EN

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DNNP005

Software VoluMEL

Operating Instructions

Subject to change without notice
Available as PDF file only
Version 1.1.0
Revision level: 01/02/2021
www.wenglor.com

Table of Contents

1. General

1.1 Information Concerning these Instructions

- These instructions apply to the product software VoluMEL (DNNP005).
- They make it possible to use the product safely and efficiently.
- These instructions are an integral part of the product and must be kept on hand for the entire duration of its service life.
- Local accident prevention regulations and national work safety regulations must be observed before, during and after initial startup.
- The product is subject to further technical development, and thus the information contained in these operating instructions may also be subject to change. The current version can be found at www.wenglor.com in the product's separate download area.

NOTE!
The operating instructions must be read carefully before using the product and must be kept on hand for later reference.

1.2 Explanations of Symbols

- Safety precautions and warnings are emphasized by means of symbols and attention-getting words.
- Safe use of the product is only possible if these safety precautions and warnings are adhered to.

The safety precautions and warnings are laid out in accordance with the following principle:

ATTENTION-GETTING WORD
Type and Source of Danger!
Possible consequences in the event that the hazard is disregarded.
- Measures for averting the hazard.

The meanings of the attention-getting words, as well as the scope of the associated hazards, are listed below:

DANGER!
This word indicates a hazard with a high degree of risk which, if not avoided, results in death or severe injury.

WARNING!
This word indicates a hazard with a medium degree of risk which, if not avoided, may result in death or severe injury.

CAUTION!
This word indicates a hazard with a low degree of risk which, if not avoided, may result in minor or moderate injury.

ATTENTION!
This word draws attention to a potentially hazardous situation which, if not avoided, may result in property damage.

NOTE!
A note draws attention to useful tips and suggestions, as well as information regarding efficient, error-free use.

1.3 Limitation of Liability

- The product has been developed in consideration of the current state-of-the-art, as well as applicable standards and guidelines. Subject to change without notice.
- A valid declaration of conformity can be accessed at www.wenglor.com in the product's separate download area.
- wenglor sensoric elektronische Geräte GmbH (hereinafter referred to as "wenglor") excludes all liability in the event of:
    - Non-compliance with the instructions
    - Use of the product for purposes other than those intended
    - Use by untrained personnel
    - Use of unapproved replacement parts
    - Unapproved modification of products
- These operating instructions do not include any guarantees from wenglor with regard to the described procedures or specific product characteristics.
- wenglor assumes no liability for printing errors or other inaccuracies contained in these operating instructions, unless wenglor was verifiably aware of such errors at the point in time at which the operating instructions were prepared.

1.4 Copyrights

- The contents of these instructions are protected by copyright law.
- All rights are reserved by wenglor.
- Commercial reproduction or any other commercial use of the provided content and information, in particular graphics and images, is not permitted without previous written consent from wenglor.

2. For Your Safety

2.1 Use for Intended Purpose

VisionApp 360 software combines the profiles of several (variant-independent) 2D/3D profile sensors within a coordinate system to form an overall image. It's individually configurable and can also be expanded with the help of various modules.

NOTE!
Further information regarding the mode of operation of the 2D/3D profile sensors is included in the operating instructions of each respective sensor.

This product can be used in the following industry sectors:

- Special machinery manufacturing
- Heavy machinery manufacturing
- Logistics
- Automotive industry
- Food industry
- Packaging industry
- Pharmaceuticals industry
- Plastics industry
- Woodworking industry
- Consumer goods industry
- Paper industry
- Electronics industry
- Glass industry
- Steel industry
- Aviation industry
- Chemicals industry
- Alternative energy
- Raw materials extraction

2.2 Use for Other than the Intended Purpose

- Not a safety component in accordance with 2006/42/EC (Machinery Directive)
- The product is not suitable for use in potentially explosive atmospheres.
- The product may only be used with accessories supplied or approved by wenglor, or in combination with approved products. A list of approved accessories and products which have been approved for use in combination with the software is available on the product detail page at www.wenglor.com.

DANGER!
Risk of personal injury or property damage in case of use for other than the intended purpose!
Use for other than the intended purpose may lead to hazardous situations.
- Instructions regarding use for intended purpose must be observed.

2.3 Personnel Qualifications

- Suitable technical training is a prerequisite.
- In-house electronics training is required.
- Trained personnel who use the product must have uninterrupted access to the operating instructions.

DANGER!
Risk of personal injury or property damage in case of incorrect initial start-up and maintenance!
Personal injury and damage to equipment may occur.
- Adequate training and qualification of personnel.

2.4 General Safety Precautions

NOTE!
- These instructions are an integral part of the product and must be kept on hand for the entire duration of its service life.
- In the event of possible changes, the respectively current version of the operating instructions can be accessed at www.wenglor.com in the product's separate download area.

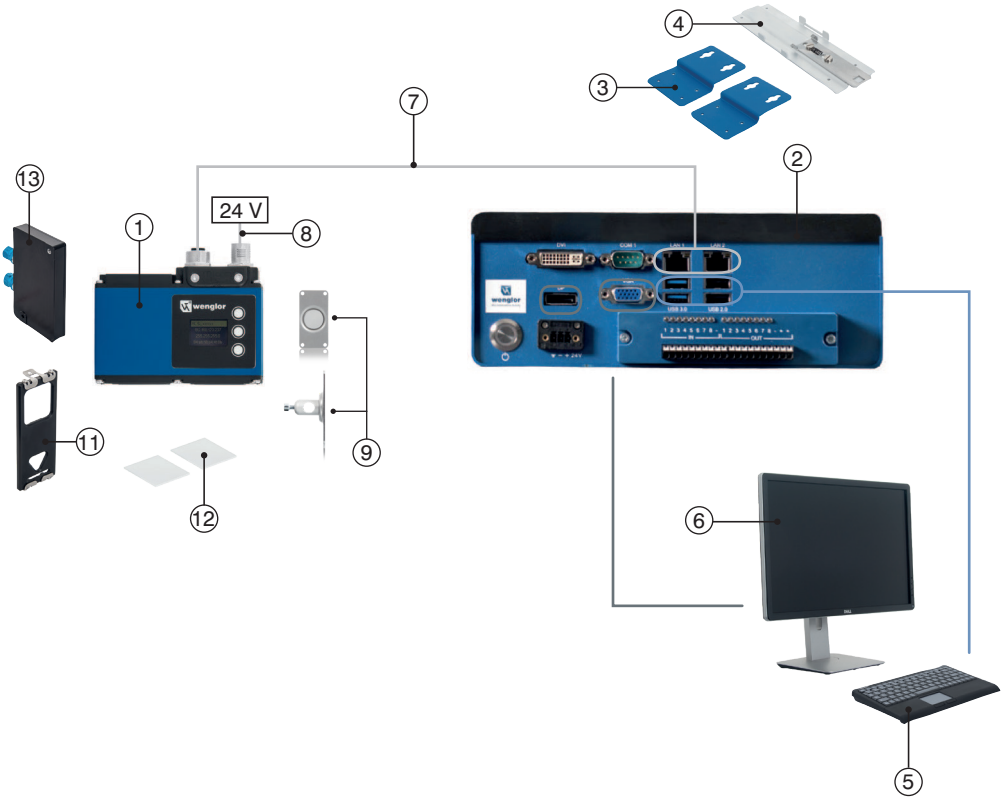
3. Technical Data

Order Number / Technical Data	DNNP005
Function	
Configuration software	Yes
Display software	Yes
Diagnosis software	Yes
Evaluation software	Yes
System Requirements	
Windows 7, Windows 10	Yes
Linux	No
32 / 64 bit	No / Yes
Min. CPU	Intel Core i7
Min. RAM	4 GB
HDD	64 GB
Network card	1 Gbit
Interface	
Ethernet (Gb)	Yes
General Data	
Usage	For 2D/3D profile sensors as of firmware version 1.1.0
Languages	EN
Licensing model	Yes

