MICRO-EPSILON

Instruction Manual

gapCONTROL Setup Software 2.1

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Contents

1 Introduction

This user manual gives you an overview of the functions of "gapCONTROL Setup Software", referred to in short as "Setup Software" in the following. This provides you with the possibility to configure and parameterize the gapCONTROL measurement system for your measurement task in order to examine and solve typical tasks with it. The gapCONTROL measurement system is a laser line sensor which is designed for applications in the industrial environment.

This product is characterized by a wide range of applications and high accuracy. Setup Software can help you solve a variety of different gap applications combined with maximum precision.

Setup Software supports the following gapCONTROL measurement systems:

- gapCONTROL 2611-10/2611-25/2611-50/2611-100
- gapCONTROL 2711-25/2711-50/2711-100
- gapCONTROL 2911-10/2911-25/2911-50/2911-100

Note: To be able to use gapCONTROL Setup Software, the gapCONTROL measurement system requires a firmware version ≥ 30. Check the firmware version on the status line if necessary (see Chapters 3.4 and 8.1).

Note: In the following the term "gapCONTROL" stands for all measurement systems listed above.

1.1 Using this Manual

The user manual contains general information on the installation and use of Setup Software and on the use of the gapCONTROL measurement system. As a user of the software it is important that you read Chapter 2 "Installation and Preparation for Measurement Operation". Chapter 3 "Working with gapCONTROL Setup Software" and Chapter 4 "Description of the Measuring Programs" describe how to use the functions offered by the software. Chapter 7 "**Fehler! Verweisquelle konnte nicht gefunden werden.**" describes how to use the gapCONTROL measurement system.

Note: Please refer to the contact address printed on the inside cover for any issues relating to queries and support or any other technical information.

1.2 Overview of the Complete System

gapCONTROL Setup Software transfers profile data from the gapCONTROL measurement system in a simple way and displays these graphically. These profile data are further processed and evaluated in measuring programs. All data are transferred either via IEEE1394 (FireWire, iLink) or via Ethernet, depending on the type of sensor, and can be stored with the software if needed.

The gapCONTROL measurement system measures two-dimensional profile data, evaluates the profile data, determines measured values of different types of gaps and evaluates them. The measured values are output at various ports (see below). Setup Software is used for parameterization of the measurement system and for the visualization of the measurement results. Once parameterization has been completed, the software can be closed and the measurement system can be disconnected from the PC. The gapCONTROL measurement system then continues to operate as an independent unit and performs the measurements.

	gapCONTROL 2611/2911	**gapCONTROL 2711**
RS422 (ASCII format)	half-duplex	full-duplex
RS422 (Modbus RTU protocol)	half-duplex	full-duplex
Ethernet (UDP protocol)	yes	yes
Ethernet (Modbus TCP protocol)	yes	yes
Analog out	x4 *	x4 *
Digital out	x8 *	x8 *

* optional, gapCONTROL Output Unit is required

Fig. 1.1: Measured values output ports

Setup Software can be operated as a demo or as full version. There are two possibilities for licensing the software and thus operating as full version:

- **gapCONTROL:** When using the gapCONTROL measurement system, this is automatically used as license for the full version.
- **Dongle:** A USB dongle can be used for licensing.

Function	Demo Version	Full Version
Data transmission via gapCONTROL (online mode)	X	X
Loading a stored profile sequence (offline mode)	X	X
Visualization of measurement results	X	X
gapCONTROL parameterization	X	X
Synchronization (triggered operation)	X	X
Filter functions	X	X
Restore default settings	X	X
Load gapCONTROL parameters offline	X	X
Offline logging of measurement results	X	X
Loading and saving parameters	X	X
Store parameters permanently on gapCONTROL *	X	X
Read parameters from gapCONTROL *	X	X
Statistical evaluation of measured values	X	X
Online logging of measurement results		X
Output of the measured values		X

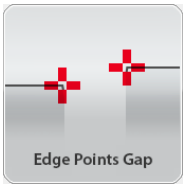
* In order to store and read all measurement parameters please use the gapCONTROL measurement system. In case of using the scanCONTROL measurement system, only a subset of the parameters is stored/read (see Chapter 3.13.17 and 3.13.18).

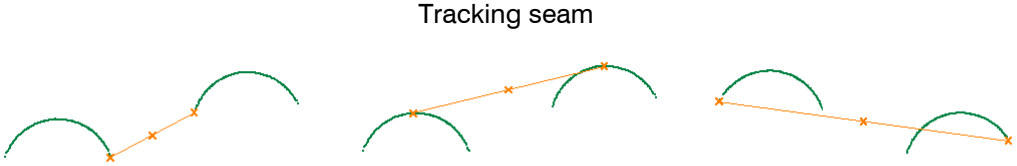
Fig. 1.2: Functional scope gapCONTROL Setup Software

1.3 Application Examples for gapCONTROL

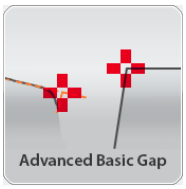
The following are just some examples of measuring tasks for which gapCONTROL is designed (on the right the measuring programs needed for solving the respective measuring task are illustrated):

