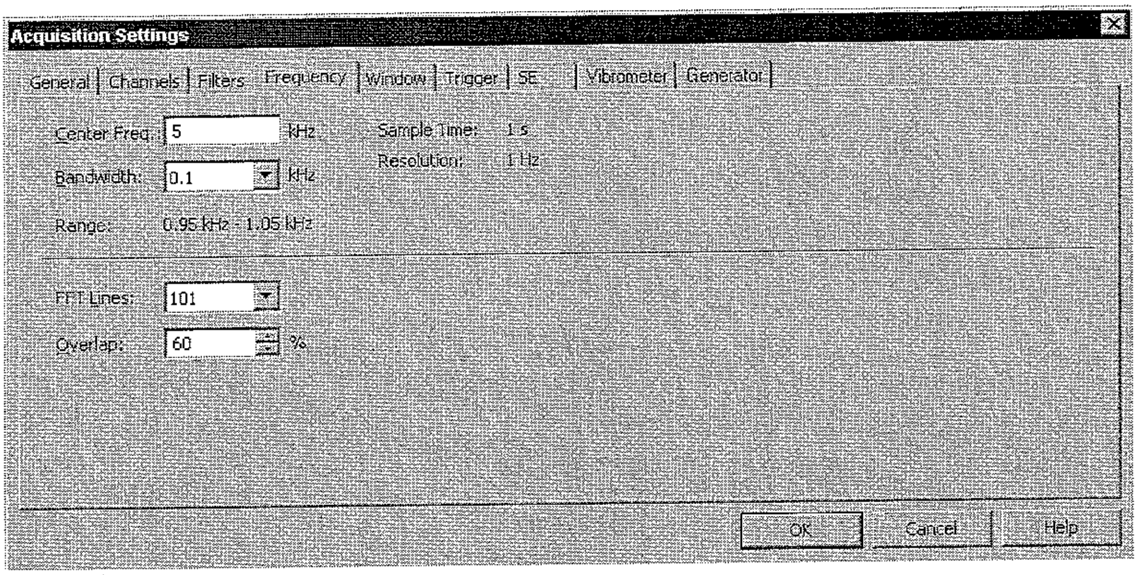


Figure 7.12: Page Frequency in the measurement mode Zoom-FFT

Frequency range

At the top left you set the frequency range to be measured.

Center Freq. Here you enter the center frequency in kilohertz.

Bandwidth: Here you select the bandwidth in kilohertz.

☞ For PSV/MSV/MSA/MMA 400-M2-20 and MSV 300-M bandwidths are only available up to 2MHz.

Range: The software calculates the frequency range to be measured and shows it here.

FFT

At the bottom you set the parameters for the Fast Fourier Transformation (FFT).

FFT Lines: Here you select the number of FFT lines that you want to analyze. The number is odd because the frequency range measured is symmetrical about the center frequency.

Overlap: This parameter only appears for certain hardware configurations. You will find information on this in section 7.2.4 and in your theory manual.

Resolution

The software calculates the following parameters and shows them at the top right.

Sample Time:

$$t_{Sample} = \frac{n_{FFT} - 1}{BW} \qquad \text{Equation 7.6}$$

n_{FFT}... Number of FFT lines
BW... Bandwidth

Resolution: $$\Delta f = \frac{1}{t_{Sample}}$$ Equation 7.7

t_{Sample} ... Sample time

☞ The highest attainable resolution depends on the frequency range measured (see above).

Max. Velocity: This parameter only appears with the option VDD. Due to the processing power of the PC, when using the option VDD only signals up to this maximum vibrational velocity can be acquired. The value depends on the bandwidth and the number of FFT lines (see above).

7.2.11 FastScan (as an Option)

In the measurement mode FastScan you can scan individual frequencies quickly. You will find information on this in section 6.7.4. You set the parameters for this on the page FastScan.

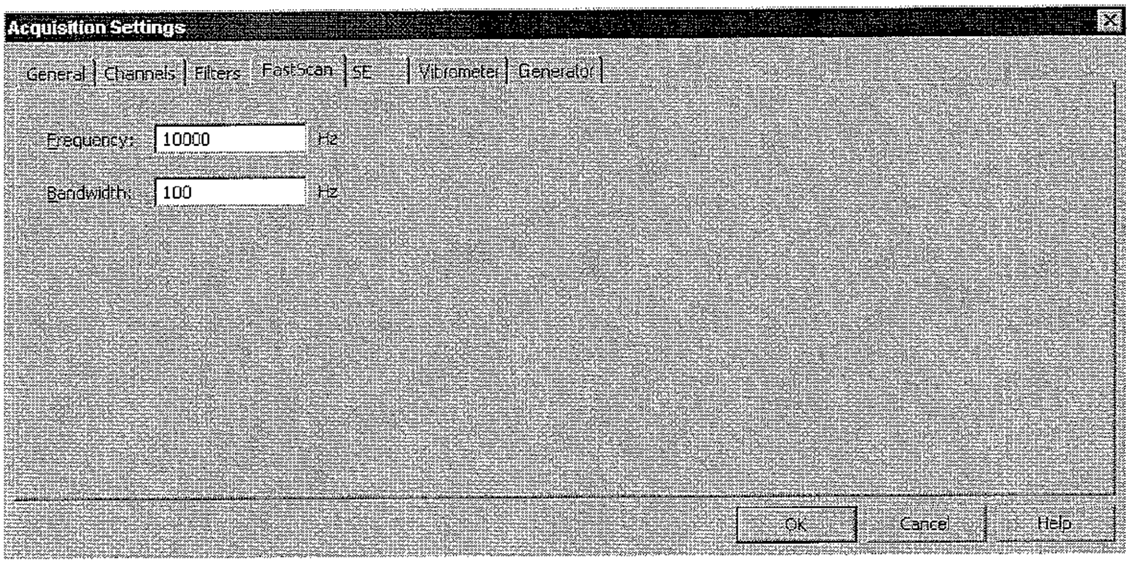


Figure 7.13: Page FastScan

Frequency: Here you enter the frequency in hertz at which you want to fast scan.

☞ If you control a function generator using the software, then in the measurement mode FastScan, a sinusoidal signal at the FastScan frequency is always used for excitation.

Bandwidth: Here you enter the bandwidth in hertz. As a general rule it can be said: The smaller the bandwidth, the better the signal-to-noise ratio, but the slower the scan.

Max. Velocity: This parameter only appears with the option VDD. Due to the processing power of the PC, when using the option VDD only signals up to this maximum vibrational velocity can be acquired. The value depends on the bandwidth and the number of FFT lines (see above).

7.2.12 Time (as an Option)

In the measurement mode Time you can save time signals instead of spectra for scans. To do this, you need the option Time Domain Data. You can select up to 64 Megasamples (67108864 samples). However, please note that the amount of memory required increases with the number of samples. The minimum amount of memory a measurement requires can be approximated using the following formula:

$$\text{File size in bytes} > \text{Active channels} \cdot \text{Number of samples} \cdot 4$$

Depending on the number of samples and the hardware configuration, there are limitations on the generator signals Burst Chirp, Burst Random and White Noise. In this case the software will give you corresponding messages. Either reduce the number of samples or select a different excitation signal (see also section 7.2.9 on this).

For PSV/MSV/MSA/MMA 400 M2-20, the maximum number of samples from a sample frequency of 10.24MHz upwards is limited by the memory on the data acquisition board. The higher the sample frequency you select, the more samples are possible.

If you are working in Windows® 2000, the software will try to use the main memory during data acquisition to buffer the acquired data.

☞ Windows® NT does not support this intermediate storage. If you are working in Windows® NT, you should not use data acquisition with a high number of samples.

While the contents of the buffer are being transferred to the hard disk, so-called buffer overruns can occur which lead to the data acquisition being aborted. All data which had been acquired before this point in time however will be saved. So make sure that your PC has got a large enough main memory (RAM). In an ideal case this is 64MB more than the file size calculated above. If the size of the RAM used should not be sufficient, the software will issue you with a warning. If possible, close all other applications during data acquisition.

Data acquisition in the measurement mode Time generates extremely large files with numerous samples. Once the file size has reached 2GB, the software will give you a warning. Files which are larger than 2GB can only be processed by operating systems from Windows® 2000 onwards.

☞ With Windows® 98 or NT you can not process or open files of this size!

You set the parameters for the measurement mode Time on the page Time.

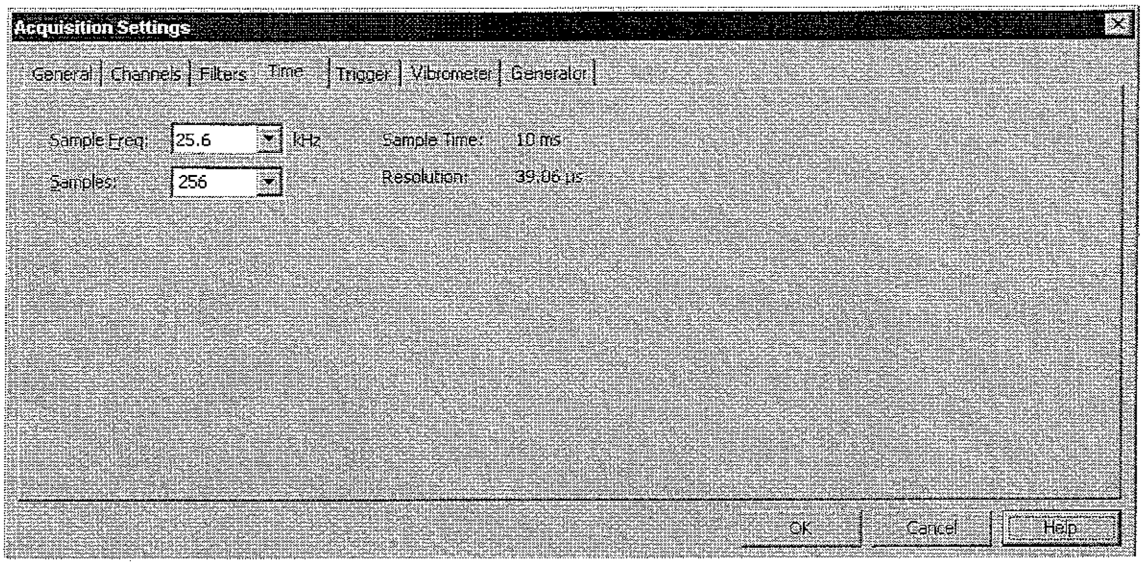


Figure 7.14: Page Time

Sample Freq. Here you select the sample frequency in kilohertz.

Samples: Here you select the number of samples. You can select in the list or enter any number.

The software calculates the following parameters and shows them on the right.

Sample Time:

$$t_{Sample} = \frac{n_{Sample}}{f_{Sample}} \qquad \text{Equation 7.8}$$

n_{Sample} ... Number of samples
f_{Sample} ... Sample frequency

Resolution:

$$\Delta t = \frac{1}{f_{Sample}} \qquad \text{Equation 7.9}$$

f_{Sample} ... Sample frequency

Max. Velocity: This parameter only appears with the option VDD. Due to the processing power of the PC, when using the option VDD only signals up to this maximum vibrational velocity can be acquired. The value depends on the sample frequency and the number of samples (see above).

7.2.13 MultiFrame (as an Option)

In the measurement mode MultiFrame you can divide measurements on combustion engines into frames and analyze the frames individually. You will find information on this in section 6.7.5. You set the parameters for this on the pages MultiFrame and Frequency.

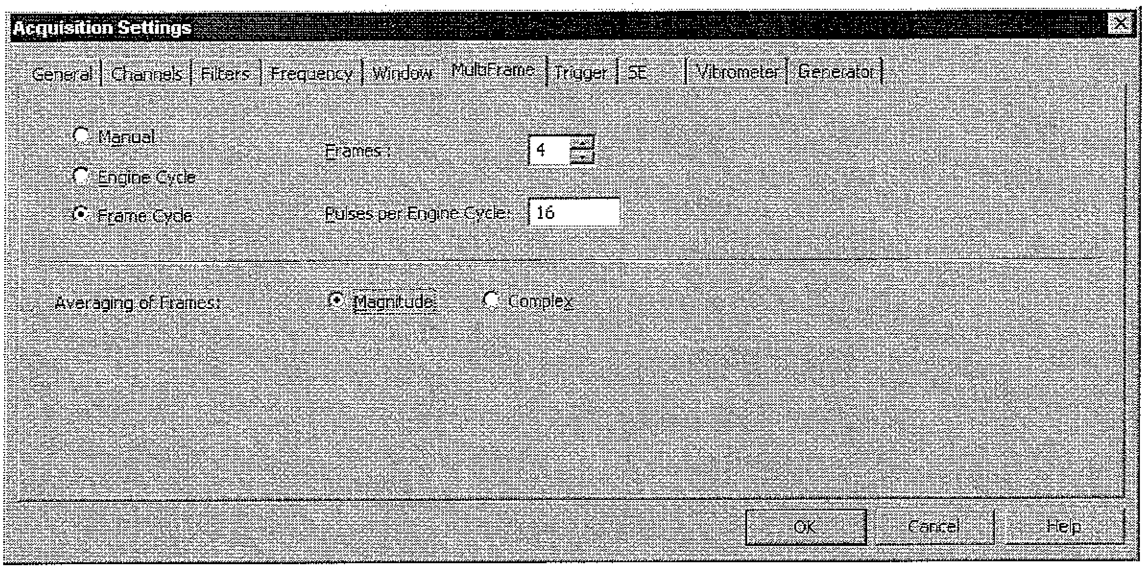


Figure 7.15: Page MultiFrame

Frame boundaries

At the top left you set how you determine the frame boundaries.

Manual: If you want to set the frame boundaries manually in the analyzer, select Manual. The start of the engine cycle is determined by a trigger signal at TRIG IN.

Engine Cycle: If the frame boundaries are to be set automatically by the engine cycle, select Engine Cycle. Start and end of the engine cycle are determined by a trigger signal (TTL, rising edge) at MultiFrame. All frames are the same length.

Frame Cycle: If the frame boundaries are to be set automatically by the frame cycle, select Frame Cycle. The start of the engine cycle is determined by a trigger signal (TTL, rising edge) at TRIG IN. A second trigger signal (TTL, rising edge) at MultiFrame ends the frame.

Number of frames

At the top right set the number of frames and the pulses per cycle.

Frames: Here you enter how many frames an engine cycle has.

Pulses per Engine Cycle: Here you enter how many trigger pulses are emitted per engine cycle. If Frame Cycle (see above), the number of pulses per cycle must be an integer multiple of the number of frames.

Averaging frames

You can analyze the spectra of the individual frames and the average of all frames. At the bottom you set how the software averages.

Magnitude or **Complex:** Here you select how the software averages over the frames. Averaging over the frames is independent of the averaging on the page General (refer to section 7.2.1).

7.2.14 Frequency in the Measurement Mode MultiFrame (as an Option)

In the measurement mode MultiFrame you can divide measurements on combustion engines into frames and analyze the frames individually. You will find information on this in section 6.7.5 and section 7.2.13. On the page Frequency additional parameters then appear for MultiFrame measurements.

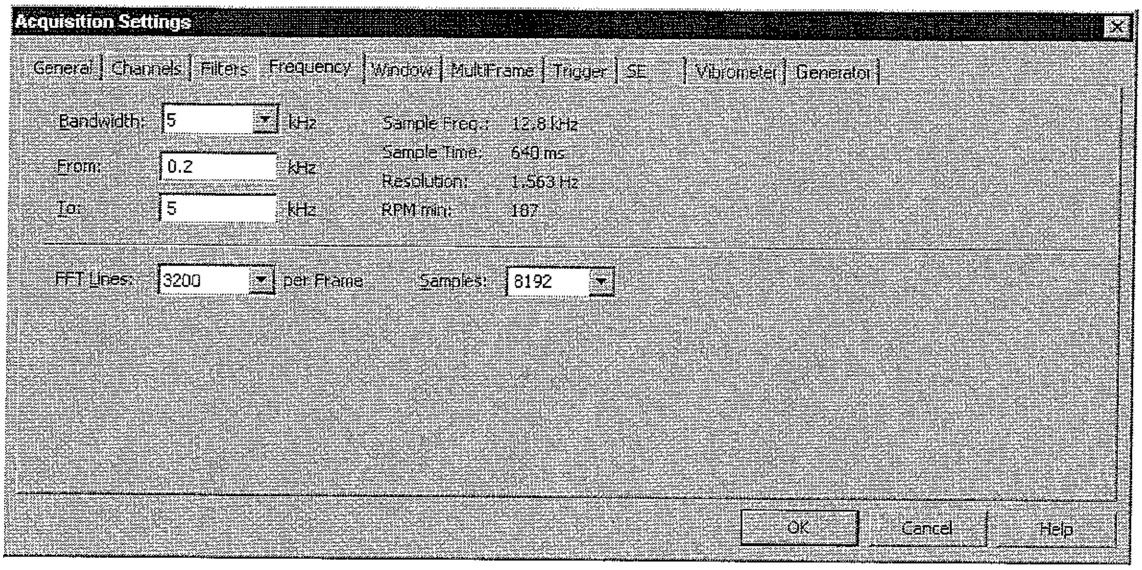


Figure 7.16: Page Frequency in the measurement mode MultiFrame

At the bottom right, set the number of samples.

Samples: Here you select the number of samples.

The software calculates the sample time and the lower RPM limit RPM_{min} which it can acquire with the parameters set and shows them on the right.

Sample Time:

$$t_{Sample} = \frac{n_{Sample}}{2.56 \cdot BW} \qquad \text{Equation 7.10}$$

n_{Sample} ... Number of samples
BW... Bandwidth

RPM min:

$$RPM_{min} = \frac{120}{t_{Sample}} \qquad \text{Equation 7.11}$$

t_{Sample} ... Sample time

You will find information on the other parameters on the page Frequency in section 7.2.4.

Click here to next page.....

8 Displaying Data

In the software you work with the following windows to display data:

- in acquisition mode: a **video window**, any number of **analyzers**
- in presentation mode: any number of **presentation windows**, **analyzers** and **signal processors**.

In the video window you can follow the progress of a scan. Read section 8.1 on this.

You can work in analyzers as described in section 8.2.

To evaluate the scan, open a presentation window and then set up the window and the view of the measurement object. See section 8.3 on this.

You select the data set to be displayed in the analyzer as described in section 8.4.

If you are using PSV-3D, you can group several individual measurement files to a combined file (stitching). See section 8.5 on this.

Afterwards you can use your measurement data as the basis for further calculations. See section 8.6 on this.

8.1 Following Scans in the Video Window

In the video window you follow the progress of scans. While scanning, you can see what status the scan points get. You will find a description of the video window in section 2.7.2.

Show and hide scan points

To show and hide the scan points in the video window, click or select View > Scan Points. To the left of the live video image you can see a legend for the status. There are different views here to select from:

- Scan
- Geometry
- Laser Focus

To change the views, click .

Scan Status

Before a scan, all scan points have got the status Not Measured.

If you do not want to scan individual scan points, you can assign them the status Disabled. See section 5.6.2 on this.

If you define the scan points, then scan points which are outside the scan area of at least one scanning head are given the status Not reachable.

When scanning, the software gives every scan point the status Valid, Optimal or Overrange.

The status Optimal can only occur if Signal Enhancement is active for at least one channel (refer to section 7.2.7). At these scan points, the signal-to-noise ratio is relatively high.

At scan points with the status Overrange the input range of the data acquisition board was exceeded on at least one channel.

If Signal Enhancement is active, scan points can change their status between Valid and Optimal.

After the scan, you can manually give the scan points the status Invalid. You will find details on this in section 9.1.

If parts of the object cover scan points in such a way that they can not be reached by at least one laser beam, they are marked as being Hidden.

Geometry Status

If there are no 3D coordinates available, the scan points are given the status No 3D coord.. If you are working with a 3D geometry or the distance sensor, you can see whether scan points were measured with the geometry scan unit (status Measured) or were calculated with the aid of triangulation of the three laser beams (status Triangulation, only PSV-3D).

Other possibilities are Imported (from Universal File or ME'Scope files with the aid of the optional geometry import, refer to section 5.4), Interpolated (3D coordinates not calculated or incorrectly calculated have been interpolated from the neighboring scan points) and Modified (the coordinates of the scan points were retrospectively changed).

If the distance measurement has failed, the affected scan points are given the status Failed. In all cases this means that these scan points do not have any valid 3D coordinates. If the signal strength of the geometry scan unit being too high or too low is the reason for the measurement failing, then you will see this from the status Too much light or respectively Too little light.

Laser Focus Status

If no focus value has been assigned, the scan points are given the status No laser focus. If you have assigned a focus value (refer to section 4.5.1 and section 4.5.2), you will see here whether you assigned the focus value manually (Assigned man.), quickly (Assigned fast) or optimally (Assigned best).

If the software has interpolated the focus value of individual scan points from those of the neighboring points, these are given the status Interpolated. Scan points for which no focus value could be determined using the method Assign Focus Best are labeled as Failed.

8.2 Working in Analyzers

Analyzers show measurement data and evaluated data in x-y diagrams. You will find a description of the analyzer in section 2.7.3.

You select the data set to be displayed in the analyzer as described in section 8.4.

Analyzers offer user-friendly functions to present data quickly and usefully. In analyzers, you can zoom, set cursors, read data and autoscale the y-axis directly. You will find more functions in the dialog Analyzer Properties. There you can set the line style and color of the graphs, scale and set up the look of the diagrams. To do so, click the corresponding icon in the toolbar of the analyzer. Alternatively, click in the analyzer with the right mouse button and select the required function from the pop-up menu.

The analyzer simultaneously shows up to 0.5 mega-samples for time series as standard. If the measurement file contains more data, then this is reloaded during scrolling. If you want to see several time values at once, then to do so you can increase the number of time values shown simultaneously as described in section 9.4.2

☞ The maximum number of time values shown simultaneously can only be increased in presentation mode. In data acquisition the analyzer only shows a maximum of 0.5 mega-samples.

8.2.1 Zooming in Analyzers

You can zoom on sections of the diagrams.

Zoom the x- or y-axis

To zoom the x- or y-axis individually, proceed as follows:

1. Point at an edge point of the section required on the axis. The cursor becomes a magnifying glass.
2. Press the mouse button and drag horizontally or vertically to the other edge point.

Scroll the x-axis

The scroll bar below the diagram shows the position of the zoomed section on the whole x-axis range. You can scroll along the x-axis with the current zoom factor. To do so, move the bar in the scroll bar to the right or to the left. You can also click the arrows to the right and left of the scroll bar.

Zoom both x- and y-axis

To zoom both x- and y-axis simultaneously, proceed as follows:

1. Click  or select Analyzer > Zoom In.
2. In the diagram, point at a corner of the section required.
3. Press the mouse button and drag to the diagonally opposite corner.

Pan the zoomed section

You can pan the zoomed diagram section. To do so, you have the following possibilities:

1. Using the middle mouse button (mouse wheel), click in the zoomed diagram. Hold the mouse button pressed and pan the diagram section. If you have given the middle button a special function (e.g. double-click), then you will have to proceed as described in step 2.
2. Click  or select Analyzer > Pan. You can now pan the section of the diagram while pressing the left mouse button.