4. System Overview

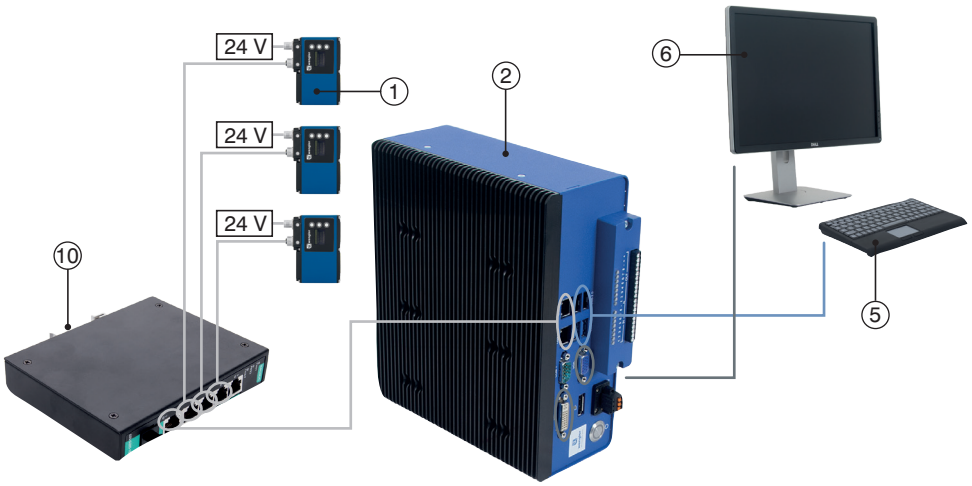
4.1 One 2D/3D Profile Sensor per Control Unit

The following illustration shows the setup when using one 2D/3D profile sensor at a control unit.



4.2 Several 2D/3D Profile Sensors per Control Unit

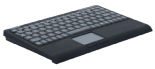
Up to 16 2D/3D profile sensors it can be connected to a single control unit in the individual trigger mode.



4.3 Overview of Order Numbers

Image	Order Number	Description	Additional Information	No.
	BB1C002	Control Unit	VoluMEL preinstalled	2
Control Unit Mounting System				
	ZB1E001	Mounting kit for wall mounting	Replacement part (included with BB1C005)	3
	ZB1Z001	Mounting system for 35 mm H-rail mounting		4
2D/3D Profile Sensors				
	MLSLxxx	2D/3D Profile Sensors		1
	MLWLxxx	2D/3D Profile Sensors		1
Mounting System for 2D/3D Profile Sensors				
	ZLSZ001, ZLSZ002	Aluminum mounting system, plastic mounting system		9

Image	Order Number	Description	Additional Information	No.
Connector Cable (M12, 8-pin to RJ45)				
	ZC1V001, ZAV50R502, ZC1V002	2 m connection cable, 5 m connection cable, 10 m connection cable		7
Connector Cables (12-pin M12)				
	ZDCL001, ZDCL002, ZDCL003	2 m straight connector cable, 5 m straight connector cable, 10 m straight connector		8
	ZDCL004, ZDCL005, ZDCL006	2 m angled connector cable, 5 m angled connector cable, 10 m angled connector cable		8
Connector Cable (12-pin M12 to 12-pin M12)				
	ZDCV001, ZDCV002, ZDCV003	2 m connector cable, 5 m connector cable, 10 m connector cable		8
Accessories for Control Unit				
	ZNNG026	Monitor with VGA and DisplayPort cable		6

Image	Order Number	Description	Additional Information	No.
	Z0044	Keyboard		5
Accessories for 2D/3D Profile Sensors				
		Protective disc retainer	Available for all modules	11
		Protective disc set, glass, protective disc set, plastic	Available for all modules	12
		Cooling unit	Available for all modules	13
	ZNNG013	Micro SD card	Replacement part (included with MLSLxxx)	–
Switch				
	EHSS001	Switch with 5 Ethernet ports		10

4.4 Synchronization of Several 2D/3D Profile Sensors

Synchronization of several 2D/3D profile sensors is required when the sensors' laser lines are located within the same scanning range and thus influence each other.

NOTE!
A 2D/3D profile sensor with red laser light and a 2D/3D profile sensor with blue laser light do not influence each other.

Procedure for Synchronizing Two 2D/3D Profile Sensors:
Wire the two 2D/3D profile sensors to each other so that one of the I/O pins of the first sensor (master) is connected to one of the I/O pins of the second sensor (slave).

Example: I/O #3 at the master is connected to I/O #4 at the slave.

Configure one I/O pin at the master as an output with time delay. Delay should be at least as long as the master's exposure time. The output signal may not be any longer than the slave sensor's exposure time.

Connector Pin Assignments:

Pin	Input/output	Function	Color
5	E/A3	Sync out	pink
6	E/A4	Sync in	yellow

Comprehensive operating instructions with an exact description of connector pins assignments can be found in the download area for the 2D/3D profile sensors at www.wenglor.com.
Information concerning the connection of several sensors can be found in section 6.3 of the operating instructions.

Example for the master:

- Exposure time 200 µs
- I/O: #3
- Trigger: INT
- Trigger delay: 0 µs

NOTE!
The master sensor can be triggered as desired.

Configure one of the slave's I/O pins as an input.

Example for the slave:

- Exposure time 200 µs
- I/O: #4
- Trigger: HW
- Trigger delay: 200 µs

5. General Information Regarding Individual Profile Evaluation

2D/3D profile sensors ascertain the height profile along a laser line. This results in a point cloud. The cloud consists of numerous points with X and Z coordinates. Ascertained data are transmitted to the control unit for evaluation where they are displayed as points with coordinates in mm.

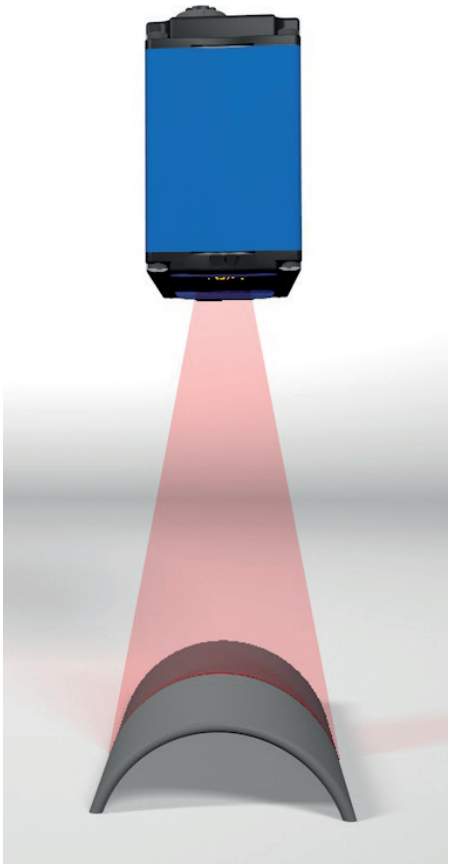
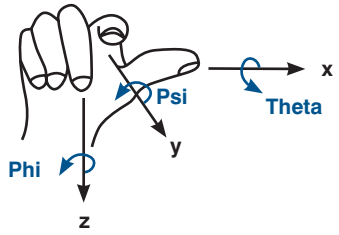


Figure 1: Individual Profile Evaluation

The origin of the coordinate system is in the sensor – in the middle of the laser line. The height or distance from the sensor is specified as the Z value. The larger the Z value, the greater the distance from the sensor. Height information for an individual profile evaluation is always within the X-Z plane.

X coordinate	In the direction of the laser line
Y-coordinate	In the conveyor belt's advancing direction or in the direction of sensor motion
Z coordinate	Distance from the sensor (height information)



NOTE!
Assignment of the coordinates only applies to the individual profile evaluation. If several sensors are combined with each other, they're aligned to the calibration object.

6. General Information Concerning the System

6.1 Browser

As a standard feature, the sensor's website is accessed with the Firefox browser.

NOTE!
Further information concerning settings are included in the operating instructions of the respective sensor.

6.2 SOS wenglorMEL Support

In the event of technical questions or problems, wenglor's technical support department can establish a connection to the control unit via remote access. The control unit must be equipped with Internet access and active approval for remote access is required to this end.

The Team Viewer for SOS wenglorMEL Support can be downloaded from www.wenglor.com. Enter article number "DNNF016" as a search term to access the download.

NOTE!
Enter customer name and a description of your question.

6.3 Software Installation

The software can be downloaded by clicking the respective link in the download tab when you're logged on as a customer. The license for enabling the software can be ordered from your wenglor sales partner or by contacting our customer service department.

7. Software

The following window appears after the software has been started:

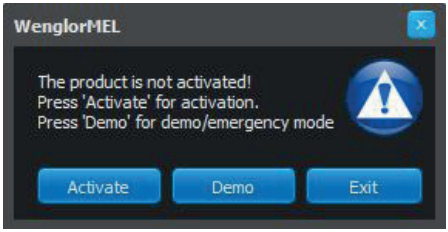


Figure 2: Software start window

- Click on "Activate" if you have or would like to request an activation key.
- Click on "Demo" to try out the software for 20 minutes free of charge.
- Click on "Exit" to close the software.

7.1 Licensing and activation

After clicking on "Activate" (see Figure 2), the following window appears:

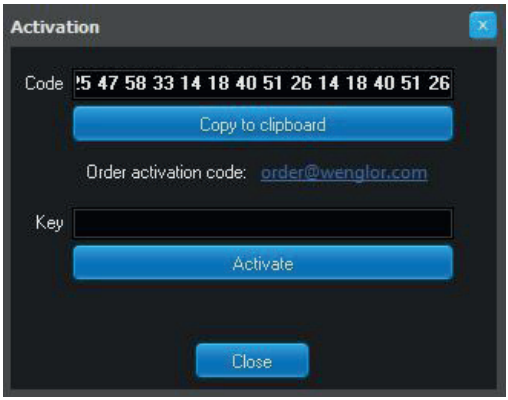


Figure 3: Software activation

If you have already received a key, enter it and click on "Activate" (see Figure 3).
If you would like to request a key, click on the email address "order@wenglor.com". Your standard email program opens automatically with an activation key request.
The activation key will then be sent to you immediately, enabling you to unlock the software as described above.

7.2 Demo and Emergency mode

If you have activated Demo mode, the following window will display:

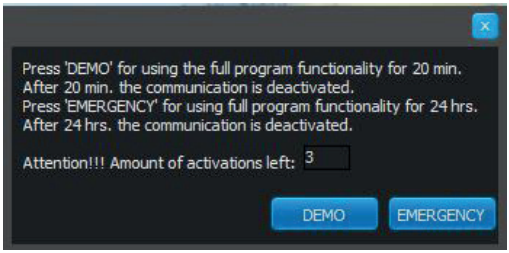


Figure 4: Demo mode

Customers, who are already working with the software and must work on another PC due to hardware problems, can use the software without an activation key for 24 hours for a maximum of 3 times by clicking on "Emergency".

8. User Interface

8.1 Start screen

After the system has been started, the VoluMEL software appears with the following start screen.

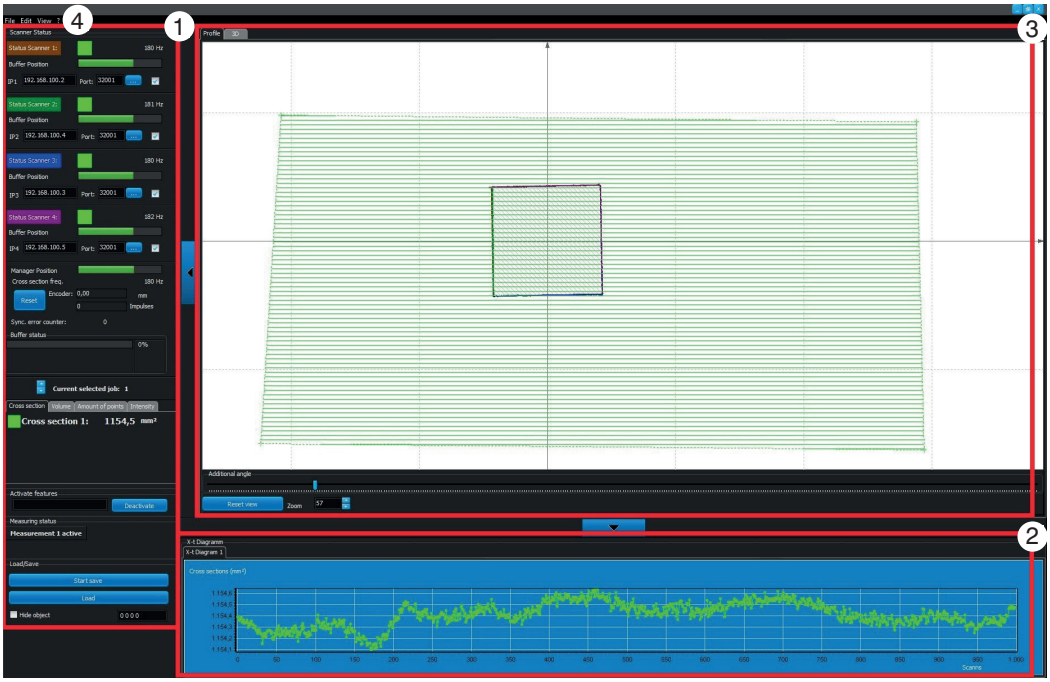


Figure 5: VoluMEL start screen

The user interface is divided into four areas:

① Status
② X/t diagram
③ 2D/3D view
④ Menu bar

8.1.1 Status

The "Status" tab contains information on the sensors used for measurement.

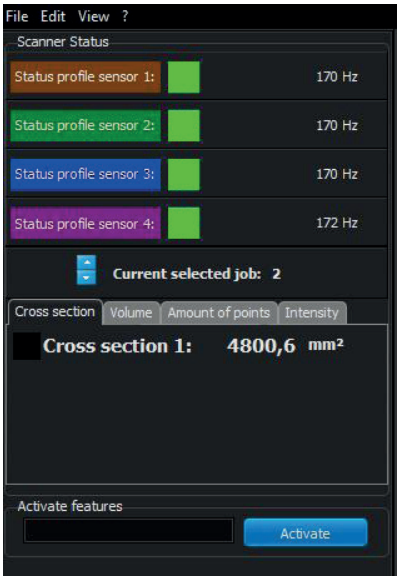


Figure 6: Status window

8.1.1.1 Scanner status

“Scanner status" displays the current status of the sensors.

- Green: Sensor connected
- Red: Sensor not connected

The sensor frequencies run approximately evenly with a difference of approx. 4 Hz. The update rate is approx. 1 Hz. The color field behind the "Status scanner x” indicates whether the sensor is connected or not.

8.1.1.2 Currently selected job

Jobs can be selected using both arrows. (see section 11).

8.1.1.3 Measured quantities

The measurement values obtained are displayed within this window:

Cross section	Cross section of the measured object in real time
Volume	Volume of the measured object (displayed after every measurement)
Amount of points	Number of measurement points
Intensity	Intensity distribution

8.1.1.4 Activating features / setting up sensor

In order to connect the sensors with the software, enter the password "MELSENSOR" into the provided line and click on "Activate". Enter the IP addresses of the sensors used in the provided fields in the window that now opens (see Figure 7). When doing so, make sure that the sensors are ordered properly (see Figure 8). The port is set to 32001 for every sensor and cannot be changed. Clicking on the ① check box will switch the respective sensor on or off. Access the scanner settings by clicking on ② (see sec. 9.3).