Zoom out

To undo the last zoom action or autoscaling, click  or select Analyzer > Zoom Out.

To undo all previous zoom actions, click  while holding the shift key pressed. You can also select Analyzer > Zoom Out holding the shift key pressed.

8.2.2 Scaling the Axes

You can scale the y-axis automatically or scale the x- and y-axis manually.

Autoscale the y-axis

When you have started a measurement or are displaying another data set, then the y-axis range is often unsuitable. You can then autoscale, i.e. the software selects the y-axis range displayed corresponding to the y-range of the data. To do so, click or select Analyzer > Auto Scale. Even if the x-axis is zoomed, the whole y-range is autoscaled, not just the zoomed section.

Scale manually

In the dialog Analyzer Properties you can scale manually and set further scaling properties. To open the dialog, point at an axis (the cursor becomes a magnifying glass) and double-click. You can also activate the analyzer (to do so, click it), select Analyzer > Properties and then display the page Ranges.

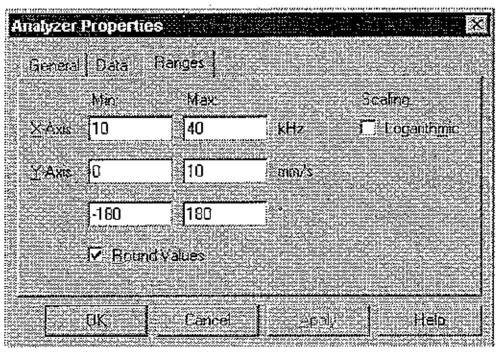


Figure 8.1: Page Ranges

Max and **Min:** Here you enter the x- and y-axis ranges you want to display.

Scale: This box only appears if the active analyzer is displaying a spectrum. Here you select logarithmic or linear scaling of the x-axis.

Round Values: Here you select whether the axis values displayed should be round. The software then rounds the values in Min and Max to be suitable. Round Values is also active when zooming. The zoomed section is then usually slightly larger than selected.

8.2.3 Setting Cursors and Reading Data

In the analyzer you can set cursors to read individual data points. Cursors are represented by thin vertical lines. In display type Nyquist you can not set any cursors. You will find details on how to animate time data in section 9.4.2.

Single cursor

To set a single cursor, proceed as follows:

1. Click  or select Analyzer > Cursor.
2. Click in a diagram.

Read data

You can see the cursor's coordinates in the legend. If the legend is not visible on the right in the analyzer, select Analyzer > Legend to display it.

Differential cursor

You can set two cursors and read the difference between coordinates. To do so, proceed as follows:

1. Click  or select Analyzer > Differential Cursor.
2. In the diagram, point at the first point you require.
3. Press the mouse button and then drag to the right or left to the second point. The difference between the coordinates also appears in the legend.

Move the cursor

You can move a cursor to the right or left. To do so, proceed as follows:

1. Point at the cursor. The mouse cursor becomes a ↔.
2. Press the mouse button and then drag to the right or left to the required point. The data in the legend is updated simultaneously.

You can also move a single cursor using the keys → and ←.

Delete the cursor

To delete cursors you have set, click  or  again.

8.2.4 Setting up the Presentation of Graphs

You set up the presentation of the graphs in the dialog Analyzer Properties. To open the dialog, point at a diagram and double-click. You can also activate the analyzer (to do so, click it), select Analyzer > Properties and then display the page Data.

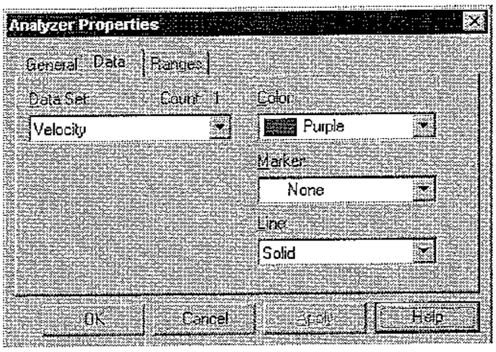


Figure 8.2: Page Data

Data Set: If the analyzer is displaying several diagrams – for example, magnitude and phase – then this is where you select the data set for which you want to set up the presentation.

Color: Here you select the color of the graph.

Marker and **line:** Here you select the view style of the graph and, if applicable, the marker. In the view styles Marker, Histogram, Thin bars and Thick bars, only measured y-values are displayed. In the other view styles, the software interpolates between the measured values.

8.2.5 Setting up Diagrams

You set up the look of the diagrams in the dialog Analyzer Properties. The current settings in the dialog are also valid for all analyzers you now open.To open the dialog, double-click an axis name. You can also activate the analyzer (to do so, click it), select Analyzer > Properties and then display the page General.

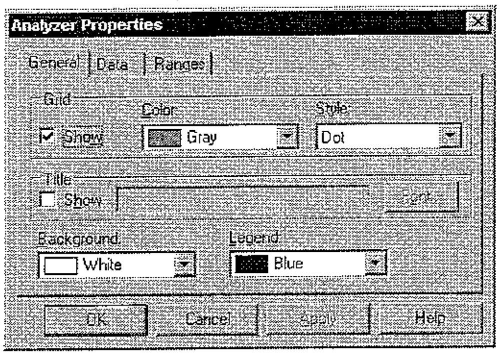


Figure 8.3: Page General

Grid

At the top you set up the grid.

Display: Tick the box to display a grid in the diagram.

Color and **Style:** Here you select the color and line style of the grid.

Title

In the middle you set up the diagram title.

Show: If you would like to display a title over the diagram, tick the box. You enter the title on the right.

Font: Click here to format the title. The dialog Font appears.

Colors

At the bottom you set up the background color of the diagram and the color of the data in the legend.

Background: Here you select the background color of the diagram.

Legend: Here you select the color of the data read in the legend.

8.3 Working in Presentation Windows

You analyze scans in presentation windows. You will find a description of the presentation window in section 2.7.5.

Depending on which functions you are working with in the presentation window, you display it in different views: See section 8.3.1 and section 8.3.2 on this. You will find more presentation options in the dialog Display Properties. You can scale there and set up the appearance of different views.

You select the data set to be displayed in the presentation window as described in section 8.4.

Apart from the display functions, in the presentation window you also have the possibility to evaluate the measurement data. See chapter 9 on this.

8.3.1 Setting up the View of the Presentation Window

Depending on which functions you are working with in the presentation window, you display it in one of four different views:

- Object
- Single Scan Point
- Average Spectrum
- Profile.

To set the view of the presentation window, click and select the view required in the pop-up menu. You can also select Presentation > View. In the Object view you will see the data superimposed on the video image, refer also to section 8.3.2. In the other three views you see the presentation window divided horizontally: at the top the Object view and at the bottom an analyzer. You work in the analyzer as described in section 8.2.

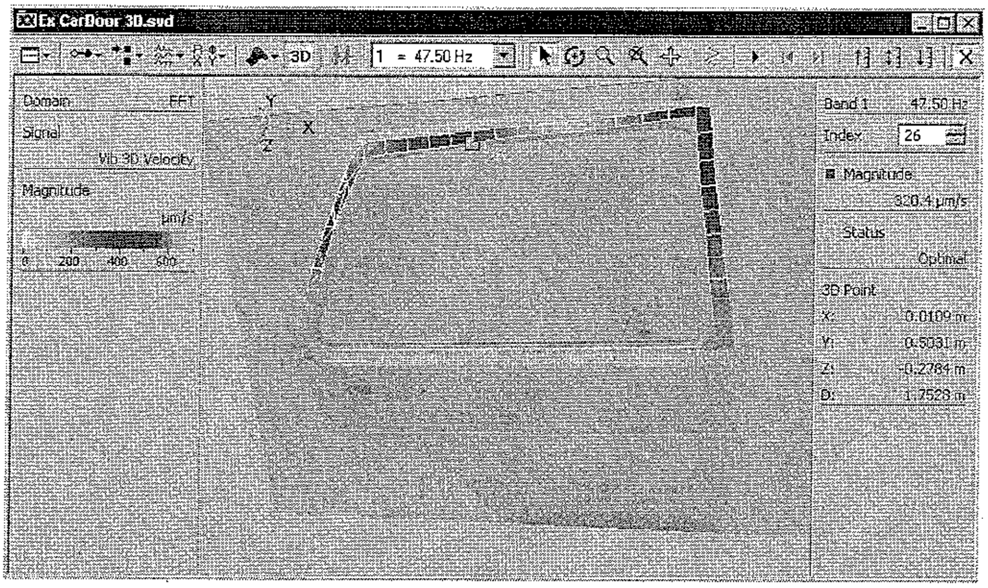


Figure 8.4: Presentation window in the view Object (3D)

Object You will see the data superimposed on the video image. You can present the data itself in different ways, see section 8.3.2 on this. You can set up the look of the object and the video image (background color, title, transparency etc.) as described in section 8.3.5.

Single Scan Point In the upper part of the presentation window you see the object. At the bottom you see an analyzer. The analyzer displays the spectrum at the single scan points. You select the scan point for which the spectrum is shown at the top. To do so, set a cursor at this scan point as described in section 8.3.4.

Average Spectrum At the top you see the object. At the bottom the analyzer displays the average spectrum of all scan points. The Average Spectrum is calculated from the amplitude spectra of the valid scan points. See also section 9.1 on this.

Profile At the top you see the object. You can draw profile sections on the object as described in section 9.3. You will see the profiles at the bottom in the analyzer.

☞ You can not draw any profile sections in the 3D view.

8.3.2 Selecting the View Style of the Data

In the presentation window you see the data superimposed on the video image. You can present the data in different ways:

- Surface
- Wireframe
- Isolines
- Scan Points
- Status Points

In all view styles you can change between the 2D and the 3D view. To do so, click . In all view styles apart from Status you will see the data color-coded. You can select the color palette for this as described in section 8.3.8. To the left of the object you can show (hide) a gauge for color-coding. To do so, select Presentation > Gauge.

To select the view style of the data, click and select the view style required in the pop-up menu. You can also select Presentation > View Style.

You can display the live video image outside the scan points.

Surface The software interpolates between the scan points.

Wireframe You see the connecting lines between the scan points as color-coded grid.

Isolines You will see equal data values connected with color-coded isolines. You can set up the presentation of the isolines (number, thickness) as described in section 8.3.6.

Scan Points You see each scan point as a color-coded square which corresponds to its data. In addition to that, you can display the index of each scan point. See section 8.3.6 on this.

Status Points You see the scan points as squares in different colors. The color shows the status of the scan point. See also section 8.1 on this.

3D View You can set up the 3D view style (projection, colors, size) as described in section 8.3.7. You can set the line of sight directly in the presentation window using the mouse. To do so, click . The mouse cursor becomes a . Drag in the direction you require.

3D Geometry You will find detailed information on the presentation of 3D geometries in your theory manual.

Read section 4.2.6 to see how to convert 2D geometry into 3D geometry.

8.3.3 Zooming in Presentation Windows

To zoom in a presentation window, proceed as described in section 2.8.

8.3.4 Setting Cursors and Reading Data

If you would like to read data at single scan points, you can set a cursor on the object. The cursor is shown as a blue square. In the view Profile you can not set a cursor.

Set a cursor

To set a cursor, proceed as follows:

1. Display the Object or Single Scan Point view. To do so, click and select Object or Single Scan Point.

2. Display any view style. To do so, click and select the view style in the pop-up menu. You can select scan points in both the surface view and also the 3D view.

Select scan points

3. Point at a scan point and click. The scan point is shown as a blue square.

Read data

In the legend you can see the data of the scan point which the cursor is at. If the legend is not visible on the right of the object, select Presentation > Legend to display it.

In the Single Scan Point view at the bottom in the analyzer you can see the spectrum at this scan point.

Move the cursor

You can move the cursor to other scan points using the mouse. The data in the legend is updated simultaneously.
In the Object view you can move the cursor within a joined area using the arrow keys as well.

☞ You can zoom on the view to be able to see details more clearly. Read section 2.8 on this.

Delete the cursor

To delete the cursor or to clear selection, in the toolbar of the presentation window, click .

8.3.5 Setting up the Object

You set up the look of the object in the dialog Display Properties. To open the dialog, double-click the object. You can also activate the presentation window (to do so, click it) and select Presentation > Properties. Then display the page General.

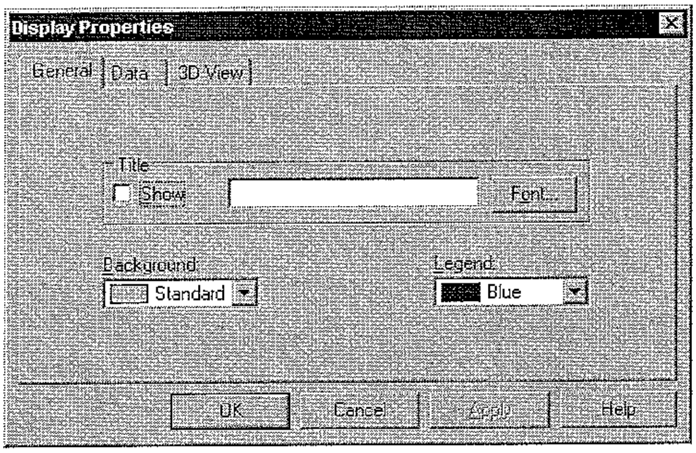


Figure 8.5: Page General

Title

At the top you set up the title of the object.

Display: If you would like to display a title over the object, mark the box. You enter the title on the right.

Font: Click here to format the title. The dialog Font appears.

Colors

At the bottom you set up the background color of the object and the color of the data in the legend.

Background: Here you select the background color of the object.

Legend: Here you select the color of the data read in the legend.

8.3.6 Setting Up Isolines and View Styles of Measurement Data and Scaling the Z-axis

To set up the view style of the measurement data and the isolines and to scale the z-axis, open the dialog Display Properties. To do so, double-click the object. You can also activate the presentation window (to do so, click it) and select Presentation > Properties.Then display the page Data. New settings on this page are immediately effective – i.e. without clicking Apply or closing the dialog.

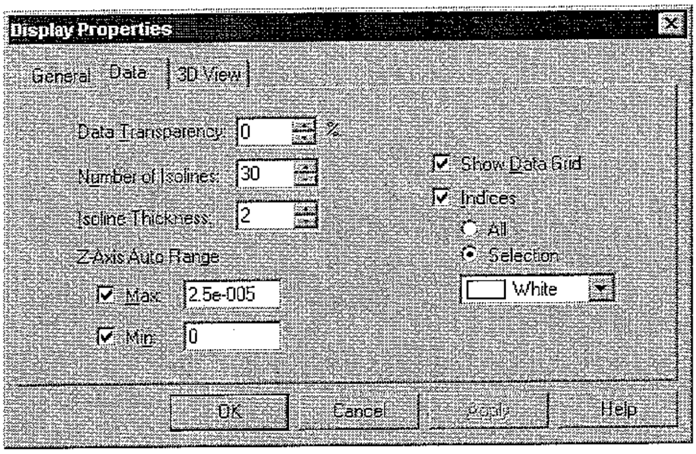


Figure 8.6: Page Data

View style of the measurement data

Data Transparency: Here you enter how transparently the superimposed is to be shown on the video image.

Show Data Grid: Tick the box if in addition to the superimposed measurement data the grid which the scan points are on is to be shown.

☞ In the Wireframe view, this box is not active.

Indices: Tick the box to show the indices of the scan points. Select whether the indices of all scan points are to be shown or only the indices of selected scan points. In the list below select the color which is to be used to show the indices.

Setting up the isolines

Number of Isolines: Here you select how close the isolines are to each other.

Isoline Thickness: Here you select the thickness of the isolines.

Automatically scale the z-axis

Z-Axis Auto Range: The software can autoscale maximum and minimum of the z-range individually. Tick the corresponding box to do so.

☞ Data which you have collected in time mode can also be autoscaled in the presentation window by clicking .

Scale the axis manually

Through entries in the fields Max: and Min: you can scale manually. As soon as you enter a value here, autoscaling is cleared correspondingly.

Max and **Min:** Enter the z-axis range here you want to display.

8.3.7 Setting up the 3D View

You set up the 3D view in the dialog Display Properties. To open the dialog, double-click the object or click it with the right mouse button and select 3D View Properties in the pop-up menu. You can also activate the presentation window (to do so, click it) and select Presentation > Properties. Then display the page 3D View.

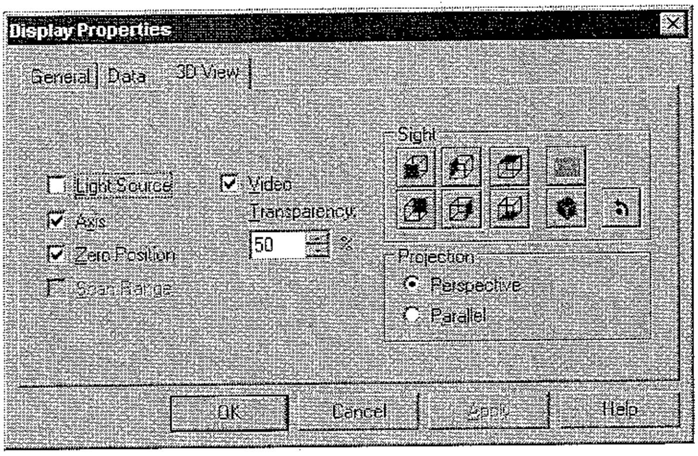


Figure 8.7: Page 3D View

Changes made to the representation or the sight are immediately effective, i.e. without clicking Apply or closing the dialog.

Light Source: Tick the box to switch on the illumination model. It simulates illuminating the object from the direction of the observer.

☞ Depending on the shape of the object, the display of light and shadow has a detrimental effect on the quality of the presentation. In this case, deactivate the box to switch off the illumination model.

Axis: Tick the box to display a coordinate system top left in the presentation window next to the object.

Zero Position: Tick the box to view the object in its original position in addition to viewing the measurement results.

Scan Range: Tick the box to show lines to help you display the position of the scanning heads in front of the object. In this way you can see whether the 3D alignment has provided a useful result.

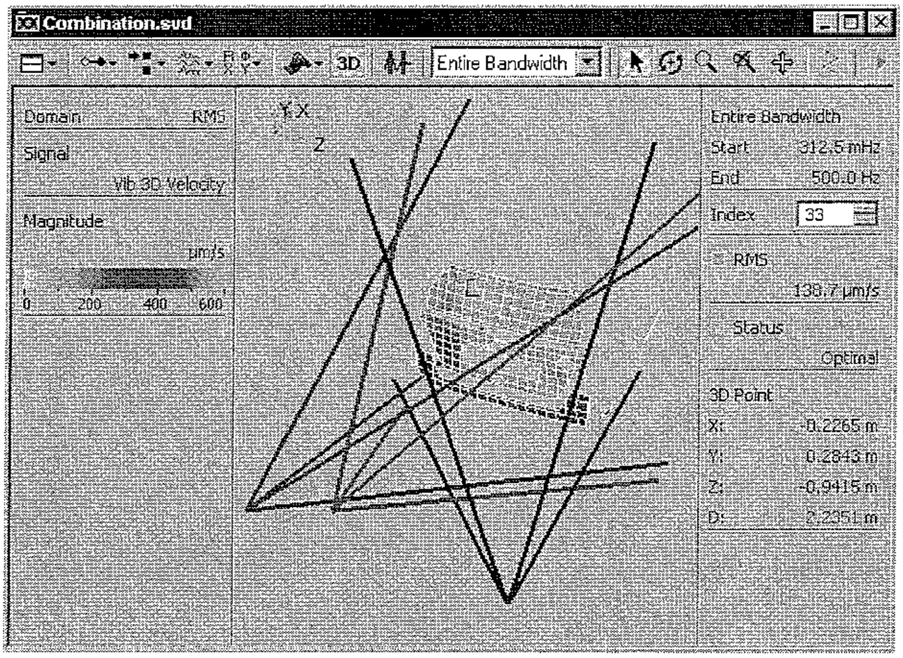


Figure 8.8: Layout of the three scanning heads

Video: Tick the box to show the video image.

Transparency: Here you enter how transparently the video image is to be displayed.

Line of sight

The icons in the field Sight show the line of sight of the object. You can move the object more precisely by clicking these icons than by dragging with the mouse.

 Sight on the object from the front

 Sight on the object from the back

 Sight on the object from the left

 Sight on the object from the right

 Sight on the object from the above

 Sight on the object from the below

 Sight of the video camera (only for 3D geometry)

 Sight on the object at an angle from front, left and above

 Rotating the object around the line of sight

You can show (hide) a coordinate system which shows you the resulting orientation of the object (see above, Axis).

☞ You can also set the line of sight directly in the presentation window using the mouse. To do so, click the object and using the mouse drag it into the direction you require.

Projection

Here you select the type of projection of the object.

Perspective: The object is shown in perspective, i.e. parts in the front of the image become larger, parts in the background of the picture are shown smaller.

Parallel: All parts of the object are shown the same size regardless of their distance from the observer.

☞ Parallel projection makes it easier to differentiate between in-plane and out-of-plane vibrations. Particularly with out-of-plane vibrations, the perspective layout viewed from the top can give the impression that the object is being stretched and contracted again.

8.3.8 Selecting the Color Palette

You can choose between different color palettes for color-coding in the presentation window. To do so, proceed as follows:

1. Click or select Setup > Color Palette. The dialog Color Palette Selection appears.

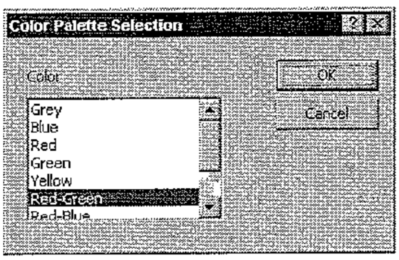


Figure 8.9: Dialog Color Palette Selection

2. Click the color palette required. Default is the color palette red-green.
3. Click OK.

   Or:

   With the right mouse button, click the gauge on the left in the presentation window and select the required color palette from the list.

8.4 Selecting the Data Set Displayed

To display a certain data set, select in the following order:

1. Time signal or type of spectrum
2. Channel or combination of channels
3. Signal or function
4. Display type in which the signal or function is shown
5. 0 dB reference
6. Only in presentation windows of data you have captured in FFT mode: Frequency band.

The selection depends on

- the measurement mode
- averaging, trigger and reference signal; see your theory manual on this as well,
- which displays have already been selected – for example, you can only display a frequency response for frequency spectra and a combination of channels.

☞ With the PSV-3D you can also select the channels Vib X, Vib Y, Vib Z and Ref1 and also combinations of channels such as Vib X & Ref1.

You first have to define frequency bands as described in section 9.2.

If an analyzer is part of a presentation window (refer to section 8.3.1), select the displayed data set in the presentation window. If possible, the analyzer displays the same data set.

To display a certain data set, proceed as follows:

Domain

1. Click [icon] or select Analyzer > Domain or Presentation > Domain.
2. Select the time signal, a spectrum or the RMS signal in the pop-up menu.