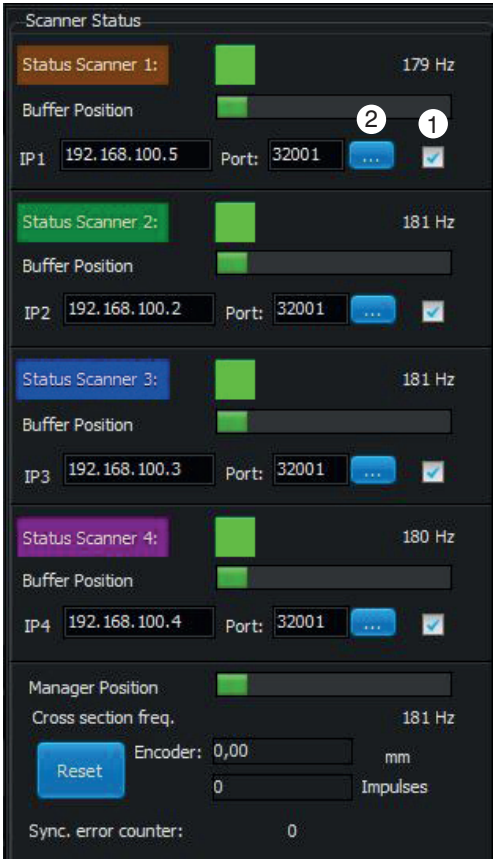


Figure 7: Entering the IP address

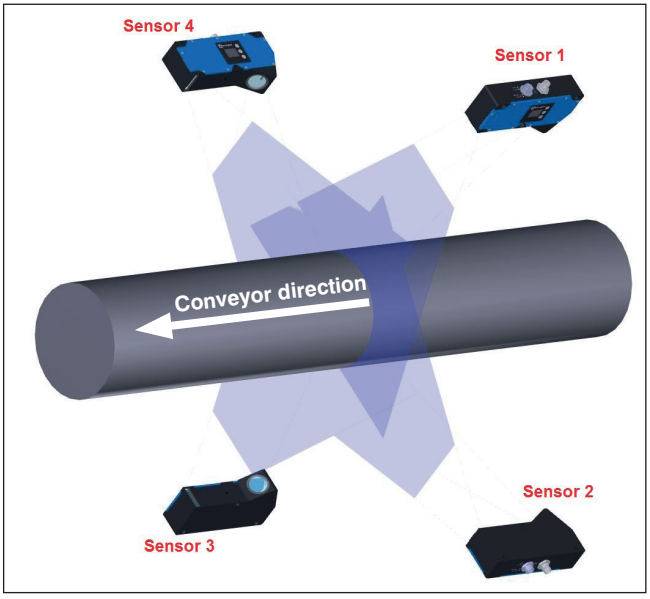


Figure 8: Correct sensor alignment relative to feed direction

8.1.2 X/t diagram

The X/t diagram shows the transmitted cross-sections of each individual measurement.
This option is only visible while the system is operating (after starting the measurement).
The following images show an X/t diagram for an example volume measurement:

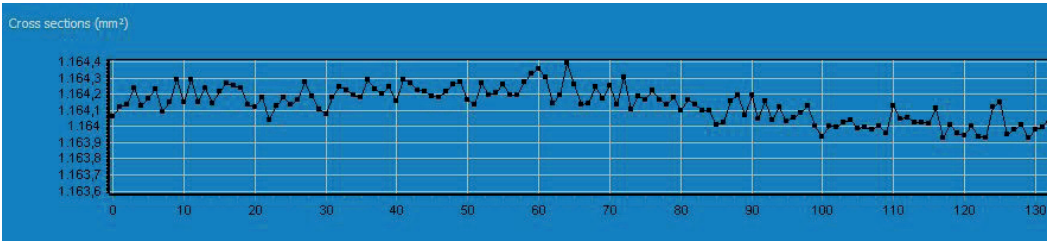


Figure 9: Representation of cross-section measured over time

8.1.3 Profile/3D view

The "Profile" and "3D" tabs enable the user to switch between a 2D view (profile) and 3D view.

The 2D view is used to represent the measured profile and for calibration, the 3D view serves for purposes of object visualization.

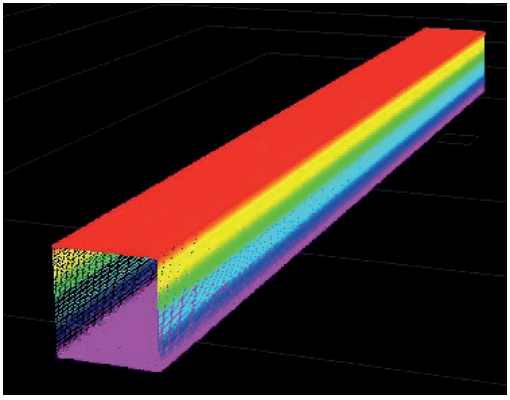


Figure 10: Measured object displayed as 3D point cloud

Certain features for positioning the object can be found in the "Picture navigation" window on the right side of the 3D area (see Figure 11).

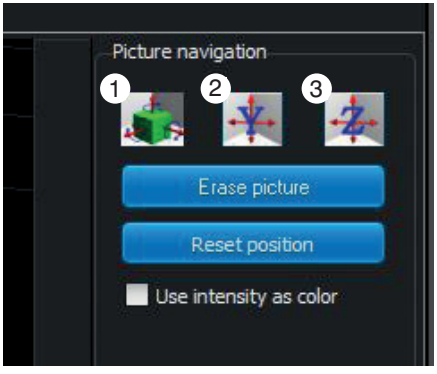


Figure 11: 3D navigation

① Rotating the point cloud
② Moving the point cloud along the y axis
③ Moving the point cloud along the z axis

Use the "Erase picture" and "Reset position" buttons to erase or reset the image to its original position. Click on the "Use intensity as color" button to display the image as an intensity image (greyscale - black / white) in contrast to the color representation in the height profile.

8.1.4 Menu bar

The menu provides the following functions

- File
- Edit
- View
- Help

8.1.4.1 File

Save current setting	Saves the current settings
Exit	Exits the program

8.1.4.2 Edit

Program for current job			Create measurement program
	Delete measurement parameters		Deletes the measurement parameters
	Delete current virtual bottom		Deletes the programmed virtual bottom
Start/Stop measurement			Starts/stops measurement
Settings			Settings (see sec. 9)
	Program settings		General program settings (see sec. 9.1)
	Job settings		Measurement settings (see sec. 9.2)
	Scanner settings		Sensor settings
		Scanner hard-ware parameters	see sec. 9.3.1
		Align scanners	Sets sensor alignment (see sec. 9.3.2)
	Interface settings		User interface settings (colors etc.), see sec. 9.4
Communication			Communication (see sec. 10)
	Test communication		Tests the communication (see sec. 10.2)
	Communication settings		Communication settings (see sec. 10.2)

8.1.4.3 View

Draw measuring ranges	
Scanner 1	Display or hide sensor 1 profile
Scanner 2	Display or hide sensor 2 profile
Scanner 3	Display or hide sensor 3 profile
Scanner 4	Display or hide sensor 4 profile
Activate all	Shows the profile of all sensors
Deactivate all	Deactivates the display of all sensors

8.1.4.4 Help

- Activate
- Manual
- Info

9. Settings

9.1 Program settings

Configure how the program behaves when starting the application via "Program Settings" (see the "Edit → Settings" menu option). The application can be configured so that it switches to operating mode immediately after being switched on, meaning all necessary services, sensors, etc. can be managed.

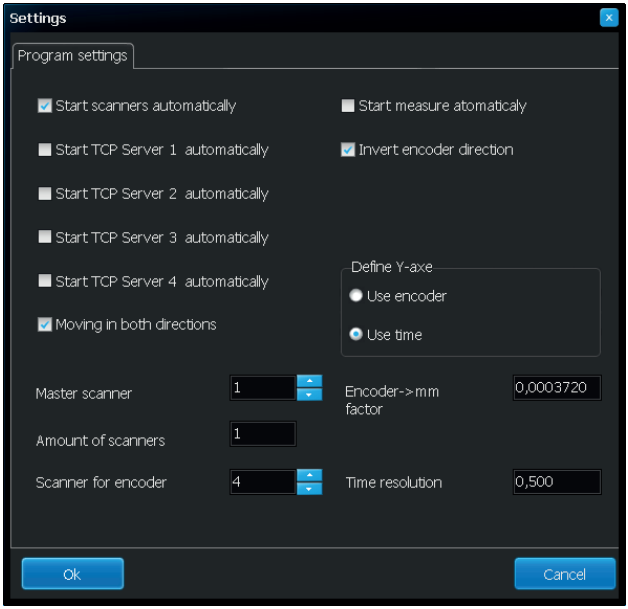


Figure 12: Program settings

Start scanner automatically	Starts scanner automatically when system starts
Start measure automatically	Starts measurement automatically when system starts
Start TCP Server 1 automatically	Automatically starts TCP/IP 1 communication
Start TCP Server 2 automatically	Automatically starts TCP/IP 2 communication
Start TCP Server 3 automatically	Automatically starts TCP/IP 3 communication
Start TCP Server 4 automatically	Automatically starts TCP/IP 4 communication
Moving in both directions	Activated: Object is measured again after returning to its start position Deactivated: Measurement will only occur if the encoder value is higher than the last
Master scanner	Index of the hardwired master sensor
Amount of scanners	Number of scanners connected with the software
Scanner for encoder	Index of the scanner that receives the encoder signal (see also E/A encoder settings in the operating instructions of the respective scanner)
Start measure automatically	Measurement starts automatically upon activation
Invert encoder direction	If activated, counting direction of the encoder is inverted. This function is helpful when the counting direction does not match the logical counting direction analogous to the direction of travel.
Use encoder	Encoder is used as trigger
Use time	Time is used as trigger
Encoder->mm factor	Serves to calibrate the profile sequence in the y direction (direction of travel). Using this factor, the encoder value is converted to a distance value (mm) and output as a y value for the 3D profile view.
Time resolution	Time resolution when "Use time" is activated (see above)
Amount of measuring threads 1-10 (needs a restart)	Number of measurement threads that should be used by the software
Delay for initialization of scanners	When connecting MLSL sensors with the software, this delay must be activated

NOTE!
The number entered under "Amount of scanners" must always correspond to the number of sensors used.

9.2 Job settings

You may select the desired job in "Job Settings" (see the "Edit → Settings" menu options) and apply various measurement settings (see sec. 11).

9.3 Scanner settings

9.3.1 Scanner hardware parameters

Use the "Scanner Settings" menu option (see the "Edit → Settings → Scanner settings → Scanner hardware parameters" menu option) to apply parameter settings for each sensor individually.

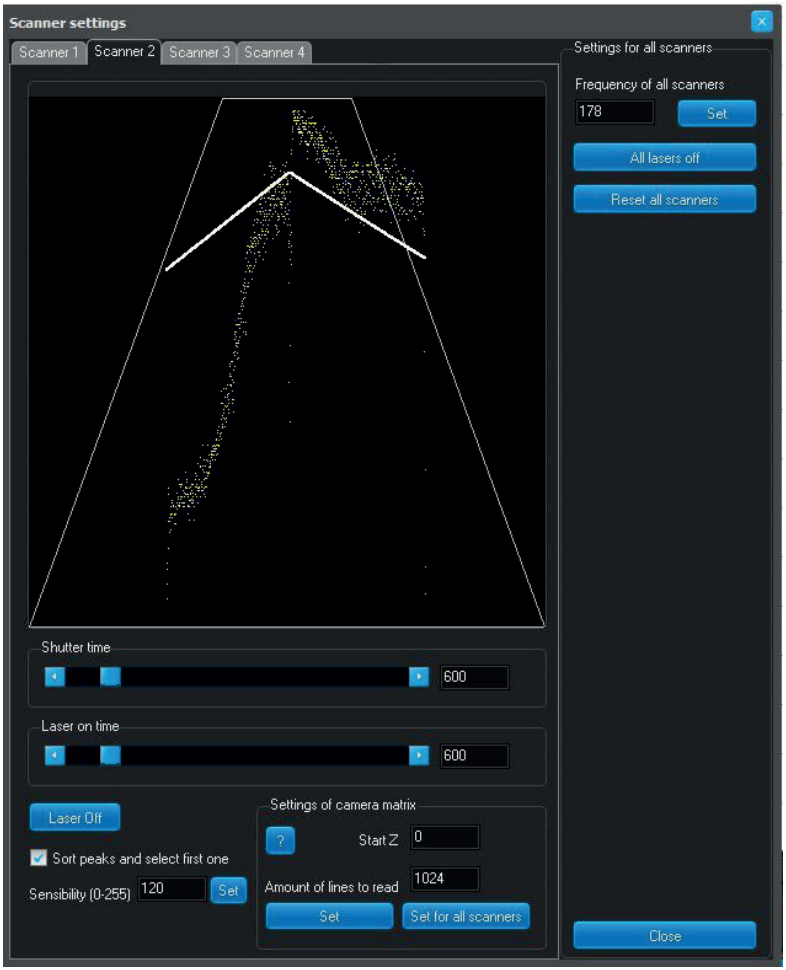


Figure 13: Setting the sensor parameters

- **Exposure and exposure control**

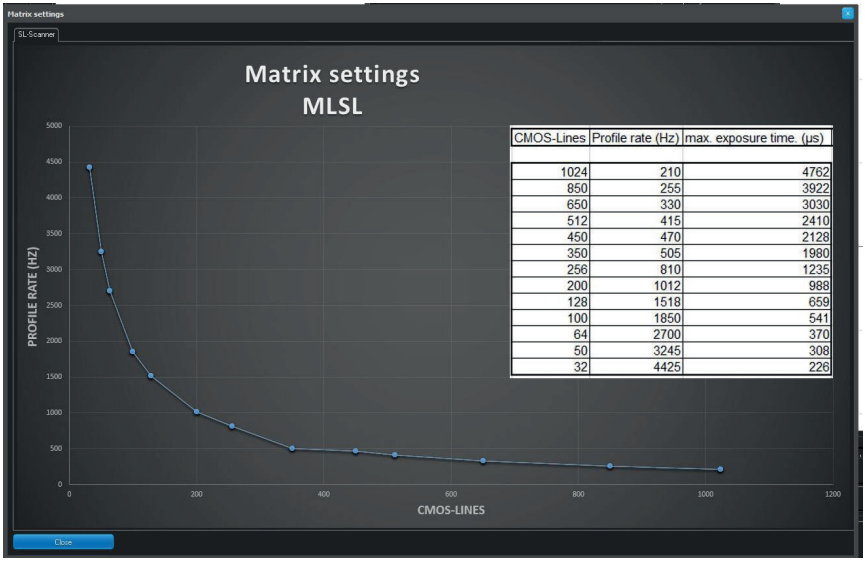
Exposure time	Setting the exposure time in µs. "Shutter time" and "Laser on time" are linked with one another and cannot be configured separately.
Laser off	Switches the laser on or off via mouse click (only selected sensor)
Sort peaks and select first one	Various peaks are processed in the software. If this function is selected, the software will automatically search for the first measurement peak
Sensibility (0...255)	Threshold value beyond which a measurement value should be used for the evaluation

- **Settings of camera matrix**

The camera matrix settings determine the size of the ROI (Region of Interest). Undesired profile information, e.g. of a feed belt, can be hidden in this way.

StartZ	Offset (in lines) beyond which the profile information from the CMOS should start being read out
Amount of lines to read	Number of lines that should be read out beyond StartZ and used for the profile evaluation

Changes to settings are applied for the respectively marked sensor or all sensors by clicking on the "Set" or "Set for all scanners" button.
Clicking on "?" displays a graphic that represents the relationship between the number of lines to be measured and the measuring rate that can be achieved with this.



CMOS-Lines	Profile rate (Hz)	max. exposure time. (µs)
1024	210	4762
850	255	3922
650	330	3030
512	415	2410
450	470	2128
350	505	1980
256	810	1235
200	1012	988
128	1518	659
100	1850	541
64	2700	370
50	3245	308
32	4425	226

Figure 14: Matrix settings for a weCat3D MLSL

NOTE!
All settings made in "Scanner Settings" are stored directly in the software. The changes do not need to be confirmed.

- **Settings for all scanners**

Confirm the entry with "Set" in order to apply the measuring rate entered. The lasers for all sensors are switched off via the "All lasers off" button. Clicking on "Reset all scanners" resets all sensors to their factory settings.

NOTE!
All sensors involved with the application must have identical measuring rates so that the VoluMEL functions properly. This ensures that the sensors will synchronize reliably. The measuring rate therefore has the same value for all sensors.

9.3.2 Align scanners

Individual sensors can be aligned in accordance with their mounting direction in relation to the feed under "Edit → Settings → Scanner settings → Align scanners" (see also Figure 8).

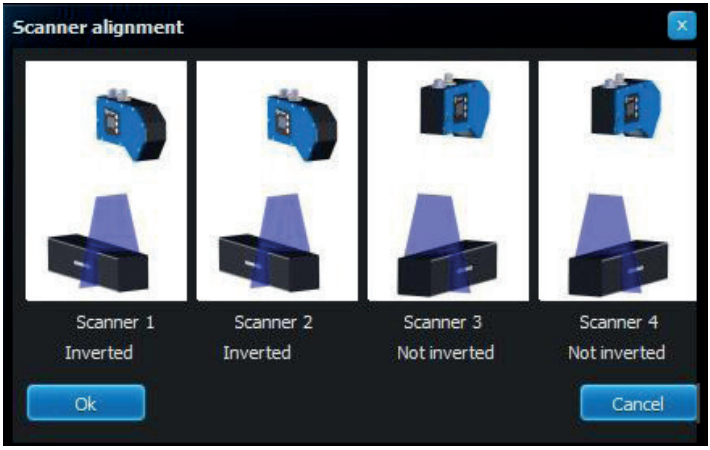


Figure 15: Aligns the sensors relative to the feed direction

Click on one of the images (see Figure 15) to invert the corresponding sensor in the VoluMEL software. Inversion is necessary if the cameras are not aligned in the same direction. This can be necessary for structural or technical reasons. The axis direction of the sensor is displayed in Figure 16 .