☞ Measurement modes FFT, Zoom-FFT and MultiFrame: To calculate and display a frequency spectrum, the software needs to acquire a complete sampling period. Therefore, during a continuous measurement, the **spectrum** of the **last complete measurement** is displayed at the same time as the **time signal** of the **current measurement**.

Channel

3. Click or select Analyzer > Channel or Presentation > Channel.
4. Select a channel or a combination of channels in the pop-up menu. If you want to use data sets which are user defined and have been generated using Polytec File Access, select the channel Usr. You will find more information on this in the manual on Polytec File Access.

Signal

5. Click or select Analyzer > Signal or Presentation > Signal.
6. Select a signal or a function in the pop-up menu. The abbreviations used are explained in table 8.1.

Table 8.1: Abbreviations for functions

Abbreviation	Function
AP	Autopower
CP	Crosspower
FRF	Frequency Response Function
H1	Frequency Response Function
H2	Frequency Response Function

Display type

7. Click or select Analyzer > Display Type or Presentation > Display Type.
8. Select the way in which the vibration is shown in the pop-up menu.

☞ In the display type Magnitude [dB (A)], the magnitude measured is frequency-weighted according to the standard EN 60651 (IEC 651) (A-weighting). The A-weighting approximately describes the acoustic sensitivity of a human at low magnitudes. The following figure shows the frequency-weighting curve. Outside the range shown, the software frequency-weights as follows: Below 10.0 Hz at -70.4 dB and above 20000 Hz at -9.3 dB.

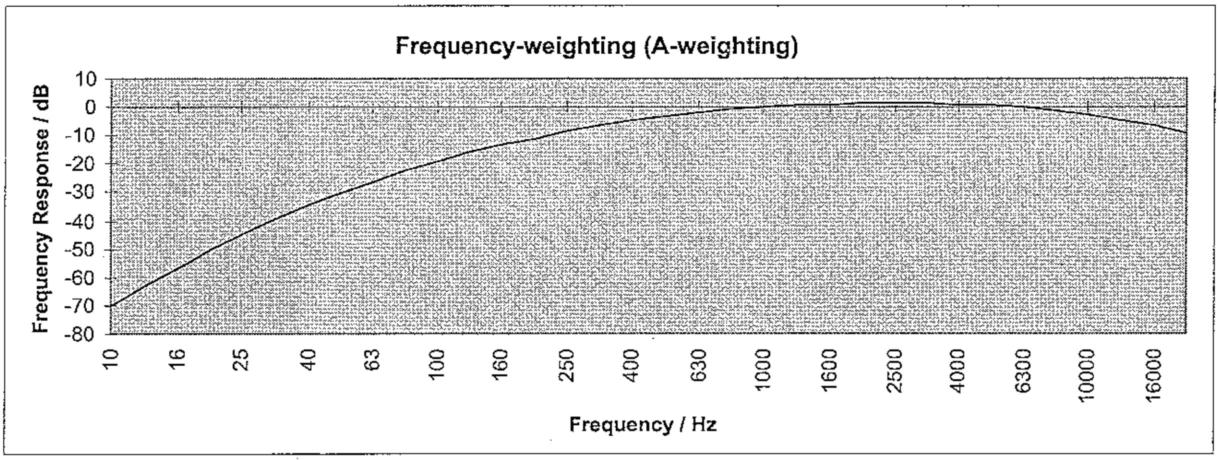


Figure 8.10: Frequency-weighting curve for the display type Magnitude [dB(A)]

☞ In the display type Nyquist, the real part of the magnitude is plotted over the x-axis and the imaginary part over the y-axis.

0 dB Reference

9. Select Setup > Preferences and if applicable open the page dB Reference.

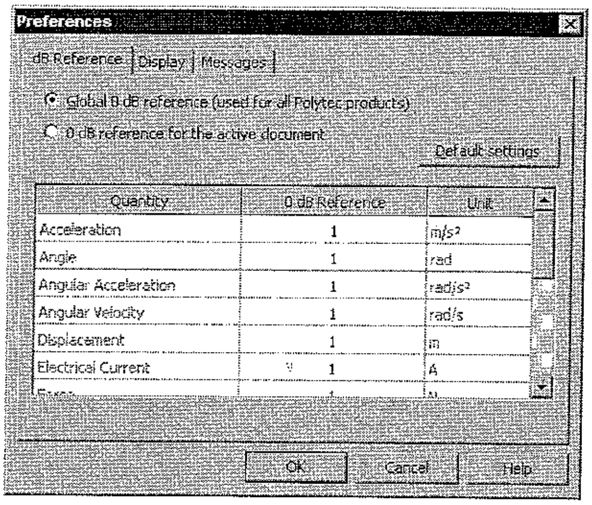


Figure 8.11: Page dB Reference

10. If the settings are to apply to all the Polytec software installed in the PC, mark Global 0 dB reference (used for all Polytec products).

    If the settings are only to apply to the file which is currently open, mark 0 dB reference for the active document.

The column Quantity shows the available physical quantities, the column Unit the respective applicable unit (ISO).

11. In the column 0 dB Reference you define the factor for the respective unit.

☞ Depending on the size of the opened file, it can take quite a while for the new value to be applied!

Example:

Quantity	**0 dB Reference**	**Unit**
Displacement	2e-3	m

The 0 dB reference for the quantity Displacement is 2 mm.

12. If you want to evaluate combined signals (e.g. Vib & Ref1), define the 0 dB reference for both quantities. The software then automatically determines the 0 dB reference of the combined signals.

☞ If you want to recover the original settings for the 0 dB reference, click Default Settings.

Frequency band (only in presentation windows)

You have three different ways of selecting the frequency band displayed:

13. Select the frequency band in the toolbar of the presentation window in the list [1 = 1.200 kHz]. If no frequency bands are defined, then the only entry in the list is Entire Bandwidth.

or

14. Press the key Pg Dn or Pg Up. You will see the next or previous frequency band.

or

15. Either display the view Single Scan Point or the average spectrum. To do so, click and select Single Scan Point or Average Spectrum.

16. In the toolbar of the analyzer, click . You see the frequency bands in the analyzer in color.

17. Click the required frequency band in the analyzer. The software shows this frequency band at the top.

In table 8.2 you will find a summary of how to select domain, channel, signal and display type.

Table 8.2: Selecting the data set displayed

Click	Or select Analyzer > or Presentation >	Display of	Example
1.	Domain	Time signal, spectrum or RMS signal	FFT, 1/3 Octave RMS Time
2.	Channel	Channel or combination of channels	Vib Ref 1 Vib & Ref 1
3.	Signal	Signal or function	Velocity Acceleration Voltage FRF Displacement/Voltage AP Displacement[2]
4.	Display type	Way in which the signal or function is shown	Magnitude Magnitude [dB] Phase Real & Imag. Nyquist

You can also evaluate the spectrum with an individual cursor, see section 9.2.1 on this.

8.5 Generating Combined 3D Files (Stitching)

If you are using PSV-3D, you can group individual measurements with 3D geometries and 3D vibration data to form combined files. For this, the following conditions have to be met:

- The individual measurements must have been made using PSV-3D.
- The coordinate systems of all individual measurements must have the same origin and the same orientation. This means that for 3D alignment the same coordinate system must have been used for the alignment points of all files.
- All individual measurements must have been made using the same basic settings. These include the number of channels, the definition of the reference channel, units, averaging mode and trigger settings as well as the setting for the optional Principal Component Analysis (MIMO).
- However you can select different vibrometer settings, generator signals, input ranges and calibration factors.

☞ If you are combining measurements with different vibrometer settings, please make sure that the possible different time delays are only corrected under the following conditions:

- as of OFV-5000 with firmware version 2.0:
- as of PSV 8.3
- acquisition of measurement data in the spectral range (FFT)

No correction is made in the time domain!

- The indices of the scan points may not appear twice. Read more about this under Change indices in section 5.6.2.

  Exception: identical scan points which are included in several individual measurements and have the same index in every individual measurement.

You can also generate a new combined filed from several combined files. To do so, proceed in the same way as when grouping individual measurements.

8.5.1 Merging Individual Measurements

To group several individual measurements into a combined file, proceed as follows:

1. Select File > New > Combine File. The dialog Create Combined File appears.

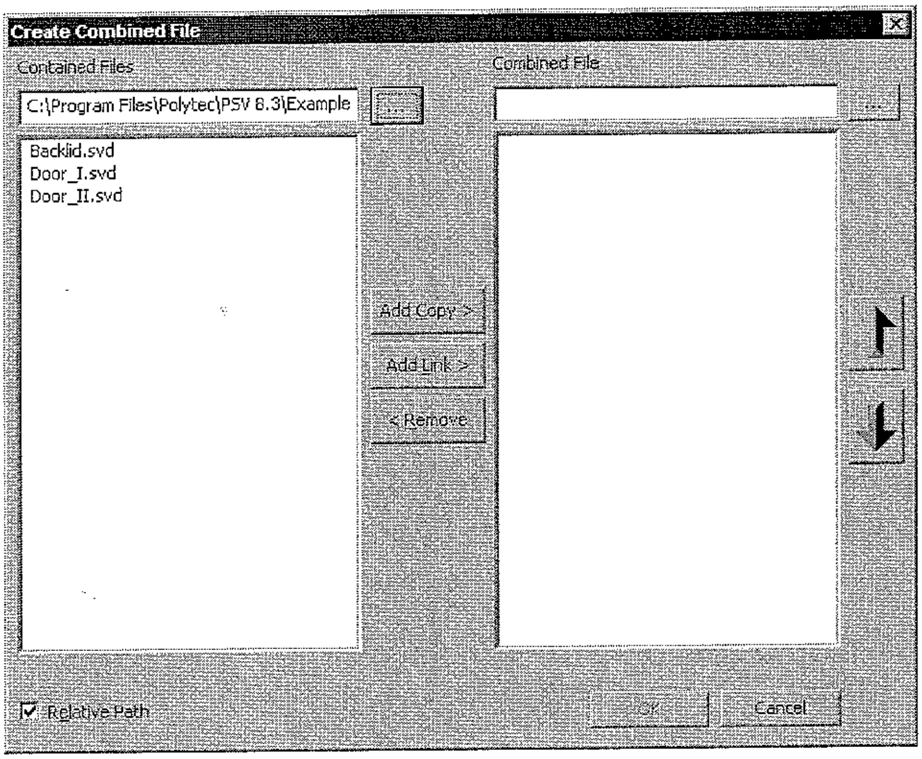


Figure 8.12: Dialog Create Combined File

Add individual measurements

2. Click next to the field Contained Files. The dialog Browse For Folder appears.

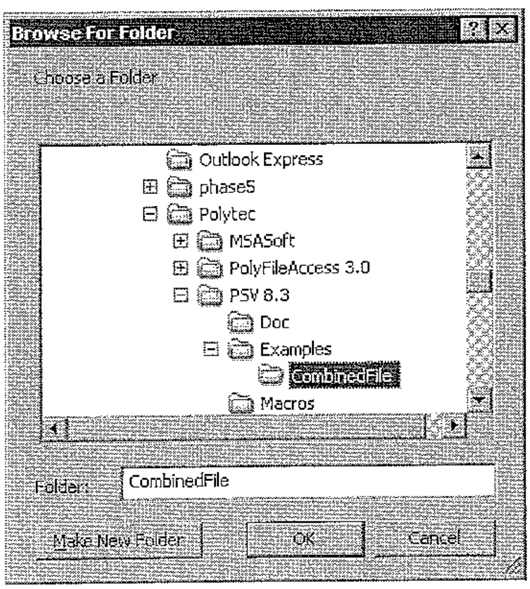


Figure 8.13: Dialog Browse For Folders

3. Navigate in the directory containing the individual measurements you want to group and click OK.

4. Mark the individual measurements you would like to group. To select several individual files at the same time, hold the Control button pressed and mark the files using the mouse. To select several consecutive files at the same time, hold the shift key pressed and mark the first and the last of these measurements with the mouse.

5. Click Copy if you want to include the selected files in the combined file.

   Or:

6. Click Link if you want to link the selected files to the combined file.

☞ If you only link individual measurements, then retrospective changes to these measurements will have an effect on the combined file.

7. Tick the box Relative Path if for linked files only the position in the file system relative to the combined file is to be saved. In this case the links also remain valid if you copy the combined file with the linked files e.g. into another directory and thereby retain the relative folder structure.

8. Click  next to the field Combined File. The dialog Save As appears.

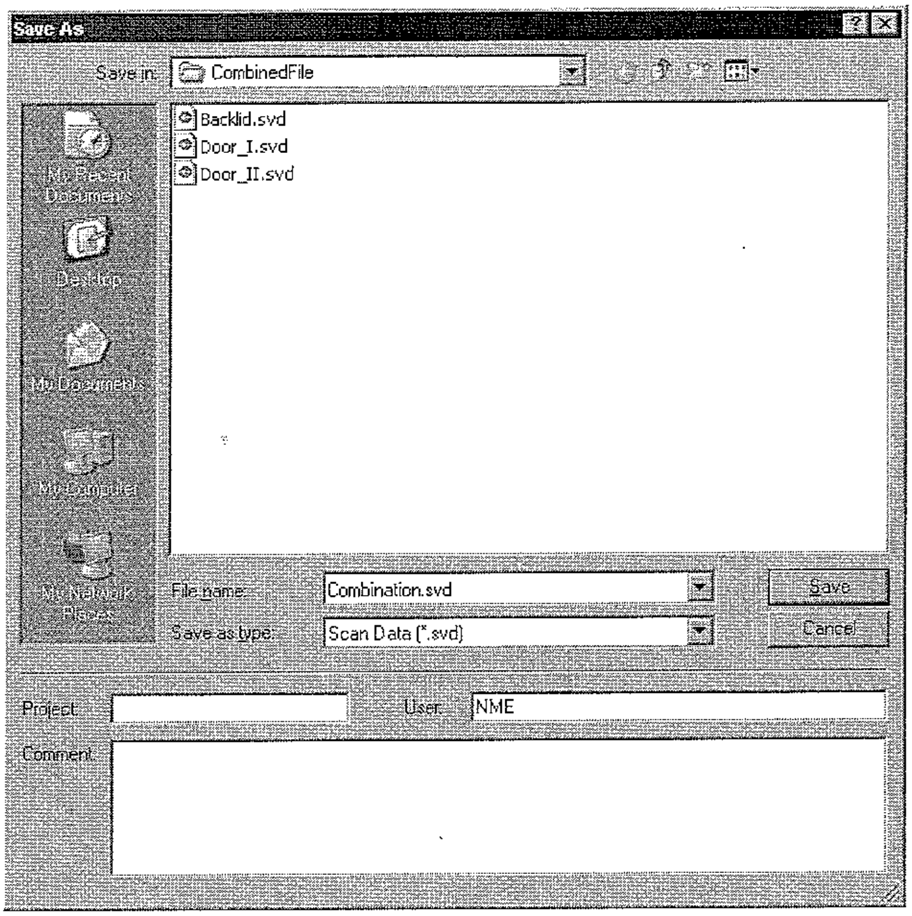


Figure 8.14: Dialog Save As

9. Navigate to the directory in which you want to save the combined files and enter the file name.

10. Click Save.

☞ If you have displayed the project browser (refer to section 2.7.4), you will then automatically be shown the directory marked there as saving location.

Remove individual measurements

11. To remove files from the list of individual measurements for the combined file, mark them as described in step 4 and click Remove.

12. Click OK.

8.5.2 Working with Combined Files

The same functions are available to you for combined files as they are for individual measurements. All other operations after merging will however only be saved in the combined file. The individual measurements remain unaffected by this.

As a general rule, every change to a file is marked with an asterisk (*) in the file name as soon as you make the change. An exception to this are the frequency bands which are immediately saved after being recalculated. Also the changes that result of you invalidate scan points are saved immediately.

Display combined file

To open the combined file, double-click the file name in the project browser or click it with the right mouse button and select Open in the pop-up menu.

In the 3D view you can simultaneously see the geometry and the 3D vibration data from all parts of the object that you scanned in the individual measurements in 3D. There are not connecting lines between the part geometries.

In the 2D view you can see the geometry and the vibration data of the individual measurements. To show the individual measurements consecutively, select them in the list Contained File.

☞ To draw a profile section (refer to section 9.3), you have to select the 2D view.

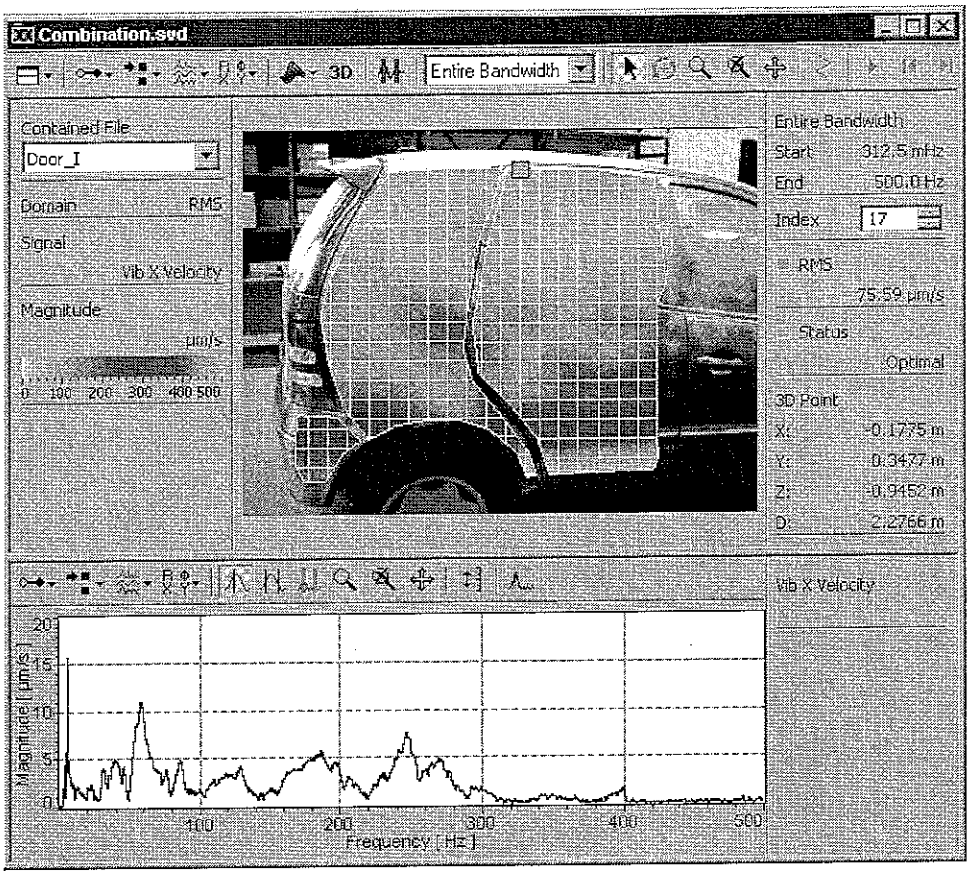


Figure 8.15: 2D view of an individual measurement from the combined file

In the project browser your can see the individual measurements as well as the settings with which these measurements were made. To do so, click the plus sign (⊞) in front of the name of the combined file or in front of the name of the individual measurements.

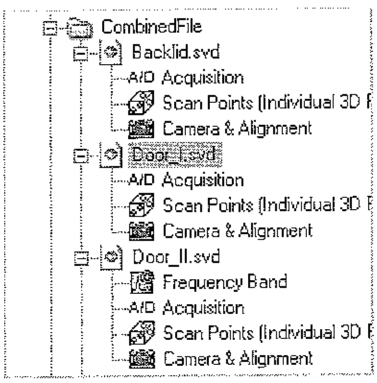


Figure 8.16: Combined file, individual measurements and settings

Overlap of individual measurements

Depending of how you defined the scan areas of the individual measurements, parts of the combined file in the 3D view can overlap.

If the combined file contains duplicate scan points which have the same indices, the software prioritizes the data for the 3D view corresponding to the order of the individual measurements in the dialog Create Combined File (refer to figure 8.12): the individual measurement which is at first place in the list Combined File is given priority 1. In the case of the 3D view of the combined file where there are scan points measured twice, the video image with the geometry data, measurement data etc. is shown from the individual measurement which contains these scan points and has the highest priority.

Sort individual measurements

To adapt the display, you have to change the order of the files. To do so, proceed as follows:

1. Open the dialog Create Combined File. To do so, click the combined file in the project browser with the right mouse button and select Properties in the pop-up menu.
2. In the list Combined File, click the individual measurement which you want to move.
3. Click ↑ or ↓, to move the selected individual measurement up or down in the list.
4. Click OK.

Apply frequency bands

You can apply frequency bands from individual measurement to the combined file. To do so, proceed as follows:

1. Open the combined file.
2. Open the frequency band definition (refer to section 9.2.2).
3. Holding the left mouse button pressed, drag the entry Frequency Band of the required individual measurement from the project browser to the frequency band definition.
4. Close the frequency band definition. A message box appears with the question whether the frequency bands are to be recalculated.
5. Click Yes.

8.6 Recalculating Data in the Signal Processor (as an Option)

If you want to further analyze measurement data you have already acquired, you can recalculate it and present the results in a direct comparison with the original data. For this purpose the signal processor is available which you can transfer the data to and can then process it further. The data calculated this way is shown in the analyzer of the signal processor. You can also save this data with the measurement file and display it again at any time.

8.6.1 Making a Calculation

To recalculate the data, you have to open the respective measurement file, transfer the measurement data to the signal processor and carry out the required arithmetic operations there.

Open the signal processor To open the signal processor, select File > New > Signal Processor. The signal processor appears.