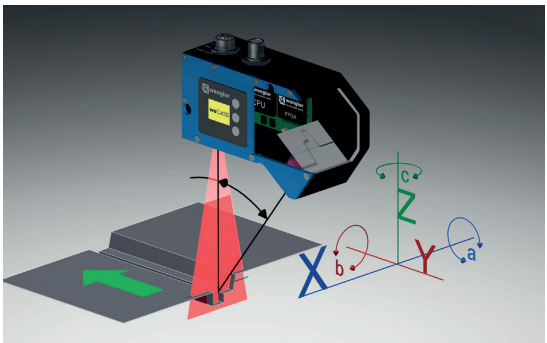


Figure 16: Defining the axis

9.4 Interface settings

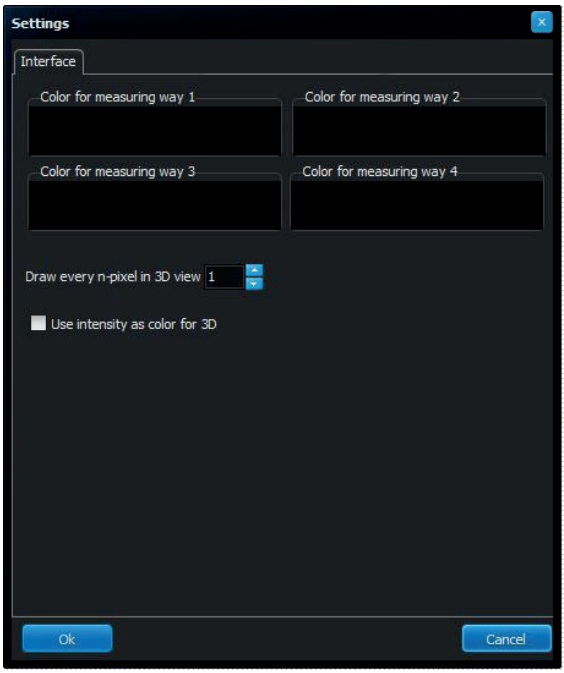


Figure 17: Interface settings

Color for measuring way 1...4	Color selection for the individual sensors
Draw every n-pixel in 3D view	Here, enter how many pixels should be displayed as 3D points
Use intensity as color for 3D	The color of the 3D image is displayed according to the intensity values

10. Communication

The interface protocol for the VoluMEL software can be found in the annex in sec. 14.1.

10.1 Communication settings

A dialog window to configure the TCP server that serves the direct communication between application and PLC opens under "Edit → Communication → Communication settings".

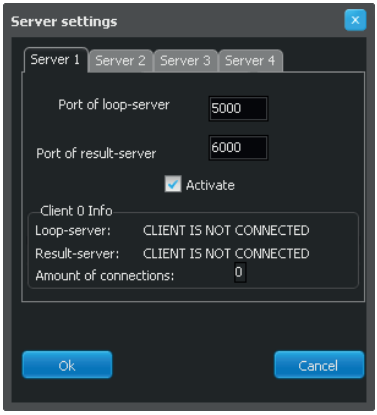


Figure 18: Server settings

The settings can be applied separately for each TCP server.

Port of loop server	Port at which the loop server is available (default: 5000)
Port of result server	Port at which the result server is configured (default: 6000)
Activate	Activates the sensor
Client x info	
Loop server	Displays whether a client (PLC) is connected
Result server	Displays whether a client (PLC) is connected
Amount of connections	Number of active connections

10.2 Test communication

The communication values and addresses of the VoluMEL software and the PLC or downstream controller are displayed under "Edit → Communication → Test communication" (see Figure 19).
The user can also check whether data can be received or sent.

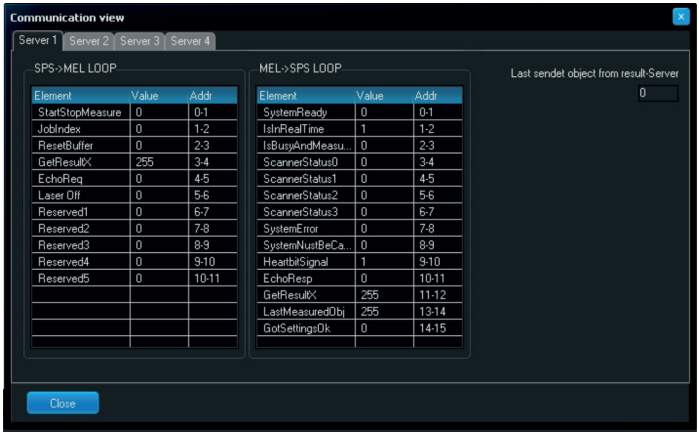


Figure 19: Displays the communication value and addresses

11. Calibrating and configuring measurement

Calibration and measurement is accomplished using Jobs (see sec. 8.1.1.2).
Jobs can be freely assigned numbers for identification (0...99).

Jobs must be carried out in the following order for the initial calibration or measurement:

- Calibration (e.g. job no. 0)
- Volume linear closed (e.g. job no. 1)
- Calibration virtual bottom (optional, depends on design, e.g. job no. 2)

11.1 Calibration object

A previously completed calibration object is required for the calibration process.
This object should have the following properties:

- The corners of the calibration object must be square. The number of corners must coincide with the number of sensors used. The size of the calibration object should be chosen so that it is located within the entire measurement range of the sensors used
- The outer dimensions must be determined at least one order of magnitude more accurately than the measurement requires
- The surface should be matte black or burnished

11.2 Start software and connect sensors

Start the software and connect the sensors as described in sec. 8.1.1.4. The sensors must be equipped to do so and ready for use (status display is green). All sensors must run in sync with one another, i.e. the frequency displayed in the status next to the sensors has a constant value.

11.3 Placement of the calibration object

If possible, the calibration object should be placed so that it is located in the middle of the measuring range. Every sensor must be aligned to one corner so that it can also measure both adjacent edges. All corners of the calibration object should be visible in the profile view.

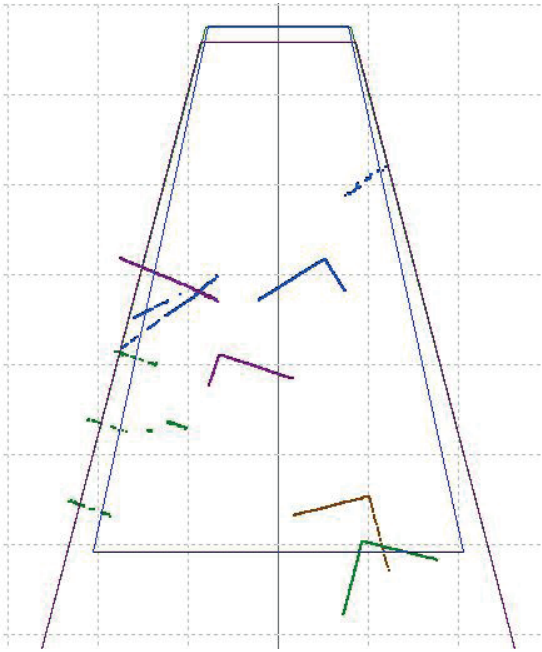


Figure 20: Calibration object is currently in the measurement field

11.4 Calibration

Jobs are set up via "Edit → Settings → Job-Settings" (see Figure 21). In the example, this is job 0 with the measuring method "Calibration":

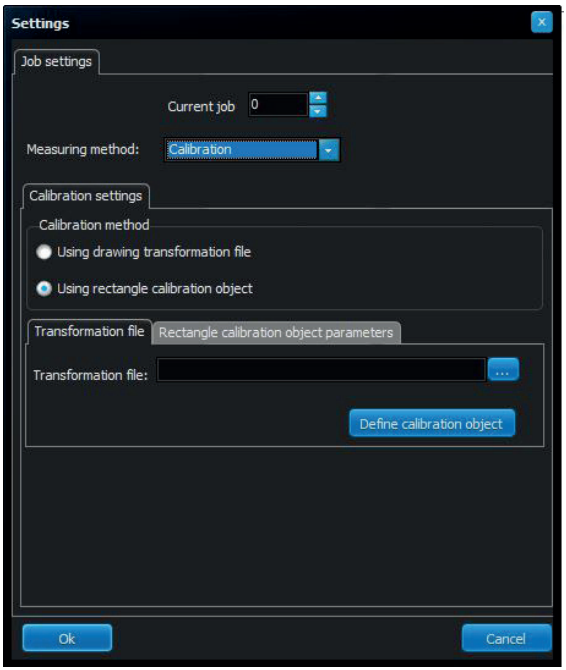


Figure 21: Job setting, "Calibration"

Define calibration objects via "Define calibration object".
A point is placed on the work area by double clicking. This can be edited by double clicking again (see Figure 22).

Figure 22: Editing the points

If the point is a corner point, then the corresponding sensor is selected according to its numbering.

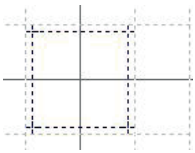


Figure 23: Depiction of the complete calibration object

The created calibration object will then be stored (see Figure 24).

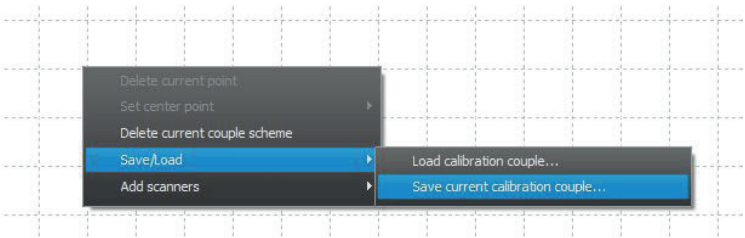


Figure 24: Saving the created calibration object

The saved object will now also be used in the job (see Figure 25).

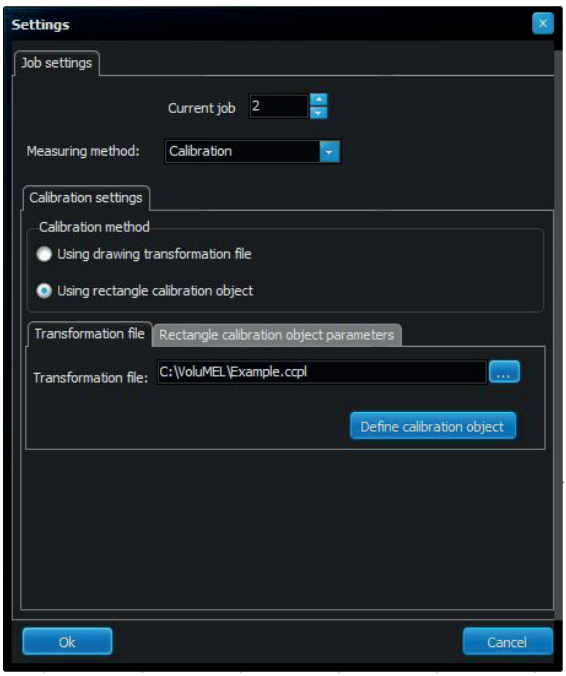


Figure 25: Using the object in the job for calibration

For calibration objects with a square cross section, the edge length can also be entered under the "Rectangle calibration object parameters" tab.

NOTE!
The edge lengths entered must match the calibration object.

The areas necessary for measurement will now be defined around the individual corners. The corner points of these areas are set by double-clicking (s. Figure 26).

NOTE!
Make sure that no interfering profiles are also closed into the calibration areas.

Every area must now be assigned to the respective sensor (identified by same color).
To do so, right click in the field, select "New area for calibration", and choose the sensor using the corresponding index.

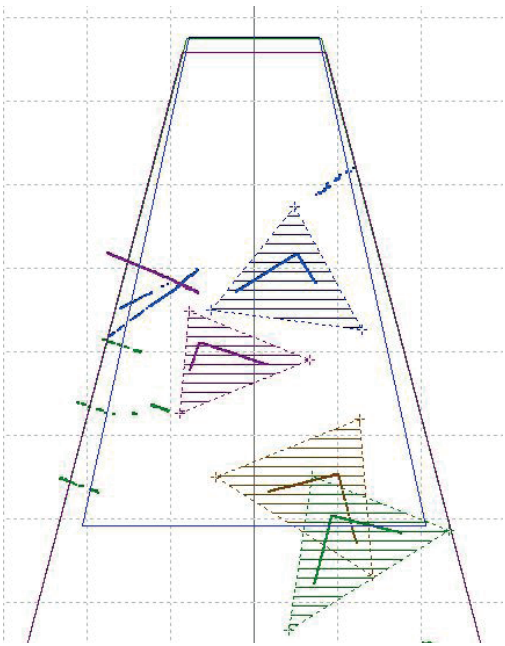


Figure 26: Selecting the area for calibration

To finish calibration, click on Edit --> Start measurement.
A closed profile should now be visible in the job "Volume linear closed".

NOTE!
Make sure that no interfering profiles are also closed into the calibration areas.

Figure 27: Depiction of the calibration object as closed profile

Now define the area that is to be measured. To do so, create an area around the profile as in the calibration. Right click in the field and click on "New area for measurement".
Under "Edit → Program settings", select "Use encoder" for "Define y axis". This ensures that the encoder of the displacement unit is used as feed information.
The measured values are now displayed in the X/t diagram, and the point cloud of the measured object is displayed on the 3D surface (sec. 8.1.2 and 8.1.3).

NOTE!
Only when all sensors are correctly arranged will the profile remain closed when the object is closed. If the shape breaks apart, as shown in Fig. 34, the sensor alignment must be adjusted. The alignment of the sensors can be changed under "Edit → Settings → Scanner settings → Align scanner". To do so, click on the corresponding sensor in the image and the sensor will be inverted (see sec. 9.3.2).

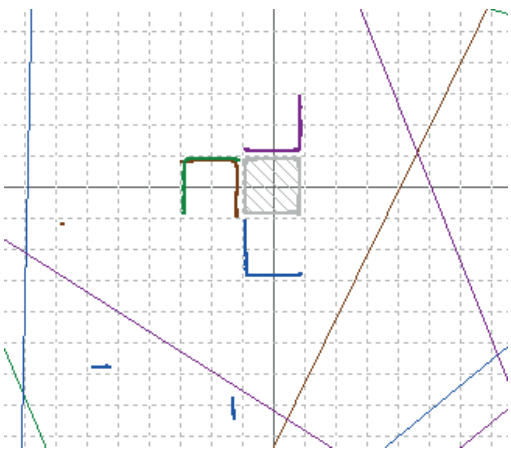


Figure 28: Open profile due to incorrect sensor alignment

12. Measurement with reference area

If the object cannot be measured on all sides, it is possible to perform a measurement with a reference document. To do so, the following steps must be performed:

- Enter the number of sensors used in "Program settings". If more sensors are to be connected to the software, they must be deactivated
- Place object for calibration under the sensors and carry out calibration (see sec. 11)
- Remove calibration object
- To program in the bottom, select the job "Virtual bottom". Limit the area for the bottom (see Figure 29) and start the measurement. The programmed bottom is now congruent with the virtual bottom.

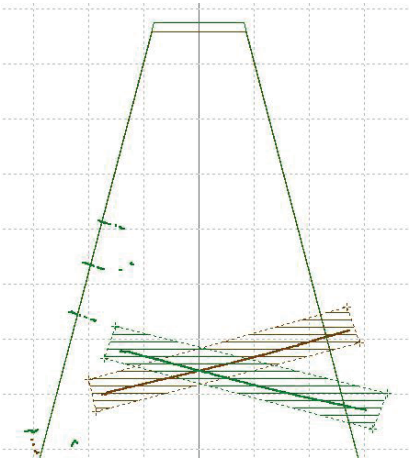


Figure 29: Limit the measurement range for the virtual bottom

- Insert measurement object
- Select the job "Volume linear closed" and check the "Use programmed bottom" box under the "Bottom settings" tab. For "Distance from bottom to determine coordinates", enter a value of approx. 0.5 mm in order to prevent the bottom, or parts thereof, from being measured (see Figure 30).