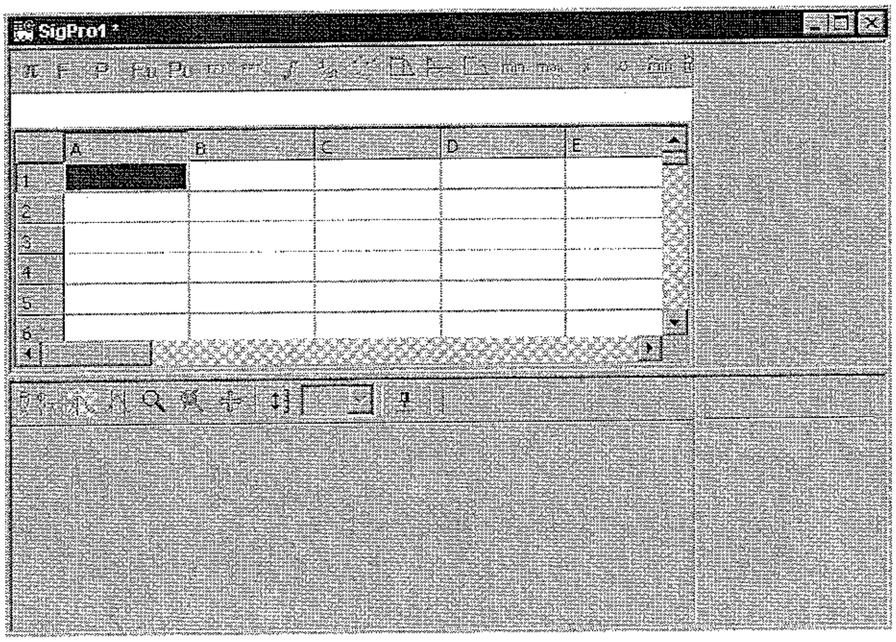


Figure 8.17: signal processor

Open a measurement file

1. To open a presentation window with a measurement file, click or select File > Open. The dialog Open appears.

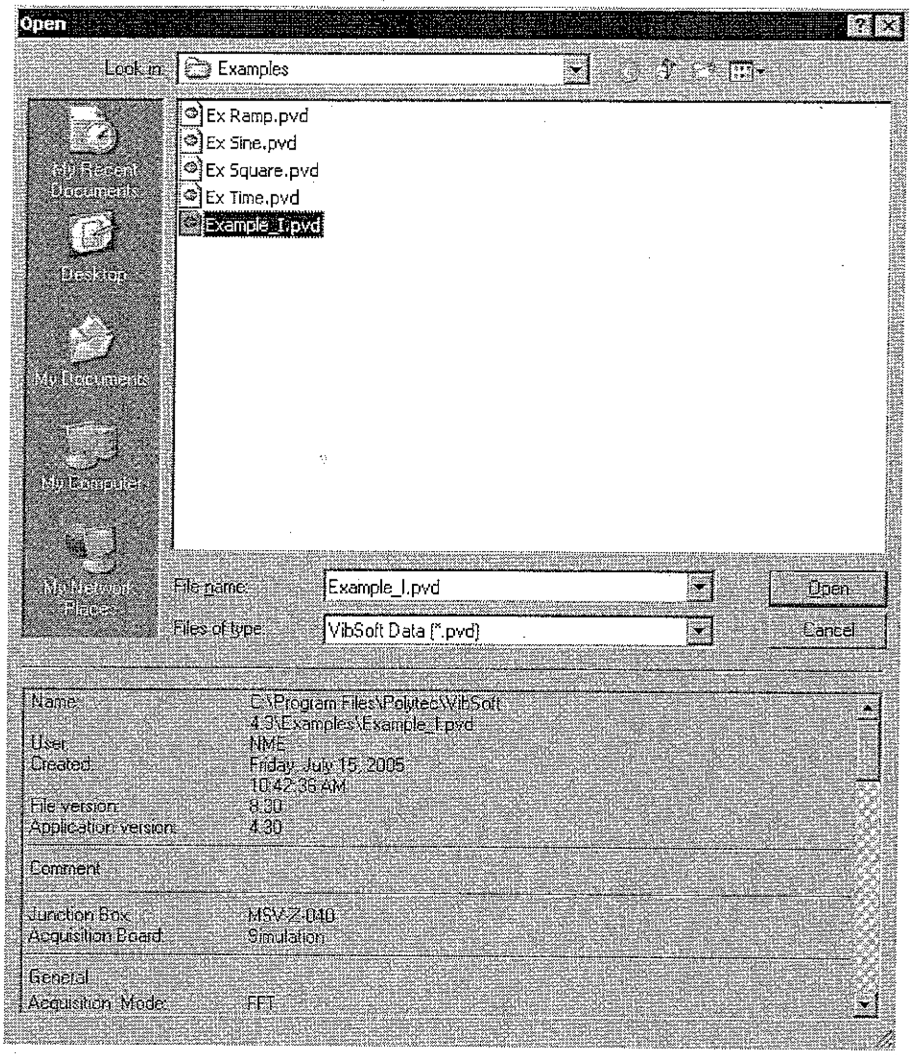


Figure 8.18: Dialog Open

2. Navigate to the saving location and select the file type and name. To make it easier to identify the files, you see meta-information at the bottom in the dialog – for example, the data acquisition board and the settings with which the data was measured.

3. Click Open. If you open a scan, a presentation window appears. If you open a single point measurement, an analyzer appears.

Recalculate measurement data

To recalculate the data in the open file, please proceed as follows:

1. In the presentation window, click a scan point with the right mouse button and select Copy in the pop-up menu. The data of the selected scan point will be copied.

   or

   Click next to the scan points and select Copy All Points in the pop-up menu. The data from all scan points will be copied.

2. Change to the signal processor.

3. Click a cell (e.g. A1) with the right mouse button and select Paste or Paste Link in the pop-up menu. The copied data is inserted in the signal processor or inserted and linked.

☞ Inserted data contains a reference to the original file and remains in the corresponding cell, even if you select other data in the sequence or close the measurement file or the signal processor. Linked data in contrast is updated in the formula as soon as you select other scan points and are lost as soon as you close the measurement file or the signal processor.

4. If you want to display the data for a single scan point, select it in the index in the analyzer of the signal processor (refer to figure 8.19).

5. If you want to display certain frames for the selected scan points, click the number of the particular frames in the analyzer of the signal processor. You can display an own graph for every frame (refer to figure 8.19 and section 8.6.3).

6. Click another cell (e.g. A2).

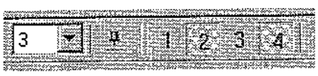


Figure 8.19: Selection of index and frames in the analyzer of the signal processor

7. Here you enter the required command and confirm it with Enter. The signal processor carries out this calculation and shows the results in the analyzer.

☞ You will find an overview of the formulae stored in the signal processor in table 8.3. You will find example applications for the signal processor in section 8.6.5.

☞ You can also enter any comments you like as text in the individual cells. In this case you just do not set an equal sign at the start of the respective text.
Invalid formulae are shown in red.

Table 8.3: Overview of the arithmetic operations of the signal processor

Command	Arithmetic operation
Add (+)	By entering + you add two numbers or Vib data sets or unite two quantities.
Sub (–)	By entering – you subtract two numbers, Vib data sets or quantities.
Mul (*)	By entering * you multiply two scalars, two Vib data sets, one Vib data set with a scalar or intersect two quantities.
Div (/)	By entering / you divide two scalars or two Vib data sets by each other, one Vib data set by a scalar or one scalar by a Vib data set.
Card	By entering Card you calculate the cardinality (number of elements) in a set.
Power (^)	By entering ^ you raise the value of scalar 1 to the power of the value of scalar 2 (notation: scalar1^scalar2, i.e. $\text{scalar1}^{\text{scalar2}}$).
Re	By entering Re you calculate the real part of a scalar or Vib data set.
Im	By entering Im you calculate the imaginary part of a scalar or Vib data set.
Exp	By entering Exp you calculate the exponential function of a scalar.
Ln	By entering Ln you calculate the natural logarithm (base e).
Sin	By entering Sin you calculate the sine (radiant).
Cos	By entering Cos you calculate the cosine (radiant).
Tan	By entering Tan you calculate the tangent (radiant).
ASin	By entering ASin you calculate the arc sine (radiant).
ACos	By entering ACos you calculate the arc cosine (radiant).
ATan	By entering ATan you calculate the arc tangent (radiant).
Abs	By entering Abs you calculate the absolute amount of a scalar or Vib data set.
Arg	By entering Arg you calculate the phase of a scalar or Vib data set.
Deg	By entering Deg you convert radiants into degrees.
Rad	By entering Rad you convert degrees into radiants.
Pi	By entering Pi you add the constant π to the formula.
Frame	By entering Frame you extract the specified frame or frames from the Vib data set. If the second parameter is a scalar, its real part is rounded up or down to the next integer and its imaginary part is ignored.
Point	By entering Point you extract the specified sample point or points from the Vib data set. If the second parameter is a scalar, its real part is rounded up or down to the next integer and its imaginary part is ignored.
FrameUnion	By entering FrameUnion you combine the frames of up to 10 Vib data sets. The maximum total number of combined frames is 12.
PointUnion	By entering PointUnion you combine the sample points of up to 10 Vib data sets. If sample points occur in more than one data set, those found first are used.

Table 8.3: Overview of the arithmetic operations of the signal processor

Command	Arithmetic operation
FFT	By entering FFT you calculate the Fourier Transformation of the Vib data set. Parameters: FFT(PSVData1, Lines[, Window, WndPar1, WndPar2]) Requirements: • PSVData1 must be a real signal. • The lines must be in the range from 25...1 046 576. • The length of the vector in PSV must at least reach the following value: Number of lines · 2, rounded up to the next power of 2. • The window function (Window) has to be one of the following characters strings: "Rectangle" "Bartlett" "BlackmanHarris" "Exponential" "FlatTop" "Force" "Hamming" "Hanning" "TaperedHanning" If you do not specify any type of window, "Rectangle" will be assumed.
Integrate	By entering Integrate you integrate the Vib data set. Requirement: The input data must be real.
Differentiate	By entering Differentiate you differentiate the Vib data set. Requirement: The input data must be real.
Resample	By entering Resample you have the Vib data set sampled again at the specified sample rate. Requirement: The input data must be real.
IFFT	By entering IFFT you calculate the inverse Fourier transformation. Requirement: The Vib data must include a complex spectrum. Note: With a measurement which is not triggered, the phase in the Vib channel is replaced by the differential phase to the Ref channel. The calculation of the inverse FFT can provide unexpected results which are hard to interpret.
Filter	By entering Filter you filter a Vib data set. Requirement: The input data must be real. As the type you select one of the strings "Lowpass", "Highpass", "Bandpass" or "Notch". As quality you select one of the strings "VeryLow", "Low", "Medium", "High" or "VeryHigh". For Flow you select the cutoff frequency for low pass and high pass and lower cutoff frequency for band-pass and notch. For Fhigh you select upper cutoff frequency for band-pass and notch.
FilterCoeff	By entering FilterCoeff you calculate a Vib data set which contains the filter core of the selected filter. Enter the sample frequency for Fsamp. As the type you select one of the strings "Lowpass", "Highpass", "Bandpass" or "Notch". As quality you select one of the strings "VeryLow", "Low", "Medium", "High" or "VeryHigh". For Flow you select the cutoff frequency for low pass and high pass and lower cutoff frequency for band-pass and notch. For Fhigh you select upper cutoff frequency for band-pass and notch.

Table 8.3: Overview of the arithmetic operations of the signal processor

Command	Arithmetic operation
Transmission	By entering Transmission you calculate a Vib data set which contains the transmission function of the selected filter. Enter the sample frequency for Fsamp. As the type you select one of the strings "Lowpass", "Highpass", "Bandpass" or "Notch". As quality you select one of the strings "VeryLow", "Low", "Medium", "High" or "VeryHigh". For Flow you select the cutoff frequency for low pass and high pass and lower cutoff frequency for band-pass and notch. For Fhigh you select upper cutoff frequency for band-pass and notch. For Count you enter the number of frequency lines for which the transmission function is to be calculated.
Min, Mean, Max, StdDev	By entering Min, Mean, Max or StdDev, you respectively calculate the minimum, average or maximum of a deviation or the standard deviation of a Vib data set which contains an individual sample point. The return value is a scalar. You can calculate Mean for real or complex data. You can only apply all the other functions to real data.
StatMin, StatMean, StatMax, StatStdDev	By entering StatMin, StatMean, StatMax or StatStdDev, you respectively calculate the minimum, average, maximum, or the standard deviation of a Vib data set. The return value is a Vib data set with an individual measurement point with the index 0. You can calculate StatMean for real or complex data. You can only apply all the other functions to real data.
	☞ It can make sense to apply StatMean to a data set which only contains a single measurement point. This does not change the data set but means that the point index is set to 0. Points with the index 0 can be compared to all other indexed points. This allows a direct comparison of the data sets from two different measurement points. For this purpose, apply StatMean to the data set of a measurement point. Then select this cell and the cell with the data set of the other sample point to compare the two.
Scale (VibData, xMin, xMax, xName, xUnit, yMin, yMax, yName, yUnit, yScale, Name, 0dBReference, Power)	By entering Scale you modify scaling information of a Vib data set. This function is usually used to adapt the scale after operations such as FFT or Integrate as these operations change the dimensions of the axes. The following list contains the changes you can make using the command Scale. • VibData: data set • xMin, xMax: boundaries of the x-axis • xName: Name of the x-axis • xUnit: Unit of the x-axis • yMin, yMax: boundaries of the y-axis • yName: Name of the y-axis • yUnit: Unit of the y-axis • yScale: the y values are multiplied with yScale • Name: Name of the data set • 0dBReference: Reference value of the dB display • Power: 1 or 2 Power = 1 shows that it is a power signal. 10dB then corresponds to a multiple of ten. For other signals you set Power = 0. 20dB corresponds to a multiple of 10.

You can also enter quantities and complex numbers. You place quantities in curly brackets and complex numbers as an option in round brackets. In table 8.4 and table 8.5 the input conventions are explained on the basis of examples.

Table 8.4: Examples for entering quantities

Command	Meaning
{1,2}	1 and 2
{1:5} or {1...5}	1 to 5
{1,4,7...9}	1, 4 and 7 to 9
{}	empty set
{*}	general set

Table 8.5: Examples for entering complex numbers

Command	Meaning
0;1 or (0;1)	i
−1.23E4;−5.67E8 or(−1.23E4;−5.67E8)	$-1.23E4 - 5.67E8 \cdot i$

Set up the signal description

You can adapt the presentation of the recalculated measurement data in the analyzer. To do so, proceed as follows:

8. Click the cell which contains the newly calculated measurement data with the right mouse button and select Signal Description from the pop-up menu. The dialog Signal Description appears.

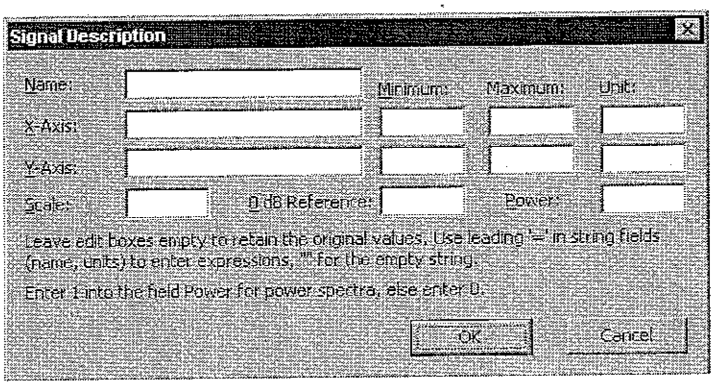


Figure 8.20: Dialog Signal Description

9. Fill in the fields as described in the following and click OK.

☞ Entries in this dialog are saved and shown in any case, even if the input data for the signal calculation changes! If you do not enter anything in a field, the original value from the input data is retained or adapted.

Name: Here you enter the description of the newly calculated measurement data. This name is shown in the respective cell. After saving the measurement data it will also appear on the list of available signals in the presentation window, refer also to section 8.6.2.

X-Axis: Here you enter the description for the x-axis.

Y-Axis: Here you enter the description for the y-axis.

Minimum: Here you enter the lower value for the scale of the x- or y-axis.

Maximum: Here you enter the upper value for the scale of the x- or y-axis.

Unit: Here you enter the abbreviation for the unit of the x- or y-axis.

Scale: Here you enter the factor by which the graphic representation of the measurement data is to be magnified or reduced.

0 dB Reference: If you have selected a view with [dB], here you enter the value which corresponds to 0 dB (reference value).

Power: If for example the signal includes a cross power spectrum, here you enter the value 1. If the signal does not contain a cross power spectrum, i.e. is not a power signal, you enter the value 0 here (default).

8.6.2 Saving Calculated Data

You can add the measurement data which you calculated in the signal processor to the original file as user defined data sets. To do so, you have the following possibilities:

☞ Requirement: the geometry of the objects, i.e. the number of scan points must be the same.

1. Mark the cell which contains the newly calculated measurement data in the signal processor.
2. Click it with the right mouse button and select Copy in the pop-up menu.
3. Then click with the right mouse button the name of the original file in the project browser and select Paste in the pop-up menu.

   Or:
4. Mark the cell which contains the newly calculated measurement data in the signal processor.
5. Holding the left mouse button pressed, drag to the presentation window.

Or:

6. Mark the cell which contains the newly calculated measurement data in the signal processor.
7. Holding the left mouse button pressed, drag to the name of the original file in the project browser.

You will immediately have another channel available with the name Usr. In the list of signals you will find the newly calculated measurement data listed with the name which you entered in the dialog Signal Description.

8.6.3 Displaying Measurement Results

At the same time as the new calculation of the data, the updated graph is shown in the analyzer. The analyzer of the signal processor has the functions described in section 2.7.3. If you mark several table cells, then you will be shown the respective frames for selection. If you select several frames, you will be shown the respective graphs in parallel.

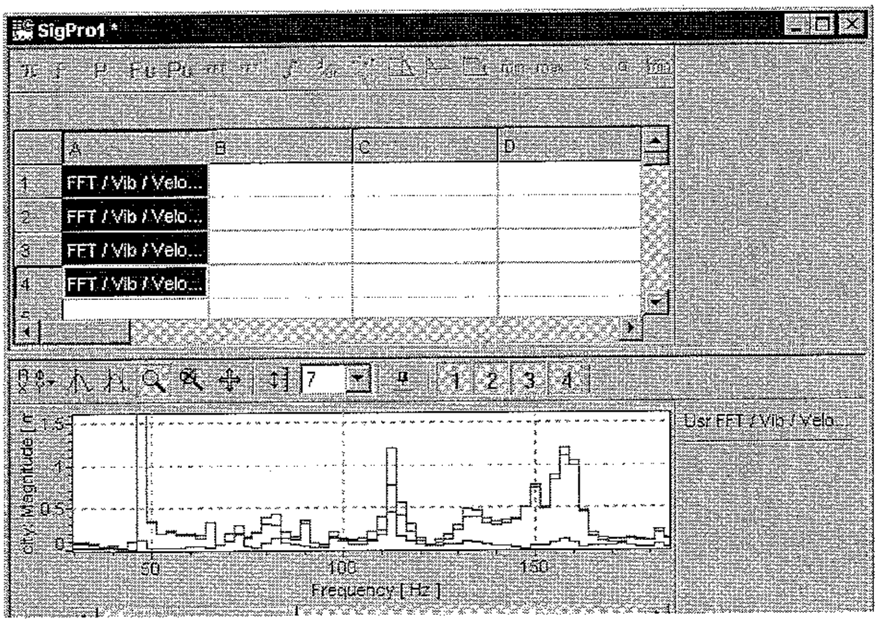


Figure 8.21: Presentation of several graphs in the analyzer

If you would like to stop updating the graph at a certain point in the arithmetic chain, click . The presentation then corresponds to the content of the table cell selected at that moment in time. All subsequent arithmetic steps are carried out anyway, but do not have any effect on the presentation of the graph. Changes in the formulae before the position marked with however still have an effect on the adaptation of the presentation up to this point.

8.6.4 Saving Formulae

To save the formula after you have recalculated the measurement data, proceed as follows:

1. Click or select File > Save As. The dialog Save As appears.

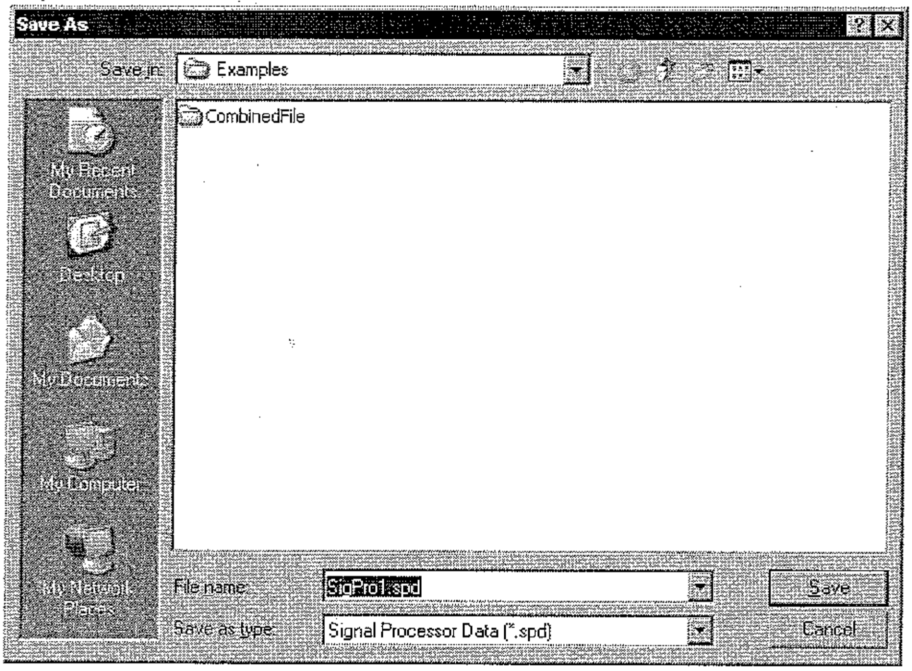


Figure 8.22: Dialog Save As

2. Navigate to the saving location and enter the file name.
3. Click Save.

☞ The file saved in this way does not contain any measurement data itself but only references to data. The reference among other things includes the full path name of the original measurement file. If you move or rename the measurement file, then the references to the measurement data become invalid. To permanently save your results, you have to add them to the original file. A file in the format .spd does not contain any data, just calculation specifications!

8.6.5 Example Applications for Editing Measurement Data

Complex average spectrum through all scan points

During data acquisition, the software calculates an average spectrum across all scan points. However, it is not complex averaging but the amplitudes of the individual spectra are calculated and these amplitudes are averaged. In this example you are shown how you can use the signal processor in presentation mode to help you calculate the complex averaged spectrum across all scan points and can then save it in the original file so that you have access to it at all times.

1. Set up a copy of the example file EXAMPLE2.SVD. To do so, copy the file from the sub-folder Examples in the PSV installation directory (normally C:\Programs\Polytec\PSV 8.2) into a directory of your choice.
2. Select File > New > Signal Processor to generate a new signal processor document.
3. Open the file EXAMPLE2.SVD and display the signal H1 Velocity / Voltage of the channel Vib & Ref1 in the domain FFT.
4. In the presentation window, click in the video image with the right mouse button and select Copy All Points in the pop-up menu.
5. Change to the signal processor.
6. Click the cell A1 with the right mouse button and select Paste in the pop-up menu. The data is available in the signal processor document.
7. Select the cell A2. To do so, click it.
8. Here you enter the command =StatMean(A1) and confirm it with Enter. The signal processor calculates the complex average through all scan points and shows this in the analyzer.