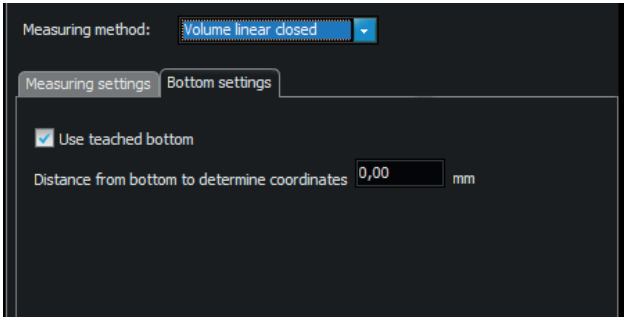


Figure 30: Bottom settings

13. Change Index

Version	Date	Description/Change	Software version
1.0.0	28/08/2019	Initial version of documentation	1.1.0.4
1.1.0	01/02/2021	• Correction System Requirements	1.1.0.4

14. Appendix

14.1 Interface Protocol

The VoluMEL software provides the option of remote control over TCP/IP communication. Here, the software provides the option to configure and activate the server (see EDIT → Communication → Communication Settings menu).

14.1.1 Controller

There is a separate server, called the loop server, with its own port (standard port: 5000) for the controller/ status of the software. The following binary data is sent via the loop server:

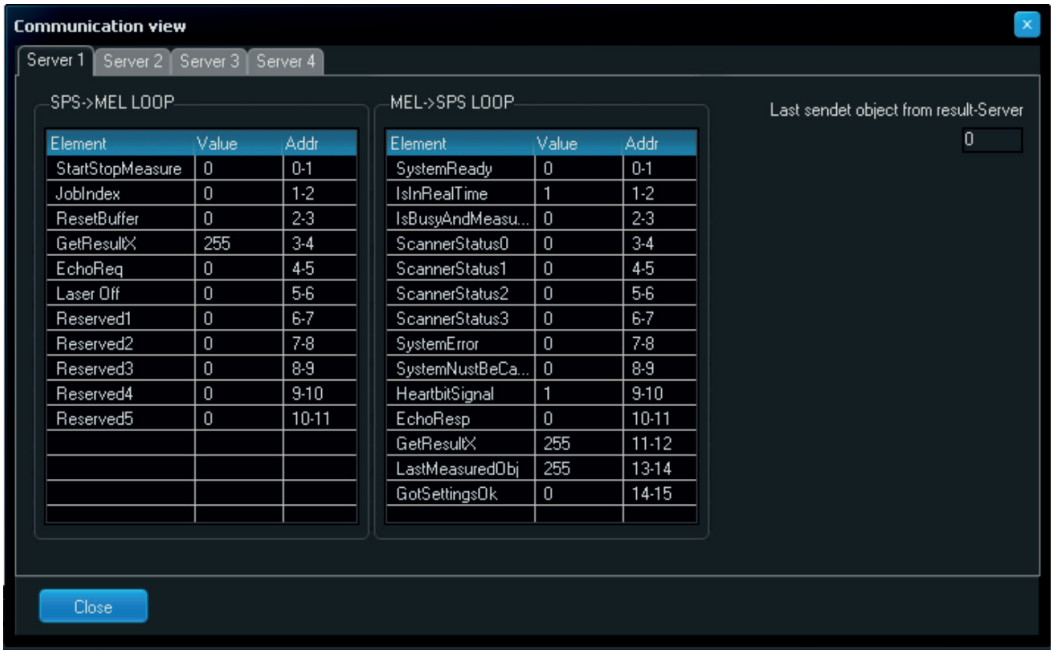
• To manage the software (Users → VoluMEL)

Byte	Data type	Info	Size	Comment
0	byte	Start/Stop measurement	1 byte	Starts/stops measurement 1: Start 0: Stop
1	byte	Load job number...	1 byte	Loads the job with the transmitted number 00...99
2	byte	Reset buffer number...	1 byte	Erases the ring memory and sets the object counter to 0 (only active for volume measurement) 1: Buffer is erased
3	byte	Get result number...	1 byte	The VoluMEL software sends the requested object data from the memory (only active for volume measurement) 0...9: Object number
4	byte	Get response	1 byte	The transmitted value is returned unchanged in response 0...255 / Echo
5	byte	Laser on/off	1 byte	1: Laser off 0: Laser on
6-10	byte	Reserved	5 bytes	Reserved

• **For status information (VoluMEL → users)**

Byte	Data type	Info	Size	Comment
0	byte	System ready	1 byte	Indicates if the system is ready or not 1: ready 0: not ready
1	byte	In real time	1 byte	Indicates whether the evaluation is in real time 1: Yes 0: No
2	byte	Busy and measurement Not ready	1 byte	Indicates whether a measurement is being carried out or not 1: ready 0: busy
3	byte	Status scanner 1	1 byte	Indicates the status of scanner 1 1: OK 0: NOK
4	byte	Status scanner 2	1 byte	Indicates the status of scanner 2 1: OK 0: NOK
5	byte	Status scanner 3	1 byte	Indicates the status of scanner 3 1: OK 0: NOK
6	byte	Status scanner 4	1 byte	Indicates the status of scanner 4 1: OK 0: NOK
7	byte	System error	1 byte	Indicates if there is a calibration error 1: Calibration error 0: no errors
8	byte	System must be calibrated	1 byte	Reserved / not used
9	byte	Heartbeat signal	1 byte	The byte toggles, at one second intervals, between the value 0 and 1
10	byte	Echo response	1 byte	Returns the transmitted value unchanged 0...255
11	byte	Get result...	1 byte	Indicates which result was requested (only active for volume measurement)
12	byte	Last measured object	1 byte	Indicates which object was last measured (only active for volume measurement) 0...9
13	byte	Got settings ok	1 byte	Reserved / not used

The output and sent data is displayed under "Edit → Communication → Test communication":



14.1.2 Data format

The measurement data is also sent over an internal server, the result server. The standard port of 6000 is used. The data is requested by the controller.
The binary format is described as follows:

Byte	Data type	Info	Size	Comment
0	byte	Start byte 0	1 byte	S: transmits the letter S in ASCII (0x53)
1	byte	Start byte 1	1 byte	T: transmits the letter T in ASCII (0x54)
2	byte	Start byte 2	1 byte	A: transmits the letter A in ASCII (0x41)
3	byte	Object number	1 byte	Object number of data (0...9)
4	byte	Calibration or measuring	1 byte	Reserved / not used
5	byte	Measuring method	1 byte	Reserved / not used
6	byte	Current job	1 byte	Indication of selected job (0...99)
7	byte	Time stamp hours	1 byte	Time stamp in hours (0...23)
8	byte	Time stamp minutes	1 byte	Time stamp in minutes (0...59)
9	byte	Time stamp seconds	1 byte	Time stamp in seconds (0...59)
10-11	short	Amount of cross sections	2 bytes	Number of cross sections present in the buffer (0...2400)
12-9611	float	Cross sections in mm^2	9600 bytes	Cross-sectional area in mm^2. Every cross-section consists of 4 bytes (float).

9612-9615	float	Encoder resolution	4 bytes	Gives the distance between the cross sections (in mm)
9616-9623	double	Encoder mm factor	8 bytes	Factor to convert the encoder impulse to a length value (in mm)
9624-9627	float	Volume in mm^3	4 bytes	Total volume of the object in mm^3
9628-9631	float	Length in mm	4 bytes	Length of the object in mm
9632	byte	Intensity scanner 1	1 byte	Determined intensity value of scanner 1
9633	byte	Intensity scanner 2	1 byte	Determined intensity value of scanner 2
9634	byte	Intensity scanner 3	1 byte	Determined intensity value of scanner 3
9635	byte	Intensity scanner 4	1 byte	Determined intensity value of scanner 4
9636	byte	Temperature scanner 1	1 byte	Current temperature of scanner 1
9637	byte	Temperature scanner 2	1 byte	Current temperature of scanner 2
9638	byte	Temperature scanner 3	1 byte	Current temperature of scanner 3
9639	byte	Temperature scanner 4	1 byte	Current temperature of scanner 4
9640	byte	Median filter size	1 byte	Filter size of the median filter
9641-9648	double	Start position 1	8 bytes	Start position of the object (encoder value)
9649-9656	double	Start position 2	8 bytes	Reserved / not used
9657-9664	double	End position 1	8 bytes	End position of the object (encoder value)
9665-9672	double	End position 2	8 bytes	Reserved / not used
9673-9792	byte	Reserved	120 bytes	Reserved / not used
9793	byte	End byte 0	1 byte	E: transmits the letter E in ASCII (0x45)
9794	byte	End byte 1	1 byte	N: transmits the letter N in ASCII (0x4E)
9795	byte	End byte 2	1 byte	D: transmits the letter D in ASCII (0x44)