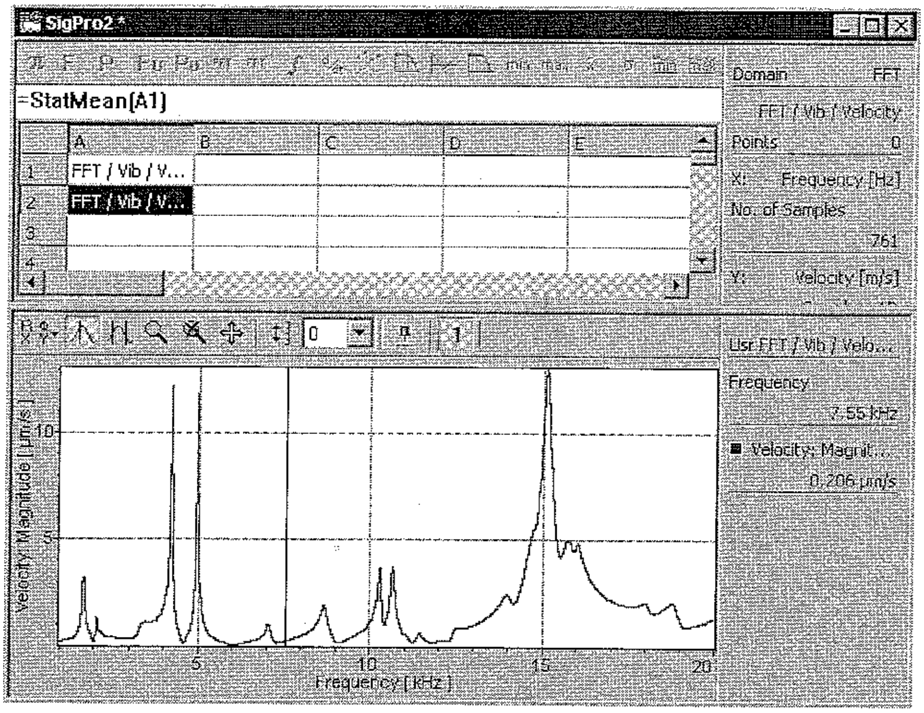


Figure 8.23: Display of the complex average through all scan points

☞ The average through all scan points is given the index 0.

9. Click [icon] in the toolbar of the analyzer and select the view Mag. [dB] & Phase in the pop-up menu to display both amplitude and also the phase of the average spectrum.

10. Click the cell A2 with the right mouse button and select Signal Description in the pop-up menu. The dialog Signal Description appears.

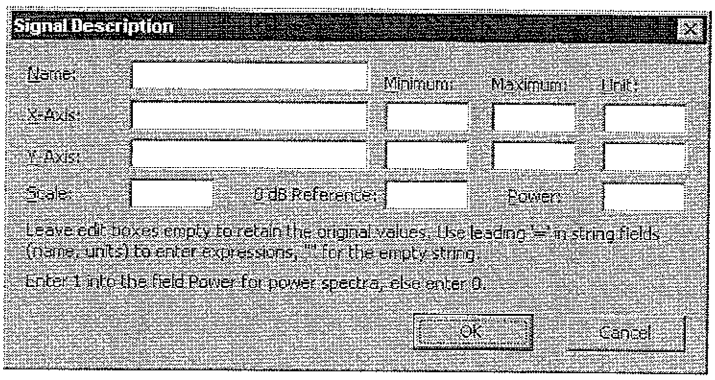


Figure 8.24: Dialog Signal Description

11. In the field Name enter the description Complex Average Spectrum and click OK to close the dialog.

12. Arrange the signal processor and the presentation window so that they are both completely visible. To do so, select Windows > Tile Horizontally.

13. Click the cell A2 in the signal processor.

14. Click the cell A2 again and holding the left mouse button pressed, drag the mouse cursor across to the presentation window. Release the mouse button there. This then means that the data in the cell A2 are added to the channel Usr as a user defined signal Complex Average Spectrum and are saved in the file.

    Or:

15. Click the cell A2 with the right mouse button and select Copy in the pop-up menu.

16. Change to the presentation window.

17. Here you select the view Average Spectrum.

18. Click the analyzer with the right mouse button and select Paste in the pop-up menu. The complex average spectrum is added to the document EXAMPLE2.SVD as a user defined signal.

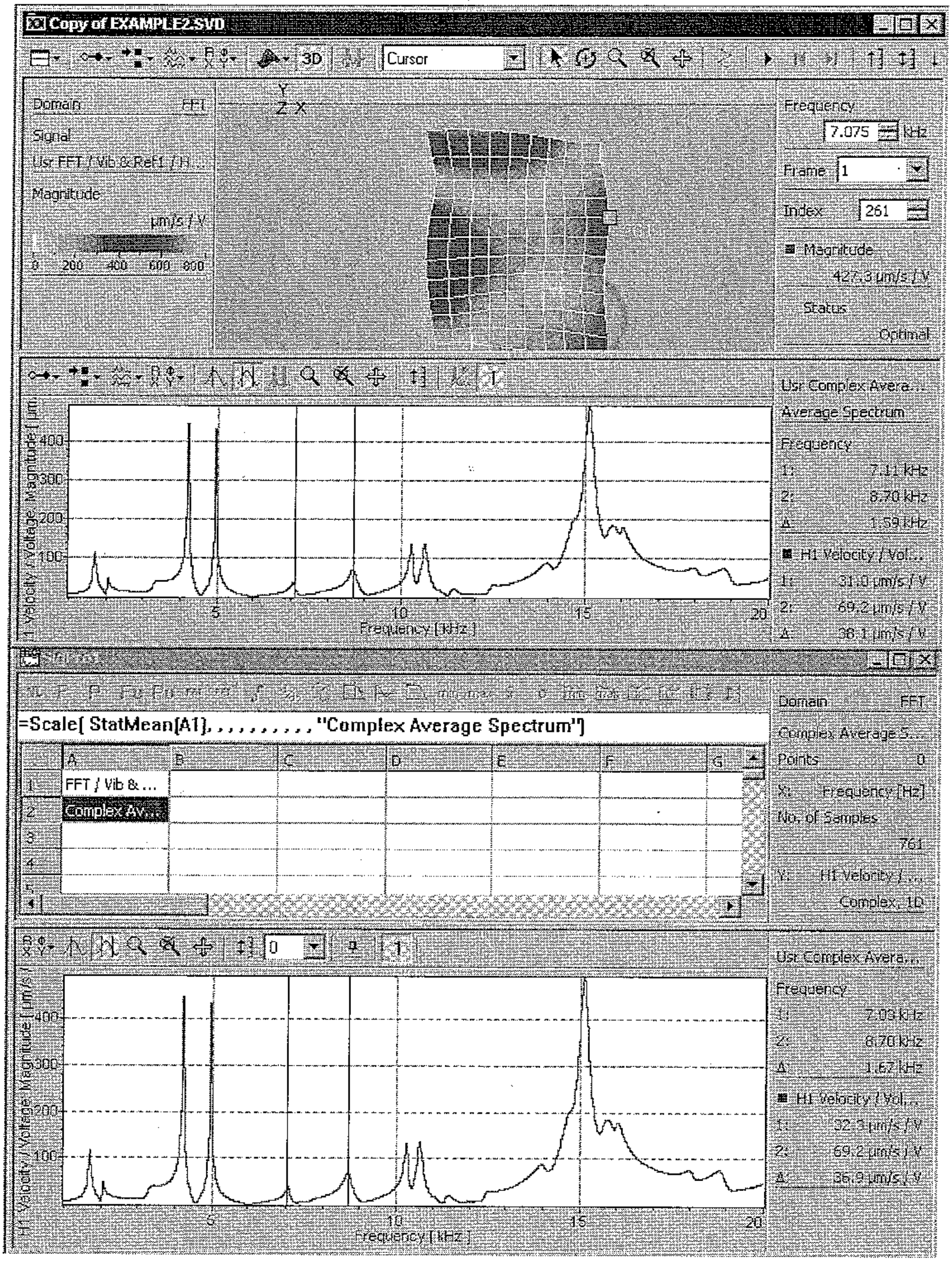


Figure 8.25: Display of complex average spectrum

You can now display the complex average spectrum again at any time. To do so, open the file EXAMPLE.SVD and select

- the view Average Spectrum in the presentation window,
- the channel Usr in the toolbar of the analyzer and
- the signal Complex Average Spectrum in the toolbar of the analyzer.

Multiplication of an FRF with the reference signal

An FRF (Frequency Response Function) is generated by dividing an answer signal (vibrometer signal) by a reference signal (excitation signal). The same applies to the signals H1 and H2. This means that the FRF has for example the unit Velocity/Voltage. The advantage of this process is that fluctuations in the excitation over the duration of the scan do not have any great effect because the measurement at every scan point relates to the excitation measured at this scan point. However, it is often desirable to show the answer in its original unit. This example shows how with the aid of the signal processor you can multiply the FRF with the average spectrum through all scan points of the excitation signal and can save and display the result in the original file.

1. Set up a copy of the example file EXAMPLE2.SVD. To do so, copy the file from the sub-folder Examples in the PSV installation directory (normally C:\Programs\Polytec\PSV 8.2) into a directory of your choice.
2. Select File > New > Signal Processor to generate a new signal processor document.
3. Open the file EXAMPLE2.SVD and display the signal H1 Velocity / Voltage of the channel Vib & Ref1 in the domain FFT.
4. In the presentation window, click in the video image with the right mouse button and select Copy All Points in the pop-up menu.
5. Change to the signal processor.
6. Click the cell A1 with the right mouse button and select Paste in the pop-up menu. The data is available in the signal processor document.
7. Change to the presentation window.
8. Here you select the signal Voltage of the channel Ref1.
9. In the presentation window, click in the video image with the right mouse button and select Copy All Points in the pop-up menu.
10. Change to the signal processor.
11. Click the cell A2 with the right mouse button and select Paste in the pop-up menu. The data is available in the signal processor document.
12. Click the cell A3.
13. Here you enter the command =A1*StatMean(A2) and confirm it with Enter. The signal processor first of all calculates the average of the spectra of the excitation signal through all scan points (StatMean(A2)) and multiplies the result at every spectrum of the signal H1, which is taken from the cell A1. The result is shown in the cell A3.

14. Click the cell A3 with the right mouse button and select Signal Description in the pop-up menu. The dialog Signal Description appears (refer also to figure 8.24).

15. In the field Name enter the description H1 Vib * Ref1 Velocity.

16. In the field Unit on the Y-axis enter the unit m/s.

17. In the field Y-Axis enter the description Velocity and click OK to close the dialog.

18. Arrange the signal processor and the presentation window so that they are both completely visible. To do so, select Windows > Tile Horizontally.

19. Click the cell A3 in the signal processor.

20. Click the cell A3 again and holding the left mouse button pressed, drag the mouse cursor across to the presentation window. Release the mouse button there. This then means that the data in the cell A3 is added to the channel Usr as a user defined signal H1 Vib * Ref1 Velocity and are saved in the file.

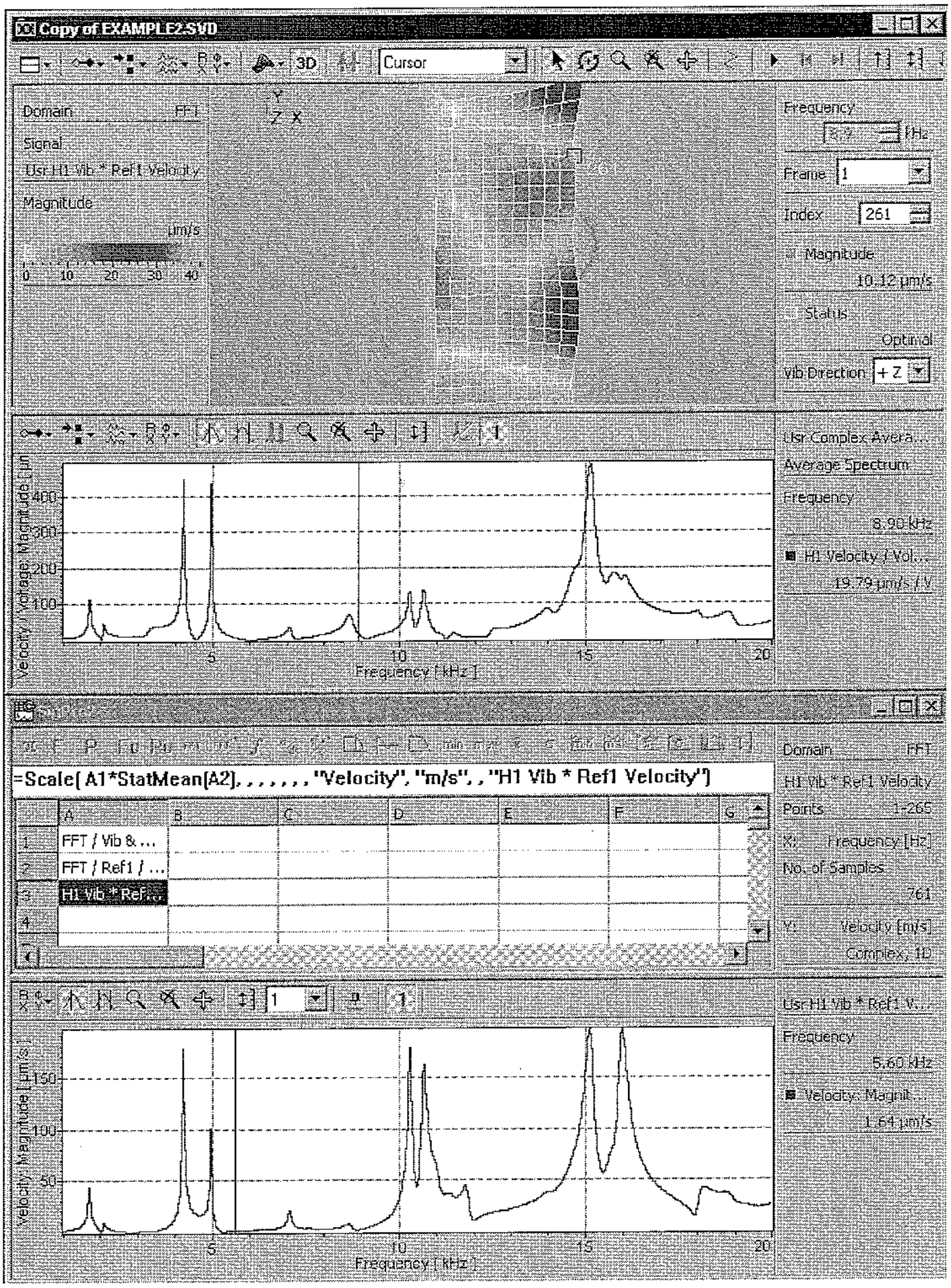


Figure 8.26: Display of the multiplication of FRF and reference signal

From now on you can display the signal H1 multiplied with the average spectrum of the reference channel at any time. To do so, open the file EXAMPLE2.SVD and select the channel Usr and the signal H1 Vib * Ref1 Velocity in the presentation window.

Postprocessing of time series

With the software option Time Domain Data, you can also capture data in the domain Time. With the aid of the signal processor this data can be evaluated. The following example shows the presentation of a time series of the response of a loudspeaker to a rectangular excitation signal.

1. Set up a copy of the example file Ex Time.pvd. To do so, copy the file from the sub-folder Examples in the PSV installation directory (normally C:\Programs\Polytec\PSV 8.2) into a directory of your choice.
2. Select File > New> Signal Processor to generate a new signal processor document.
3. Open the file Ex Time.pvd and display the signal Velocity of the channel Vib in the domain Time.
4. Click in the analyzer with the right mouse button and select Copy in the pop-up menu.
5. Change to the signal processor.
6. Click the cell A1 with the right mouse button and select Paste in the pop-up menu. The data is available in the signal processor document.
7. Click the cell A1. In the analyzer of the signal processor you will see a graphic representation of the time series measured.
8. Click the cell A2.
9. Here you enter the command =Integrate(A1) and confirm with Enter.
10. Click the cell A2 with the right mouse button and select Signal Description in the pop-up menu. The dialog Signal Description appears (refer also to figure 8.24).
11. In the field Name, enter the description Integrated to displacement.
12. In the field Y-Axis, enter the description Displacement.
13. In the field Minimum of the Y-Axis, enter the value −10e−6.
14. In the field Maximum of the Y-axis, enter the value 10e−6.
15. In the field Unit of the -Axis enter the unit m and click OK to close the dialog.

    The analyzer will now display the displacement signal gained by integrating the velocity signal. Along the time axis you will be able to see a linear decay in the signal. This decay is caused by a negative offset on the velocity signal which has an increased effect due to insufficient modulation of the data acquisition board when acquiring the velocity signal.

16. Copy the content of cell A2 into cell B2. To do so, select cell A2 and press the key combination Ctrl+C. Then select cell B2 and press the key combination Ctrl+V.

17. Click in the formulae editor where the formula from cell B2 is displayed.

18. There replace the parameter (A1) of the function Integrate by entering (A1-Mean(A1)) and confirm the change with Enter.

    This change to the formula means that the offset from the time series is subtracted in cell A1. For this purpose, first of all the average of the time series is determined and this average is subtracted from every time value in the time series. As the time series is periodic in the time window measured, this has the effect of completely correcting for the offset.
    Then the integration is calculated.

19. Click the cell B2.

20. Then also select the cell A2. To do so, hold the Ctrl key pressed and click the cell A2.

    The analyzer in the signal processor now shows two graphs. One corresponds to the signal in cell B2 and one to the signal in cell A2. Through a direct comparison of the graphs you can clearly see the disappearance of the linear decay by correction of the offset.

21. Click cell B3 and enter = here.

22. Then click  in the toolbar of the signal processor. This command inserts a template for the function FFT into the input field and the formulae editor.

23. Replace the descriptions VibData with B2, Lines with 256 and Window with "Rectangle" and delete the two descriptions WindowParameter. In doing so, make sure that you put the description "Rectangle" in inverted commas.

24. Confirm the change with Enter.

25. Click the cell B3 with the right mouse button and select Signal Description in the pop-up menu. The dialog Signal Description appears (refer also to figure 8.24).

26. In the field Name, enter the description FFT displacement.

27. In the field X-Axis, enter the description Frequency.

28. In the field Unit of the X-Axis, enter the unit Hz and click OK to close the dialog.

    From the 512 samples of the integrated time series in cell B2, the signal processor will now calculate an FFT with 256 lines and will display this in the analyzer.

29. Arrange the signal processor and the presentation window so that they are both completely visible. To do so, select Windows > Tile Horizontally.

30. Click the cell B2 in the signal processor.

31. Click the cell B2 again and holding the left mouse button pressed, drag the mouse cursor to the analyzer. Release the mouse button there. This process adds the data in cell B2 as a user defined signal Integrated to displacement to the channel Usr and saves it in the file.

32. Repeat steps 30 and 31 for the cell B3. This means you are saving the content of the cell as a user defined signal FFT displacement in the file.

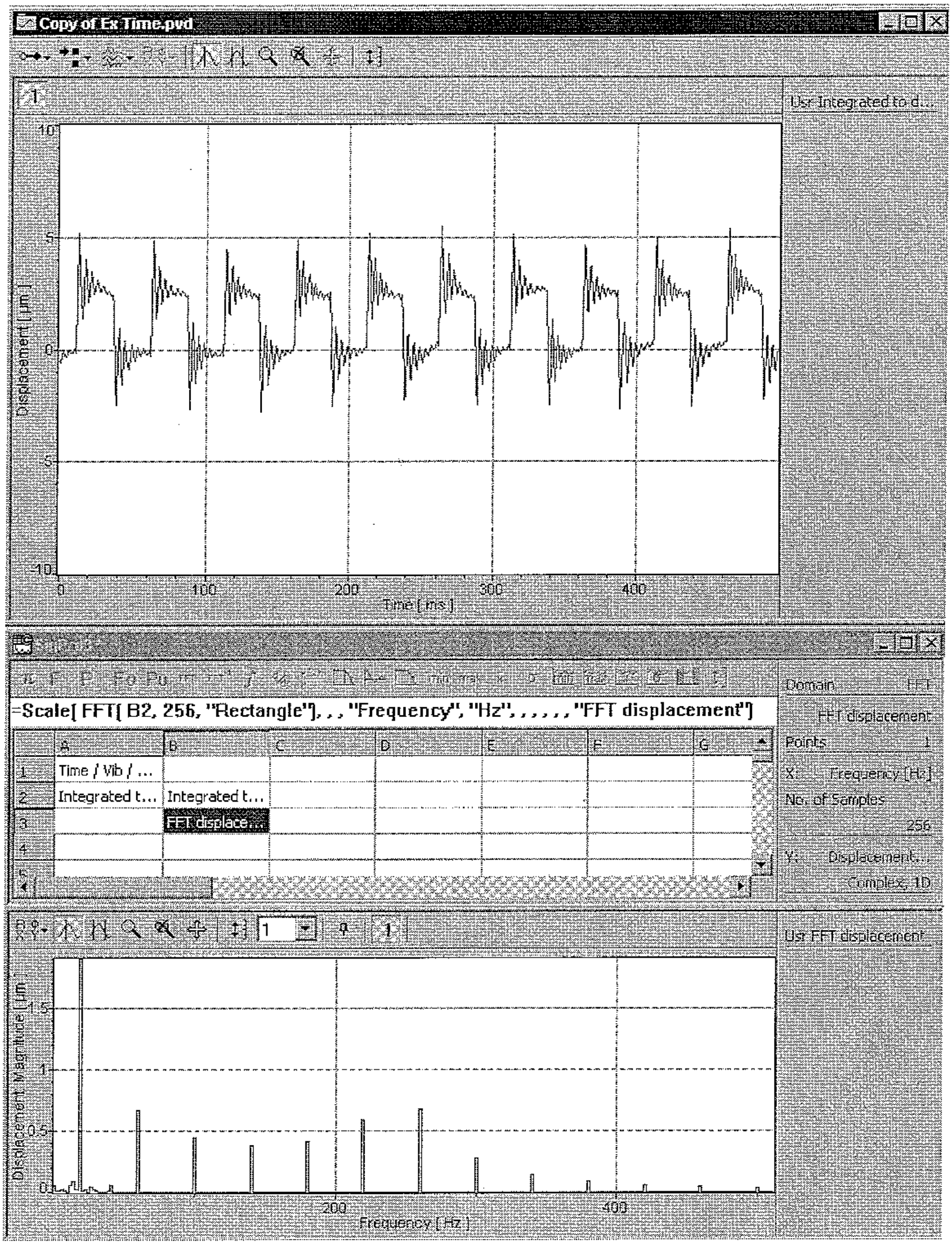


Figure 8.27: Display of postprocessed time series

You can now display the integrated time series and the FFT calculated from it at any time. To do so, open the file Ex Time.pvd and select the domain FFT or Time and the channel Usr.

9 Evaluating Scans

The software offers numerous possibilities to evaluate scans. To do this, first open the scan as described in section 10.1.1. Depending on which measurement mode you used to acquire the data, you will see the results of your measurement in the time or frequency range.

You can see which mode a measurement was carried out in by opening the additional information in the dialog at the bottom of a file.

If you have opened a scan, you will see in the status bar which mode the measurement was carried out in.

If you open a scan, which has been generated in FFT mode, in presentation mode for the first time, you will see the root mean square of the magnitude over the whole bandwidth. You can apply certain evaluation functions directly to the root mean square. See section 9.1 and section 9.3 on this. You can also evaluate sections of the measured spectrum – for example, in the proximity of resonance or 1/3 octave bands. To do so, you first have to define these frequency bands as described in section 9.2. At the peak frequencies of the frequency bands you can also animate the vibration, see section 9.4 on this. You can also evaluate the spectrum with a single cursor, on this refer to section 9.2.1.

In FastScan mode you only measure a certain individual frequency. Correspondingly you will only see a surface-like presentation of the data of this frequency if you open the scan in presentation mode.

If you open a scan generated in Time mode for the first time in presentation mode, you will see the root mean square of the magnitude over the whole sample time. With the time data animation you can present the momentary magnitude of the sample time for selected ranges.

9.1 Processing Data

You can prepare a scan for display with the following commands in the menus Edit and Presentation:

- invalid
- Valid
- Invalidate Not Optimal Points
- Interpolate Data
- Filter Data

In addition you can change specification of vibrational direction

You can undo all commands.

In presentation mode you can mark the scan points you have already measured to be measured again. To do so, allocate the points the status Invalidated as described in the following. Then change back into acquisition and open the file to measure again as described in section 6.2.

In principle, you could give all scan points the status Invalidated, but this is only necessary for those points which have not provided any meaningful measurement result (e.g. those with a bad signal-to-noise ratio). For scan points with the status Invalidated the software does not display any measurement data. The averaged spectrum over all scan points is corrected correspondingly.

☞ Scan points with the status Optimal can only be present if Signal Enhancement was active during scanning (refer to section 6.7.1 and section 7.2.7).

Invalidate

To allocate the status Invalidated to one or several scan points, proceed as follows:

1. Place a cursor at the scan point or points. See section 8.3.4 on this.
2. Press the key combination Ctrl+space bar or select Edit > Modify Selected Points > Invalidate.
3. To reinstate the original status of the scan points, press the key combination Shift+space bar or select Edit > Modify Selected Points > Valid.

Invalidate Not Optimal Points

You can allocate the status Invalidated to all scan points which do not have the status Optimal. This command is only active if

- Signal Enhancement was active while scanning (refer to section 6.7.1 and section 7.2.7)
- not all scan points have got the status Optimal.

To do so, proceed as follows:

1. Select Edit > Invalidate Not Optimal Points.
2. To return to the initial status of the scan points, select Edit > Invalidate Not Optimal Points again.

☞ If you had changed the status of single scan points with the command Invalidate (see above), these scan points are also allocated their original status.

Interpolate Data

For scan points with the status Overrange or Invalid the software does not display any measurement data. You can interpolate and display data from neighboring scan points for these as well as for not optimal scan points.

☞ The software allocates the status Overrange while scanning. You can allocate the status Invalidated manually (see above).

To interpolate, proceed as follows:

1. Select Presentation > Interpolate Data. If you would like to interpolate not optimal points as well, then in addition to that select Edit > Invalidate Not Optimal Points.

2. To undo the command, select Presentation > Interpolate Data again.

> **Caution!**
>
> If Interpolate is active, then in ASCII export only the interpolated data is saved. If you export as a Universal File or access via Polytec File Access, you will obtain the original data.

Filter Data

You can smooth the display of scans with a filter. Filtering is done on two levels. First of all median averaging and then center value filtering of neighboring scan points is carried out.

To smooth the display, proceed as follows:

1. Select Presentation > Filter Data.

2. To undo the command, select Presentation > Filter Data again.

> **Caution!**
>
> If Filter Data is active, then in ASCII export, only the smoothened data is saved. If you export as a Universal File or access via Polytec File Access, you will obtain the original data.

☞ The commands Interpolate Data and Filter Data represent measures taken to rid measurements of interference signals and noise levels. When defining the quantity of scan points, already ensure that there is a sufficient scan point density, depending on the maximum vibration frequency in the object to be measured. Careful scan point definition also helps avoiding interference signals caused by unsuitable selection of scan points, e.g. glancing incidence at the edge of an object or undesirable measurements in object openings.

Change specification of vibrational direction

You can still retrospectively change the direction of the vibration in the presentation window. The vibration direction shown in the legend is the one you selected in the dialog Acquisition Settings on the page Channels (refer to section 7.2.2). Here you can select the direction of the vibration.

☞ You can not change the direction of the vibration for 3D geometries.

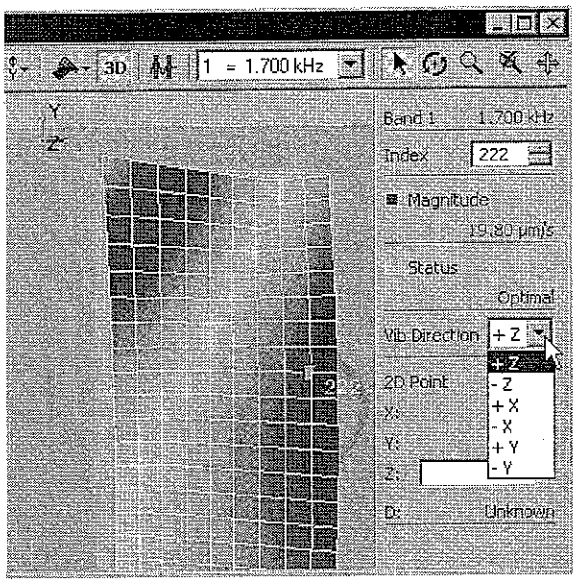


Figure 9.1: Selecting vibration direction

The direction of the vibration defines the scanning head coordinate system. Read up on this in section 4.1 as well (Enter coordinates of axes) and in your theory manual.

9.2 Evaluating Sections of a Spectrum

You can evaluate sections of the measured spectrum. There are two ways of doing this: Select the required points in the spectrum with a cursor, or define so-called frequency bands.

9.2.1 Setting Cursors and Evaluating the Frequency Range (Cursor Mode)

Requirement

With a single cursor you can evaluate spectra for scans which contain a complete spectrum. Scans without a complete spectrum are those

- in which only frequency bands are saved (refer to section 10.2.1)
- which were measured in the measurement mode FastScan
- which were measured in the measurement mode Time.

For evaluation, proceed as follows:

1. Select the domain FFT.
2. From the list Frequency Band, in the toolbar of the presentation window, select the entry Cursor.

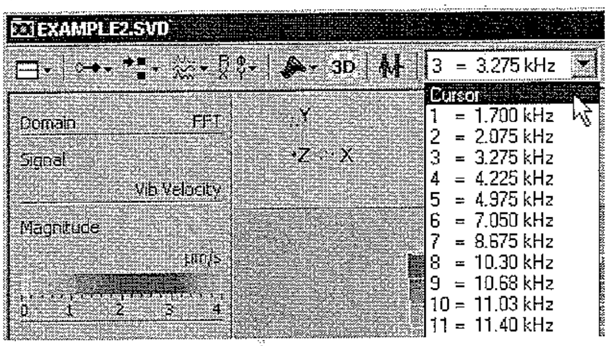


Figure 9.2: Select the entry Cursor

3. Set a single cursor in the analyzer as described in section 8.2.3. The frequency and the amplitude at the current cursor position can be seen in the legend on the right. If the legend is not visible on the right in the analyzer, select Analyzer > Legend to display it. In the presentation window you will see the vibration position which the object under investigation takes at the selected frequency.
4. Drag the cursor while holding the left mouse button pressed to the left or right. This updates the data in the legend and the analysis window.

☞ If you do not set a cursor or delete the cursor you had set, you can also enter the required frequency directly in the legend of the presentation window.

9.2.2 Defining Frequency Bands (not in Time Mode)

To analyze the spectrum with the aid of frequency bands, start by entering the start and end frequencies of the frequency band in the frequency band definition. The software determines the peak frequency and the bandwidth of the frequency bands.

Requirement

You can define frequency bands for scans

- whose file is not write-protected and
- which contain a complete spectrum.

Scans without a complete spectrum are those

- in which only frequency bands are saved (refer to section 10.2.1)
- which were measured in the measurement mode FastScan
- which were measured in the measurement mode Time.

Save

The software automatically saves the frequency band definition in the scan and loads it when you reopen the scan. You can also save frequency band definitions separately as an ASCII file and load them into several scans. See section 10.2.5 and section 10.1.2 on this.

☞ As a general rule, every change to a file is marked with an asterisk (*) in the file name as soon as you make the change. When calculating frequency bands, all changes made thus far are saved.

Define

To define frequency bands, proceed as follows:

1. Either display the view Single Scan Point or Average Spectrum. To do so, click and select Single Scan Point or Average Spectrum.
2. Open the frequency band definition. To do so, click or select Setup > Frequency Bands. The dialog Frequency Band Definition appears.
3. Enter the start and end frequencies of the frequency bands as described below. You have two possibilities to do so: directly in the analyzer or in the dialog Frequency Band Definition. The software determines the peak frequencies of the frequency bands for the data set displayed in the view set.
4. You can change between different views or display other data sets without closing the frequency band definition. The software does not determine the peak frequencies again at that point. To determine the peak frequencies again, in the dialog Frequency Band Definition click .
5. If the software is to calculate 1/3 octave bands, then in the dialog Frequency Band Definition click .
6. When you have defined all frequency bands, close the frequency band definition. To do so, click again or select Setup > Frequency Bands. The software calculates the root mean square of the frequency bands and saves them in the scan.

Analyzer

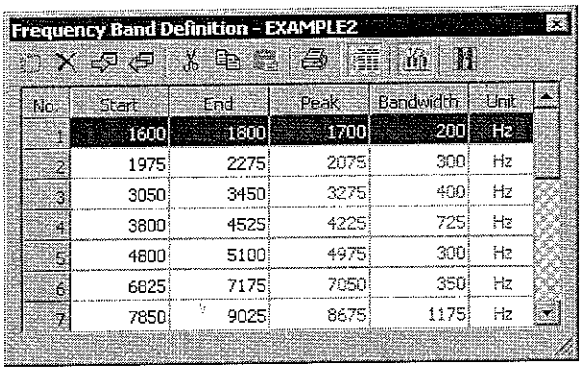
To enter start and end frequency of a frequency band directly in the analyzer, proceed as follows:

1. Click in the analyzer.
2. Point at the diagram (not at the edge of the diagram).
3. Point at the start point of the required frequency band.
4. Press the mouse button and then drag right or left to the end point. The software displays the frequency band in color and enters it in the dialog Frequency Band Definition (see below).

Dialog

To enter start and end frequency of a frequency band in the dialog Frequency Band Definition, proceed as follows:

1. The dialog Frequency Band Definition consists of a toolbar and a table, the frequency band editor. If you can not see the table, display it. To do so, in the toolbar, click .



No.	Start	End	Peak	Bandwidth	Unit
1	1600	1800	1700	200	Hz
2	1975	2275	2075	300	Hz
3	3050	3450	3275	400	Hz
4	3800	4525	4225	725	Hz
5	4800	5100	4975	300	Hz
6	6825	7175	7050	350	Hz
7	7850	9025	8675	1175	Hz

Figure 9.3: Dialog Frequency Band Definition

2. In the toolbar, click . A new line is added to the bottom of the table.
3. Enter the start frequency in hertz. The start and end frequency must be on FFT lines. The software replaces the value entered by the next possible one.
4. Press Tab or click the corresponding cell in the column End.
5. Enter the end frequency in hertz.
6. Press Enter. The software enters the peak frequency and the bandwidth in the frequency band editor and displays the frequency band in the analyzer in color.

Select

To delete or copy frequency bands from the definition, you have to select them first. To do so, proceed as follows:

1. Click the frequency band in the analyzer or its line number in the frequency band editor.
2. To select further frequency bands, press the Control key and click the number of the line in the frequency band editor.
3. To select all frequency bands or to undo a selection, click the top left of the table.

Delete

To delete frequency bands from a definition, proceed as follows:

1. Select the frequency bands as described above.
2. Press the Delete key or in the frequency band editor, click .

Copy

You can copy a frequency band definition via the clipboard into another scan. To do so, proceed as follows:

1. Select the frequency bands as described above.
2. In the dialog Frequency Band Definition, click .
3. Close the frequency band definition. To do so, in the presentation window click or select Setup > Frequency Bands.
4. Open the scan into which you want to copy the frequency bands.
5. Open the frequency band definition again.To do so, click or select Setup > Frequency Bands.
6. In the dialog Frequency Band Definition, click .

Drag with the mouse

You can also apply frequency bands to another scan in the project browser by dragging with the mouse. To do so, proceed as follows:

1. Holding the left mouse button pressed, drag the entry Frequency Band from the project browser to the frequency Band definition.

Figure 9.4: Entry Frequency Band in the project browser

2. Close the frequency band definition. A message box appears with the question whether the frequency bands are to be recalculated.
3. Click Yes.

9.3 Displaying Profiles

You can display profiles of the data. To do so, you first draw profile sections on the object. You will see the profiles at the bottom in the analyzer. The software automatically saves the profile sections in the scan and loads them when you reopen the scan.

☞ If you want to draw profile section in a file (including a combined file) or want to display a profile, you first of all have to change over to 2D view.

Draw profile section

To draw a profile section on the object, proceed as follows:

1. Display the Profile view. To do so, click and select Profile in the pop-up menu.
2. Display the view style Surface, Wireframe, Isolines or Scan Points. To do so, click and select the view style in the pop-up menu.
3. Click .
4. Point at the object and click the start point of the profile section. The cursor becomes a .
5. Click as many other vertex points as you like. You can see the profile at the bottom in the analyzer.
6. To define the end point of the profile section, double-click.

Select profile sections

To edit profile sections, you have to select them first. To do so, proceed as follows:

1. Click .
2. Point at a profile section. The cursor becomes a .
3. Click. The software marks the vertex points of the profile section with white handles.
4. To select further profile sections, click them while holding the shift key pressed.
5. To select all profile sections, press the key combination Ctrl+A or select Edit > Select All.
6. To remove a profile section from the selection, click it while holding the shift key pressed. The white handles disappear.

Move profile sections

To move profile sections, proceed as follows:

1. Select the profile sections as described above.
2. Point at one of the lines (not at a vertex point). The cursor becomes a .
3. Press the mouse button and drag in the direction required.

Move vertex points

You can change the shape of profile sections by moving the individual vertex points. To do so, proceed as follows:

1. Select a profile section as described above.
2. Point at a vertex point. The cursor becomes a .
3. Press the mouse button and drag in the direction required.

Duplicate profile sections

To duplicate profile sections, proceed as follows:

1. Select the profile sections as described above.
2. Click or select Edit > Copy. The profile sections are copied onto the clipboard.
3. Click or select Edit > Paste.

Delete profile sections

To delete profile sections, proceed as follows:

1. Select the profile sections as described above.
2. Press the Delete key or select Edit > Delete.

Animate

You can animate the profiles' vibrations. See section 9.4 on this.

9.4 Animating Vibrations

For you to be able to animate the measured vibration, during the scan either the signal has to be triggered (phase-related measurement) or a reference signal has to have been captured.

☞ In the measurement mode Time you can not capture a reference signal.

9.4.1 Measurement Mode FFT, Zoom-FFT, FastScan, MultiFrame

If you have carried out a measurement in one of the above mentioned modes, you can set how many images per animation cycle are shown.

To animate a vibration, proceed as follows:

Preparation

1. Define frequency bands for the scan. See section 9.2 on this.
2. Display the frequency band whose peak frequency you want to animate.

   Or:
3. Go to cursor mode (refer to section 9.2.1).
4. Display the FFT spectrum. To do so, click and select FFT in the pop-up menu.
5. Display a complex signal.

☞ For complex signals, the display type Phase is available.

6. It is useful to display the 3D view style. To do so, click 3D. You can animate in all view style apart from the Status view style.
7. If from the list Frequency Band in the toolbar of the presentation window you select the entry Cursor, then depending on the size of the file and the memory capacity of your computer, the following dialog may appear:

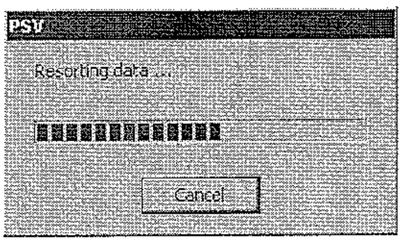


Figure 9.5: Resorting data

If you click Cancel here, you will be given the following message:

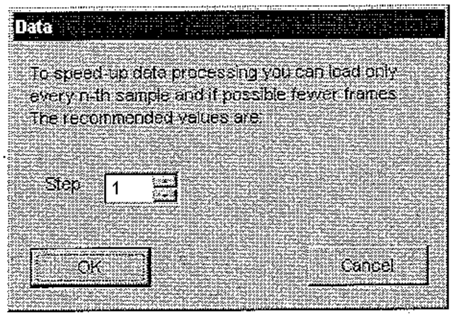


Figure 9.6: Dialog to reduce the quantity of data (general)

It is recommended that you use the suggested value or enter a higher one. Click OK. Subsequently the data will be resorted and you can start animation.

☞ If you set a smaller step size than the one suggested, the subsequent resorting of the data can take quite some time!

User defined data sets

If you are working with user defined data sets (see section 8.6 on this as well), you can also evaluate these.

8. To do so, click and select the channel Usr in the pop-up menu. It is also necessary to resort the data for this. If you abort this, the dialogs shown in figure 9.5 and figure 9.6 will also be shown. In addition to this you can also limit the display of frames here to reduce the quantity of data. The same recommendations as above also apply here.

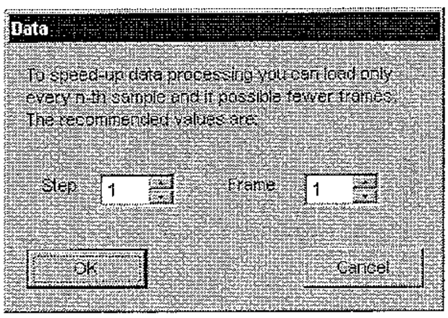


Figure 9.7: Dialog to reduce the quantity of data (for user defined data sets)

Start

There are two ways of starting animation:

9. To start the animation in the active presentation window, click or select Animation > Start. The software shows the signal in the display type Instant Value and animates the vibration. You can see the instantaneous angle in the legend in the field Angle 120°. If the legend is not visible on the right of the object, select Presentation > Legend to display it.

or

To start animations simultaneously in all open presentation windows, select Animation > Start All.

Velocity

10. To increase or decrease the speed of the animations, select Animation > Increase Speed or Animation > Decrease Speed.

Stop

There are two ways of stopping animations:

11. To stop the animation in the active presentation window, click again or select Animation > Stop.

or

To stop all current animation, select Animation > Stop All.

Step forward, step backward

You can manually make animations run forwards and backwards. To do so, click and or select Animation > Step Forward and Animation > Step Backward. You will see the next or previous animation frame respectively.

Frames per animation cycle

If you have carried out the measurement in FFT mode, you can set the number of frames per animation cycle in the dialog Preferences. To open the dialog, select Setup > Preferences. Then display the page Display.

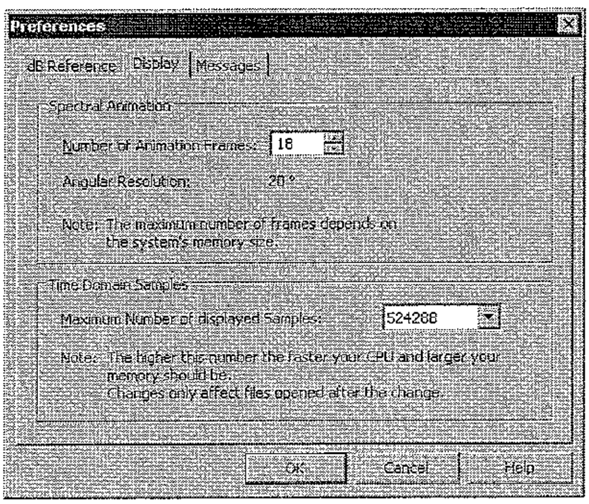


Figure 9.8: Page Display in the dialog Preferences

Number of Animation Frames: Here you enter how many frames per animation cycle you want to see. The minimum number is 8, the maximum number depends on the capacity of your computer's memory. The default setting is 18.

Angular Resolution: The software calculates the phase angle between the data of two frames and displays it here.

Maximum Number of displayed Samples: Here you enter an upper limit for the number of samples to be shown simultaneously in the time domain.

Scale

You can scale the degree of deflection in the animation with non-scalar data. To do so, you have three possibilities:

- To increase the deflection shown, click or select Presentation > Scale Up.
- To show the deflection with the default setting, click or select Presentation > Auto Scale.
- To weaken the deflection shown, click or select Presentation > Scale Down.

Display the vibrational directions (only 3D data)

Once you have made a measurement with the PSV-3D you can show the vibrations of the object individually in x, y and z direction. You can also combine displaying two vibrational directions with each other. To display and hide the vibrations in the various directions, click the icons X, Y and Z. If the letter in the icon is shown in black, then the vibration is being shown in the respective plane. If the letter in the icon is shown in gray, then the vibration is not being shown in the respective plane.

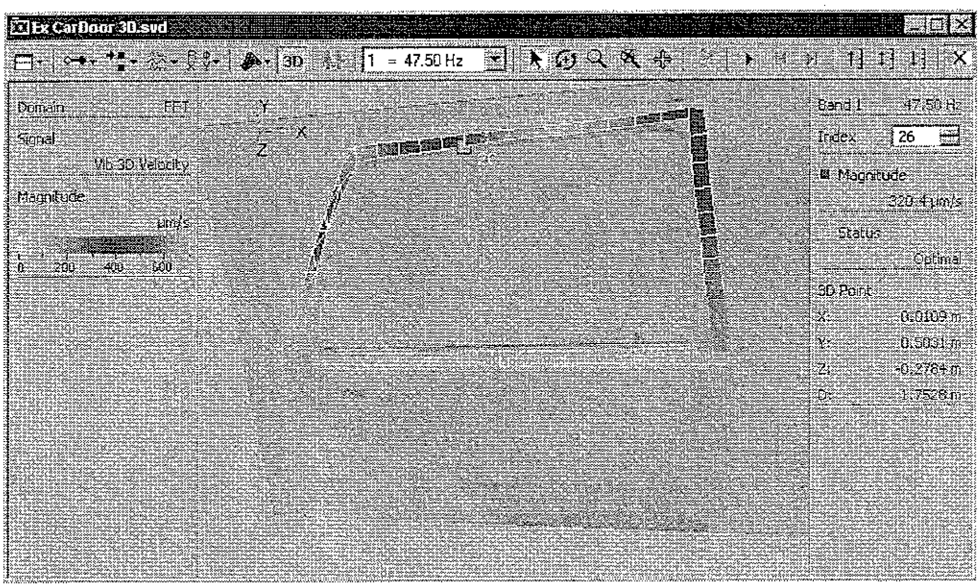


Figure 9.9: Presentation window in the view Object

Save

You can save animations in multimedia format *.avi. See section 10.2.6 on this.

9.4.2 Measurement Mode Time

If you have carried out the measurement in Time mode, you will see the animation in the time domain. To animate a vibration, proceed as follows:

Preparation

1. Display the time domain. To do so, click and select Time in the pop-up menu.

   Depending on the size of the scan file and capacity of your computer's memory, the following dialog may appear:

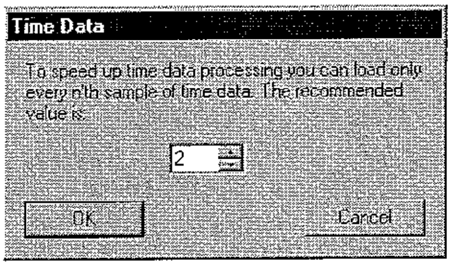


Figure 9.10: Dialog for reducing the time data step size

It is recommended that you use the suggested value or enter a higher one. Click OK. This means that the time data is resorted and the z-axis scaled correspondingly and you can start the animation in time domain.

☞ If you set a smaller step size than the one suggested, the subsequent resorting of the time data can take quite some time!

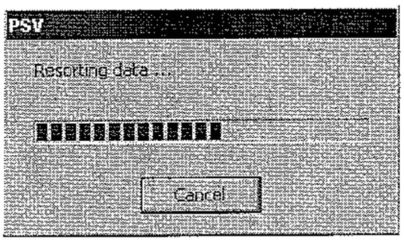


Figure 9.11: Resorting data

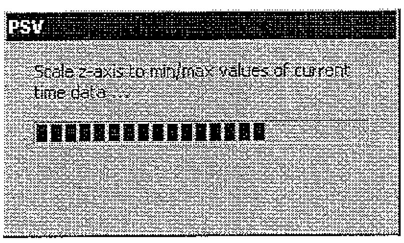


Figure 9.12: Scaling the z-axis

☞ If you click Cancel during resorting, the dialog to reduce the time data step size opens again (refer to figure 9.10).

To return to RMS mode, click Cancel.

2. It is useful to display the 3D view style. To do so, click 3D. You can also animate in all other view styles, however not in the Status view.

3. Select the section within the sample time in which the data is to be animated. There are two ways to do this:

   - Enter the start and end time directly into the legend to the right of the presentation window. If the legend is not visible, select Presentation > Legend to display it.

or

Open an analyzer. To do so, click and select Single Scan Point.

Click and with a further mouse click, set the starting point directly in the diagram. (As initially the starting point is identical with the current point in time, it is marked by a red line.)
Hold the mouse button pressed and drag it to the right. A second black line will appear which marks the end point. If the line is in the right place, release the mouse button.

Start

There are two ways of starting animation:

4. To start the animation in the active presentation window, click or select Animation > Start. You can see the defined time frame and the current status of the animation and also the step size in the legend.

or

To start animations simultaneously in all open presentation windows, select Animation > Start All.

You can let the animation run forwards or backwards and stop it at any time, change its speed or save it as described in the following:

Velocity

5. To increase or decrease the speed of the animations, select Animation > Increase Speed or Animation > Decrease Speed.

Stop

There are two ways of stopping animations:

6. To stop the animation in the active presentation window, click again or select Animation > Stop.

or

To stop all current animation, select Animation > Stop All.

Step forward, step backward

You can manually make animations run forwards and backwards. To do so, click  and  or select Animation > Step Forward and Animation > Step Backward. You will see the next or previous animation frame respectively.

Save

You can save animations in multimedia format *.avi. See section 10.2.6 on this.

10 Managing Data

10.1 Opening Files

The software can open the following files:

- scans in proprietary binary format Scan Data *.svd
- single point measurements in proprietary binary format Single Point Data *.pvd
- signal processor files in proprietary binary format *.spd,
- frequency band definitions in ASCII format
- settings in proprietary binary format *.set.

☞ You can only open files which have been generated with the same or an older version of the software.

Once you have opened a file, you can use the command Info to display additional information in the project browser which you saves with the file. See also section 2.7.4 on this. The dialog File Information appears.

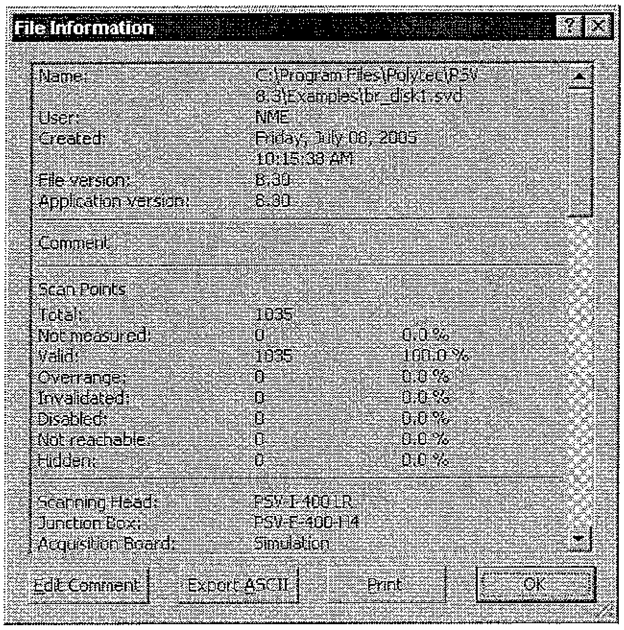


Figure 10.1: Dialog File Information

10.1.1 Opening Scans, Single Point Measurements and Signal Processor Documents

In presentation mode, you can open scans and single point measurements in the proprietary binary formats Scan Data *.svd and Single Point Data *.pvd. There are two ways of doing this:

- the dialog Open
- the list of most recent files in the menu File.

You can also open the last scan measured if you change into presentation mode. To do this, follow the instructions in the software.

You can use the project browser to open the files, refer to section 2.7.4 on this.

Dialog

To open a scan or a single point measurement, proceed as follows:

1. Click  or select File > Open. The dialog Open appears.

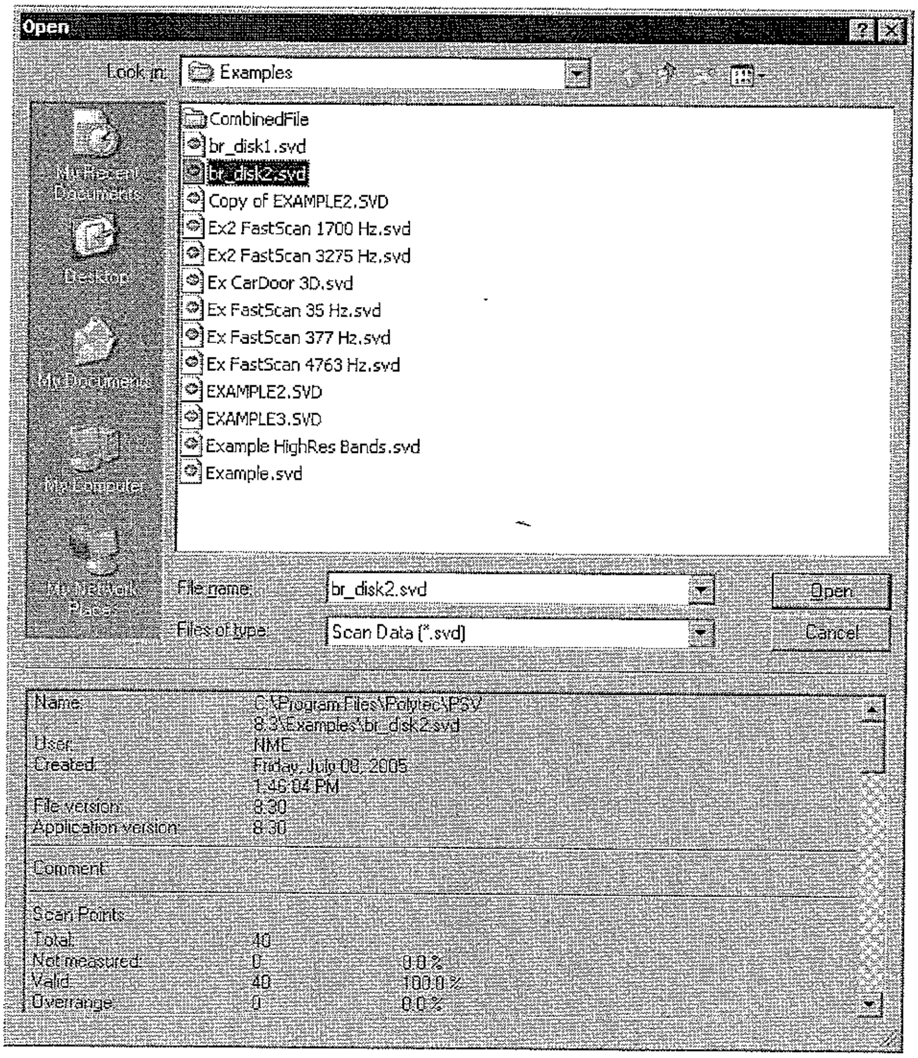


Figure 10.2: Dialog Open

2. Navigate to the saving location and select the file type and name. To make it easier to identify the files, look at meta-information at the bottom in the dialog – for example, the data acquisition board and the settings with which the data was measured.
3. Click Open. If you open a scan, a presentation window appears. If you open a single point measurement, an analyzer appears.

File list

In presentation mode, in the menu File at the bottom there is a list with up to nine files which you last opened. In the menu File at the bottom there is a list with up to nine files which you last opened.To open one of these files again, click it in the list.

10.1.2 Loading Frequency Band Definition

In presentation mode, you can load frequency band definitions in ASCII format.

☞ When you load a frequency band definition, the existing one is overwritten.

To load a frequency band definition, proceed as follows:

1. Open the scan you want to load a frequency band definition for. See section 10.1.1 on this.
2. Open the frequency band definition. To do so, click . The dialog Frequency Band Definition appears.
3. In the dialog Frequency Band Definition, click . The dialog Open appears.
4. Navigate to the saving location and select the file.
5. Click Open.
6. Close the frequency band definition. To do so, click  again.

10.1.3 Loading and Deleting Settings

In acquisition mode, you can load settings from files in proprietary binary format *.set and load them from measurement files. You can only delete settings if they are saved in a settings file (*.set). You can not delete the settings of a measurement file.

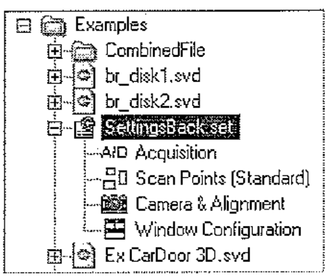
You can load the following information from setting files and measurement files:

- the settings for data acquisition in the dialog Acquisition Settings (only possible for identical data acquisition boards)
- the scan point definition
- the settings of the optics (alignment, only PSV 400 and PSV 300: zoom and focus of the video camera)
- the window configuration (not possible from scans).

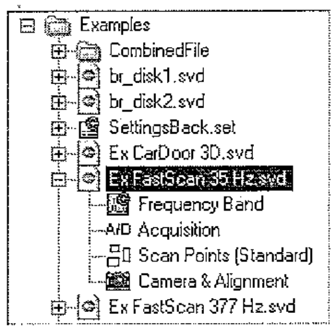
Load

To load settings, proceed as follows:

1. Open the project browser (refer tosection 2.7.4).
2. Open a directory which contains setting files or measurement files.
3. Click the plus sign (⊞) in front of the setting file (*.set) or measurement file (*.svd), whose settings you want to load. You will see a list of settings which are saved in the file.



Settings in the setting file



Settings in the measurement file

Figure 10.3: List of saved settings

Load individual settings

4. If you only want to load certain settings from a file, mark them. To mark several settings at once, hold the control key pressed and click the respective settings.
5. Double-click the selected line(s).

   Or:
   Click the marked settings with the right mouse button and select Load in the pop-up menu.

Load all settings

6. If you want to load all settings from a setting file, double-click the file name.

   Or:
   Click the file name with the right mouse button and select Load in the pop-up menu.

A message box appears with the question whether you want to overwrite your settings until now. Click Yes.

Delete

To delete settings, proceed as follows:

☞ You can only delete settings if they are saved in a settings file (*.set). You can not delete the settings of a measurement file.

1. Open the project browser (refer to section 2.7.4).

2. Click the plus sign (⊞) in front of the setting file (*.set), whose settings you want to delete. You will see a list of settings which are saved in the file (refer to figure 10.3).

Delete individual settings

3. If you only want to delete certain settings from the setting file, mark them. To mark several settings at once, hold the control key pressed and click the respective settings.

4. Click the marked settings with the right mouse button and select Delete in the pop-up menu.

Delete the setting file

5. If you want to delete the setting file, click the file name with the right mouse button and select Delete in the pop-up menu.

10.2 Saving and Exporting

The software provides the following ways of saving and exchanging data:

- save scans in proprietary binary format Scan Data *.svd
- save scans with frequency band data, but without point data in proprietary binary format Scan Data *.svd
- save scans with user defined data sets, but without frequency band data and original point data in proprietary binary format Scan Data *.svd
- save single point measurements and average spectrum in the proprietary binary format Single Point Data *.pvd
- export measurements in Universal File Format *.uff (as an option)
- export measurements in ME'Scope format (as an option)
- saving frequency band definitions in ASCII format
- save animations in multimedia format *.avi
- save settings in proprietary binary format *.set
- export measurement data in ASCII format
- save windows in various graphics formats
- copy windows as graphics onto the clipboard.
- newly calculated measurement files as a signal processor document in the format *.spd.

10.2.1 Saving Scans

Complete scan

When you start a scan, the software automatically creates a file for the scan and prompts you to save. See section 6.2 on this. When scanning, the software saves the following data in proprietary binary format Scan Data *.svd:

- the settings (refer also to section 10.2.7),
- the spectra at all completely measured scan points (single point spectra),
- the average spectrum of all scan points,
- the root mean square of the magnitude over the entire bandwidth.

Even if you abort a scan, the software has saved all scan points which had already been measured.

In presentation mode you can define frequency bands for a scan (refer to section 9.2) and draw profile sections (refer to section 9.3). The software automatically saves the frequency band definitions and profile sections in the scan.

Frequency bands

In presentation mode, often only certain sections of the frequency range measured are of interest. For these sections you usually define frequency bands and then evaluate only those frequency bands. You can then save this scan without the single point spectra, as the frequency bands contain all relevant information. This means you can save a lot of disc space. The scan is then subject to certain limitations:

- You can not define any other frequency bands.
- The view Single Scan Point is not available.

Please note that the average spectrum saved corresponds to the original data and not to the spectrum created by removing invalidated single points (refer also to section 9.1).

To save a scan without single point spectra, proceed as follows:

1. Open the scan you want to save. See section 10.1.1 on this.
2. Define the frequency bands which you want to evaluate. See section 9.2 on this.
3. Select File > Save Bands. The dialog Save As appears.
4. Navigate to the saving location and enter the file name. The software suggests the file name scan name_b. However, you can also select another file name.

☞ If you have displayed the project browser (refer to section 2.7.4), you will then automatically be shown the directory marked there as saving location.

5. Click OK.

10.2.2 Saving Single Point Measurement and Average Spectrum

In acquisition mode, you can save the measurement in the active analyzer in the proprietary binary format Single Point Data *.pvd. In presentation mode, you can save the single scan point or the average spectrum displayed from a scan. Please note that the average spectrum saved corresponds to the original data and not to the spectrum created by removing invalidated single points (refer also to section 9.1). In doing so, the software saves the following data:

- time signals
- spectra
- parameters for data acquisition and evaluation.

To save, proceed as follows:

1. Select File > Save Analyzer As. The dialog Save As appears.

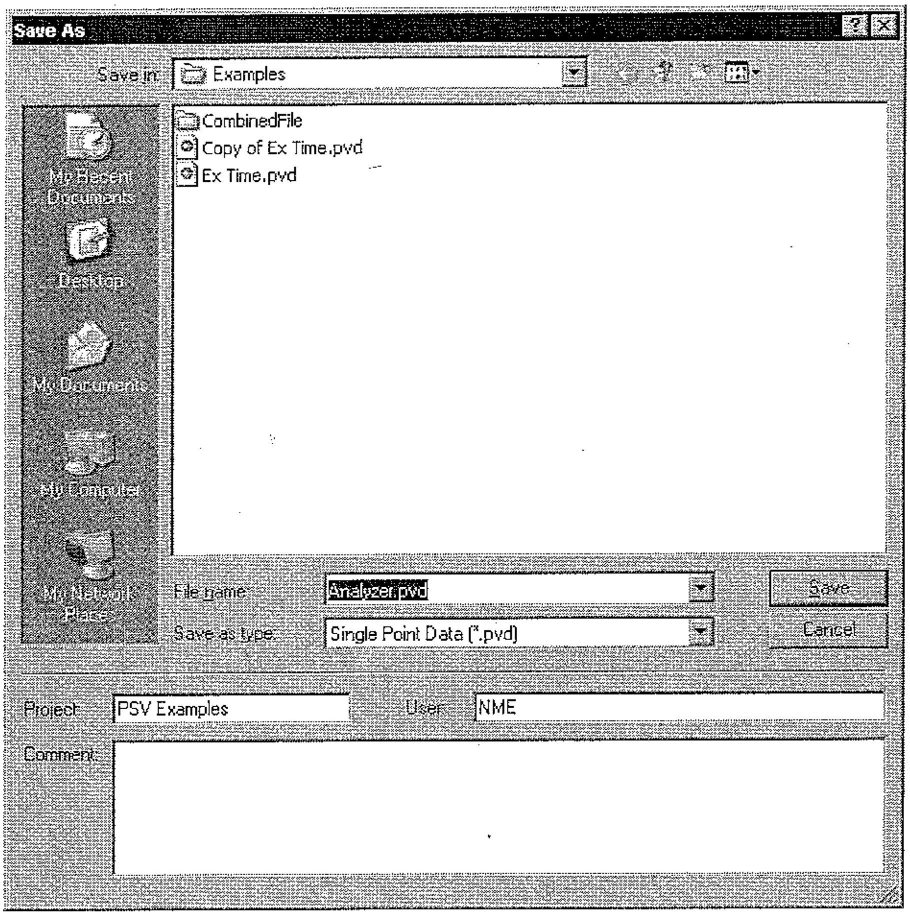


Figure 10.4: Dialog Save As

2. Navigate to the saving location and enter the file name.

☞ If you have displayed the project browser (refer to section 2.7.4), you will then automatically be shown the directory marked there as saving location.

3. At the bottom in the dialog you can enter meta-information to give the file more precise properties. This meta-information is part of the file properties which you can also view and edit in Explorer. You can also call up this information using the command Info in the project browser (refer to section 2.7.4).

4. Click Save.

10.2.3 Exporting Universal File (as an Option)

In both acquisition and presentation mode, you can export files in Universal File format which is compatible with the modal analysis software from the companies SDRC (MTS), LMS and STAR and Vibrant (ME'Scope). To do this, you need the option Universal File Format.

☞ You can export Universal Files in acquisition, but not in APS mode.

Scan points with the status Not Measured, Overrange or Invalidated are not exported. Data evaluation with Presentation > Filter Data and Presentation > Interpolate Data does not have any effect on export, the measured data is exported. Only with option VDD: Measurements in measurement mode I/Q can not be exported as Universal Files.

Signals which have been gained from the original signals through integration and differentiation can be exported.

To export a Universal File, proceed as follows:

1. If you want to carry out a Universal File Export in presentation mode, open the scan you want to export. See section 10.1.1 on this.

2. Select File > Export > Universal File. The dialog Save As appears.

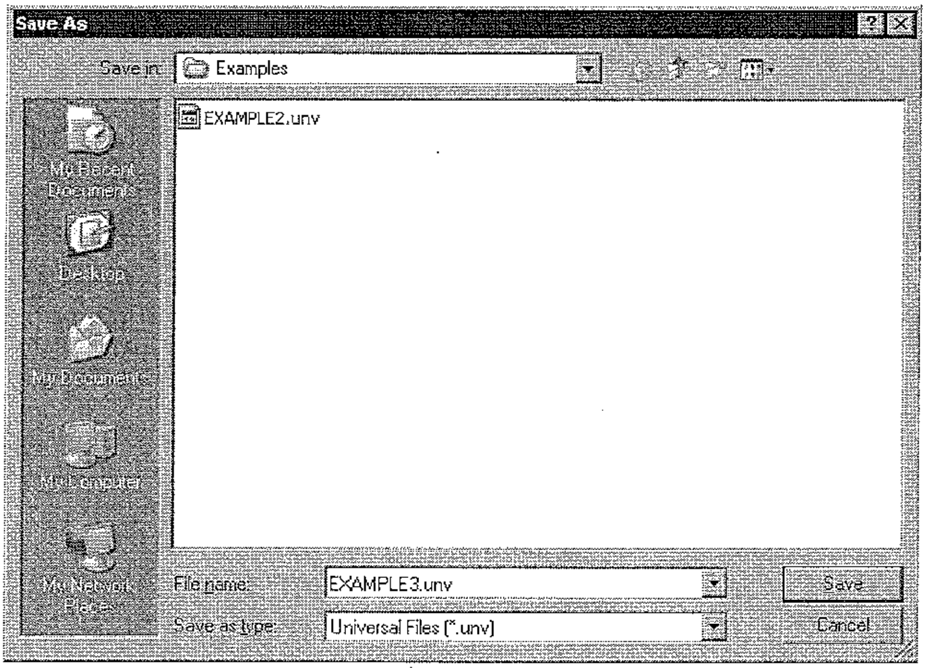


Figure 10.5: Dialog Save As

3. Navigate to the saving location and enter the file name.

☞ If you have displayed the project browser (refer to section 2.7.4), you will then automatically be shown the directory marked there as saving location.

4. Click Save. The dialog Universal File Export appears.

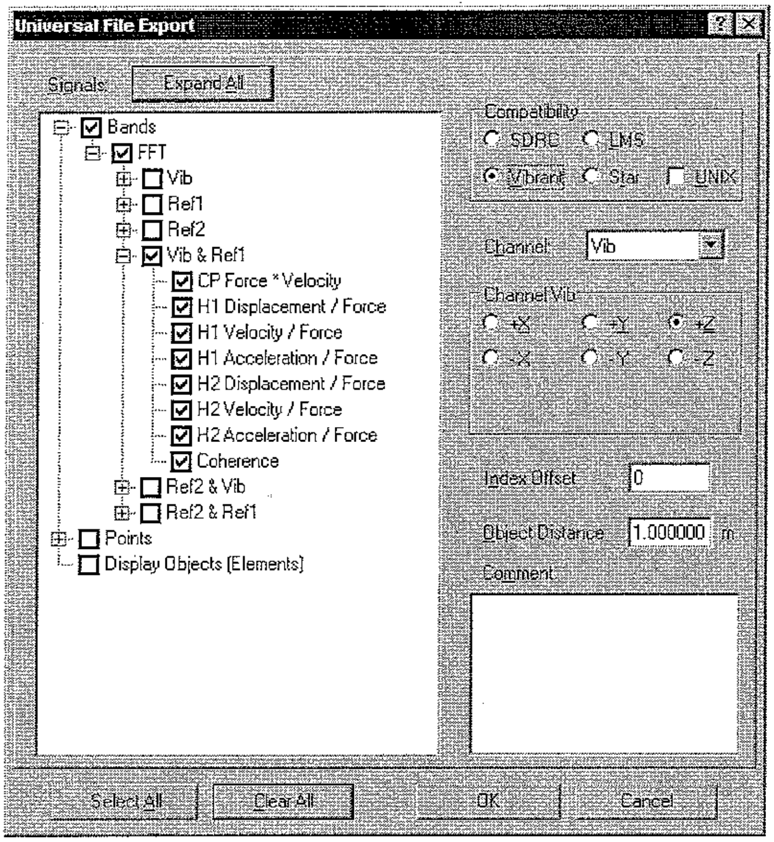


Figure 10.6: Dialog Universal File Export in presentation mode

5. If you export the data in acquisition mode, you are only offered the display of objects to choose from.

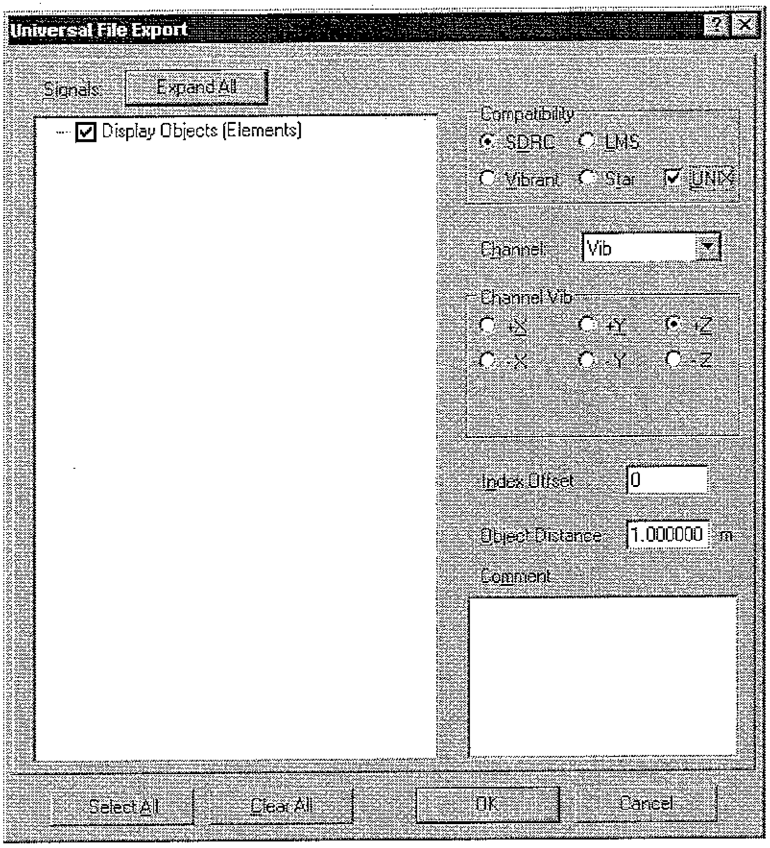


Figure 10.7: Dialog Universal File Export in acquisition mode

6. Mark the signals which you want to export and set the parameters for export. You will find information on this in the following.

7. Click OK.

You can correct the entries from the measurement file again for the current export and also enter new settings for files which already exist. The changes however do not have any effect on the measurement file saved.

Signals

On the left you mark the signals which you want to export. The selection available depends on which signals you have measured and whether frequency bands have been defined. If Display Objects (Elements) is ticked, then a graphic representation of the scan points and their connections is exported.

☞ If you want to export a Universal File in acquisition mode, here you can only select the display of the objects.

Parameters

On the right you set the parameters for export.

Compatibility: Here you select the modal analysis software which the Universal File is to be compatible with. You will find a brief description of the data sets used in table 10.1. For detailed information on this, see the manual for your modal analysis software.

Table 10.1: Data sets which are exported in the Universal File

Data Set	Description	SDRC (MTS)	LMS	STAR	Vibrant
Header	General information, e.g. file name, date, comment	151	151	151	151
Units	Units of the signals and coordinates	164 Double precision	164 Double precision	164 Double precision	164 Double precision
Nodes (Geometry)	Coordinates of the scan points	2411 Double precision	2411 Double precision	15 Single precision	2411 Double precision
Elements (Trace Lines)	Graphic representation of the scan points and their connections	2412+82 Integer	82 Integer	82 Integer	2412+82 Integer
Frequency bands	A data set for every frequency band and every signal	55 Single precision	55 Single precision	55 Single precision	55 Single precision
Scan points	A data set for every signal and every scan point	58 Single precision	58 Single precision	58 Single precision	58 Single precision

UNIX: Tick the box if you carry out modal analysis under UNIX. Text lines will then be ended with a line feed to be UNIX-compatible. Special characters in the comment – for example, German umlauts – are not adapted to UNIX.

Channel: Here you select the channel for which you want to see or change the direction of the vibration or the reference excitation.

Channel <Name>: Here you can see the direction of the vibration or the reference excitation for the selected channel (e.g. Ref3) and change it if necessary.

☞ It is not possible to specify the vibrational direction for the channel Vibrometer 3D.

Reference Point: If you have measured the reference signal at one of the scan points, then you can enter the index of this reference point here.

Index Offset: Here you can enter an offset which the software adds to the indices of the scan points. This helps avoid an index being allocated more than once if you want to evaluate several scans at the same time.

Object Distance: Here you enter the stand-off distance in meters, measured from the front panel of the scanning head. In proprietary file format, the coordinates of the scan points are saved as angles, in the Universal File however in cartesian coordinates. Thus the stand-off distance is required for the conversion. For measurements with the close-up unit PSV-A-410 or OFV-056-C, you have to add 41 millimeters to the stand-off distance. This corresponds to the optical path length within the close-up unit. As a preset the software shows the distance here which you have given in the legend in the element 2D Point (refer to section 4.1). You can correct this distance here again however, this does not have any effect on the distance saved in the measurement file.

☞ This field does not appear for 3D geometries.

Comment: Here you can enter comments up to 80 characters long.

10.2.4 Exporting ME'Scope (as an Option)

You can export files in ME'Scope format in both data acquisition and also in presentation mode. To do this, you need the option ME'Scope.

In data acquisition you can export the object geometry so that you can makes further use of it in other applications for example. You can export scans in presentation mode. Export will provide up to three files with the following data:

- single points in the format *.blk (block)
- frequency bands in the format *.shp (shape)
- geometry in the format *.str (structure)

Scan points with the status Not Measured, Overrange or Invalidated are not exported. Data evaluation with Presentation > Filter Data and Presentation > Interpolate Data does not have any effect on export, the measured data is exported. Only with option VDD: Measurements in measurement mode I/Q can not be exported as ME'Scope.

To export to ME'Scope, proceed as follows:

1. If you want to carry out an ME'Scope Export in presentation mode, open the scan you want to export. See section 10.1.1 on this.

2. Select File > Export > ME'Scope. The dialog Save As appears.

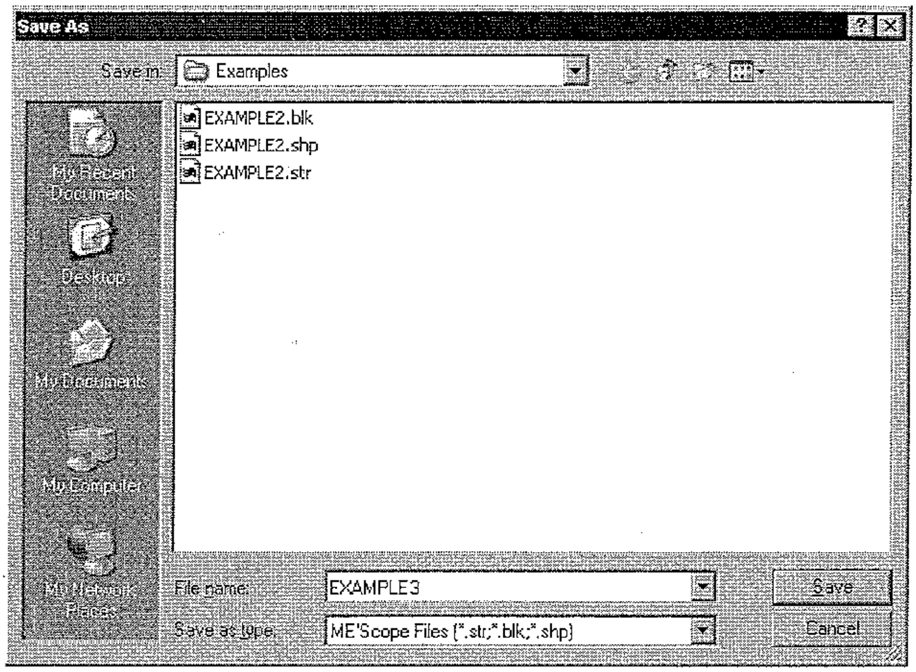


Figure 10.8: Dialog Save As

3. Navigate to the saving location and enter the file name.

☞ If you have displayed the project browser (refer to section 2.7.4), you will then automatically be shown the directory marked there as saving location.

4. Click Save. The dialog ME'Scope Export appears.

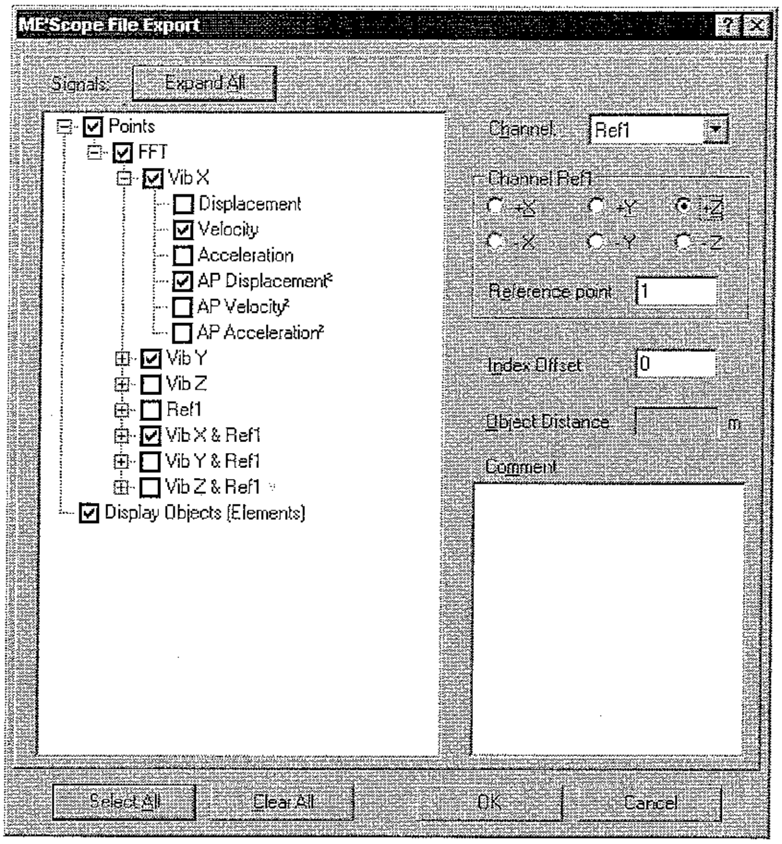


Figure 10.9: Dialog ME'Scope Export in presentation mode

5. If you export the data in acquisition mode, you are only offered the display of objects to choose from.

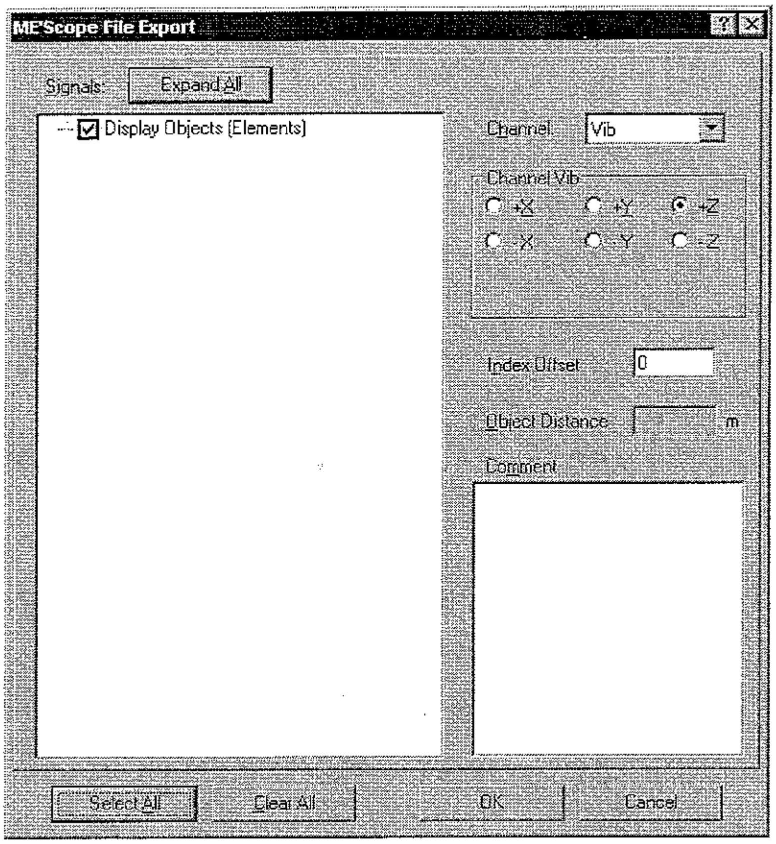


Figure 10.10: Dialog ME'Scope Export in acquisition mode

6. Mark the data which you want to export and set the parameters for export. You will find information on this in the following.

☞ Different domains, e.g. Time and FFT, can not be exported together. Export these domains individually one after the other.

7. Click OK.

You can correct the entries from the measurement file again for the current export and also enter new settings for files which already exist. The changes however do not have any effect on the measurement file saved.

Signals

On the left you mark the signals which you want to export. The selection depends on whether you are exporting in acquisition or in presentation mode, which signals you measured and whether frequency bands have been defined. If Display Objects (Elements) is ticked, then a graphic representation of the scan points and their connections is exported.

Parameters

On the right you set the parameters for export.

Channel: Here you select the channel for which you want to see or change the direction of the vibration or the reference excitation.

Channel <Name>: Here you can see the direction of the vibration or the reference excitation for the selected channel and change it if necessary.

☞ It is not possible to specify the vibrational direction for the channel Vibrometer 3D.

Reference Point: If you have measured the reference signal at one of the scan points, then you can enter the index of this reference point here.

Index offset: Here you can enter an offset which the software adds to the indices of the scan points. This helps avoid an index being allocated more than once if you want to evaluate several scans at the same time.

Object Distance: Here you enter the stand-off distance in meters, measured from the front panel of the scanning head. In proprietary file format, the coordinates of the scan points are saved as angles, in ME'Scope format however, as cartesian coordinates. Thus the stand-off distance is required for the conversion. For measurements with the close-up unit PSV-A-410 or OFV-056-C, you have to add 41 millimeters to the stand-off distance. This corresponds to the optical path length within the close-up unit. As a preset the software shows the distance here which you have given in the legend in the element 2D Point (refer to section 4.1). You can correct this distance here again however, this does not have any effect on the distance saved in the measurement file.

☞ This field does not appear for 3D geometries.

Comment: Here you can enter comments up to 80 characters long.

10.2.5 Saving Frequency Band Definition

In presentation mode, you can save the current frequency band definition in ASCII format. To do this, proceed as follows:

1. Open the frequency band definition. To do so, click . The dialog Frequency Band Definition appears.

2. In the dialog Frequency Band Definition, click . The dialog Save As appears.

3. Navigate to the saving location, enter the file name and select the file extension.

☞ If you have displayed the project browser (refer to section 2.7.4), you will then automatically be shown the directory marked there as saving location.

4. Click Save.

5. Close the frequency band definition. To do so, click again.

10.2.6 Saving Animations

In presentation mode, you can save animations in multimedia format *.avi. You will find information on animations in section 9.4.

To save an animation, proceed as follows:

1. Open the scan you want to save an animation for. See section 10.1.1 on this.

2. Set your animation up as described in section 9.4.1 or section 9.4.2.

3. Select File > Save Animation. The dialog Save As appears.

☞ If the presentation window contains an analyzer, you can select whether you would like to save an animation from top, bottom or both diagrams.

4. Navigate to the saving location and enter the file name.

☞ If you have displayed the project browser (refer to section 2.7.4), you will then automatically be shown the directory marked there as saving location.

5. Click Save.

10.2.7 Saving Settings

In acquisition mode, you can save the current settings in proprietary binary format *.set. A setting file contains:

- the settings for data acquisition in the dialog Acquisition Settings
- the scan point definition
- the settings of the optics (alignment, only PSV 400 and PSV 300: zoom and focus of the video camera)
- the window arrangement .

To save settings, proceed as follows:

1. Click or select File > Save Current Settings As. The dialog Save As appears.

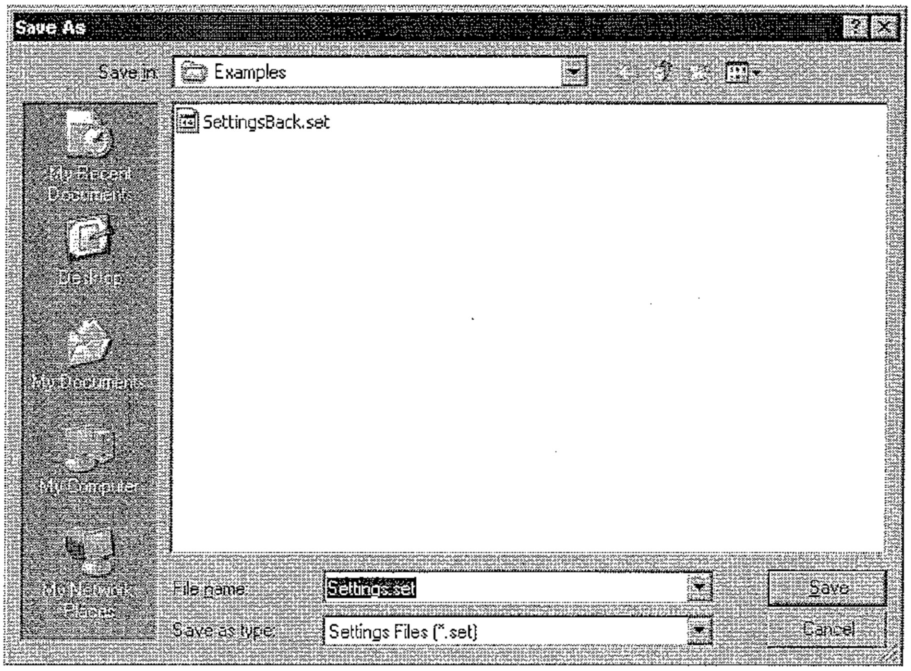


Figure 10.11: Dialog Save As

2. Navigate to the saving location and enter a file name.

☞ If you have displayed the project browser (refer to section 2.7.4), you will then automatically be shown the directory marked there as saving location.

3. Click OK. All current settings are saved in the file.

10.2.8 Exporting Measurement Data in ASCII Format

You can export the data in the active analyzer or presentation window as an ASCII file. The coordinate system for ASCII export corresponds to the coordinate system of the live video image which you set the scan points on. The upper left corner in the coordinate system of the live video image is defined as u=0, v=0, the bottom right corner as u=4/3, v=1. To calculate the angles of the scanner mirrors from the coordinates, you will need the information from the alignment. You will get this from Polytec File Access.

To export the measurement data in ASCII format, proceed as follows:

1. Select File > Export > ASCII. The dialog Save As appears.
2. Navigate to the saving location, enter the file name and select the file extension.

☞ If you have displayed the project browser (refer to section 2.7.4), you will then automatically be shown the directory marked there as saving location.

3. If you are exporting from the presentation window in the view Single Scan Point, Average Spectrum or Profile, then at the bottom of the dialog you see the field Select Data. Select whether you want to export the data sets from the upper or the lower diagram.
4. Click Save.

10.2.9 Saving Graphics

You can save the active window in different graphics formats. The title bar and the frame are not saved. The live video image is saved without scan points.

To save, proceed as follows:

1. Select File > Save Graphics. The dialog Save As appears.
2. Navigate to the saving location, enter the file name and select the file type.

☞ If you have displayed the project browser (refer to section 2.7.4), you will then automatically be shown the directory marked there as saving location.

3. If you are saving the graphics from the presentation window in the view Single Scan Point, Average Spectrum or Profile, then at the bottom of the dialog you see the field Select Graphics. Select whether you want to save the upper, the lower or both diagrams.
4. Click Save.

10.2.10 Copying Graphics onto the Clipboard

You can copy the active window as graphics onto the clipboard. The title bar and the frame are not copied. The live video image is copied without scan points.

To copy, proceed as follows:

1. Click  or select Edit > Copy.
2. If you are copying diagrams from the presentation window in the view Single Scan Point, Average Spectrum or Profile, then the dialog Select Graphics appears. Select whether you want to copy the upper or the lower diagram.
3. Click OK.

You can then paste the graphics from the clipboard into other applications.

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Polytec Deutschland

POLYTEC GmbH
Hauptsitz
Polytec-Platz 1-7
76337 Waldbronn

Tel.: (07243) 604-0
Fax: (07243) 69944
E-mail: info@polytec.de
Internet: http://www.polytec.de

POLYTEC GmbH
Vertriebs- und Beratungsbüro Berlin
Schwarzschildstraße 1
12489 Berlin

Tel.: (030) 6392-5140
Fax: (030) 6392-5141
E-mail: polytecberlin@polytec.de
Internet: http://www.polytec.de

International from outside Germany (D)
POLYTEC GmbH
Headquarters
Polytec-Platz 1-7
D-76337 Waldbronn

Tel.: +49 7243 604-0
Fax: +49 7243 69944
E-mail: info@polytec.de
Internet: http://www.polytec.com

Polytec International

France (F)
Polytec-PI, S.A.
32 rue Délizy
F-93694 Pantin

Tel.: +33 (0) 1 48 10 39 34
Fax: +33 (0) 1 48 10 09 66
E-mail: info@polytec-pi.fr
Internet: http://www.polytec-pi.fr

Great Britain (GB)
Lambda Photometrics Ltd.
Lambda House, Batford Mill
GB-Harpenden, Hertfordshire AL5 5BZ

Tel.: +44 (0) 1582 764334
Fax: +44 (0) 1582 712084
E-mail: info@lambdaphoto.co.uk
Internet: http://www.lambdaphoto.co.uk

Japan (J)
Polytec KK
Hakusan High Tech Park
1-18-2 Hakusan, Midori-ku
J-Yokohama-shi, 226-0006 Kanagawa-ken

Tel.: +81 (0) 45 938-4960
Fax: +81 (0) 45 938-4961
E-mail: info@polytec.co.jp
Internet: http://www.polytec.co.jp

USA West
Polytec, Inc., North American Headquarters
1342 Bell Avenue, Suite 3-A
Tustin, CA 92780

Tel.: +1 714 850 1835
Fax: +1 714 850 1831
E-mail: info@polytec.com
Internet: http://www.polytec.com

USA Midwest
Polytec, Inc., Midwest Office
3915 Research Park Dr., Suite A-12
Ann Arbor, MI 48108

Tel.: +1 734 662 4900
Fax: +1 734 662 4451
E-mail: info@polytec.com
Internet: http://www.polytec.com

USA East
Polytec, Inc., East Coast Office
25 South Street, Suite A
Hopkinton, MA 01748

Tel.: +1 508 544 1224
Fax: +1 508 544 1225
E-mail: info@polytec.com
Internet: http://www.polytec.com

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