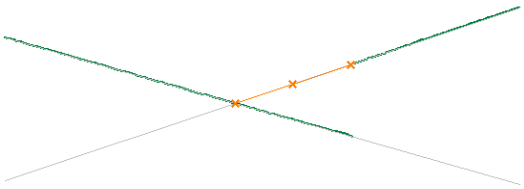
Tracking seam



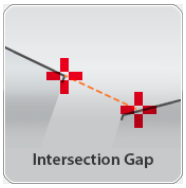


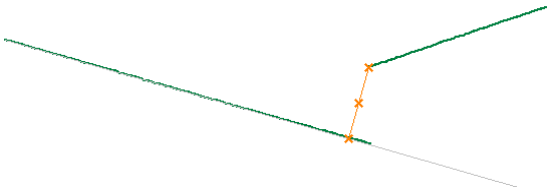
Distance



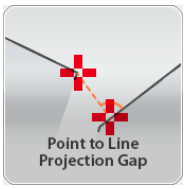


Intersection seam





Perpendicular seam



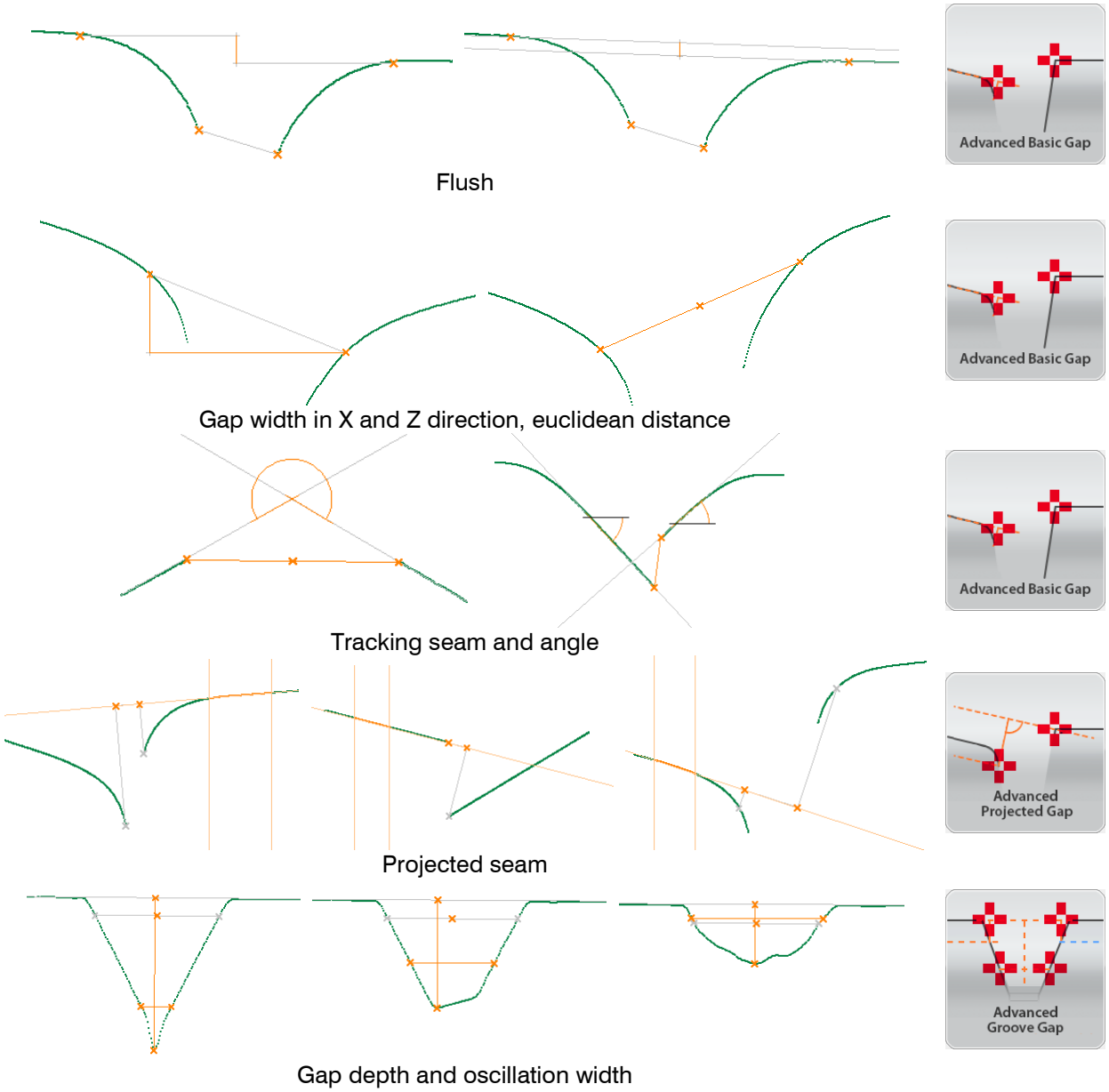


Fig. 1.3: Examples of applications

1.4 Definition of Basic Terms

- **Profile:** A profile consists of an individual measuring points. Each of these points is defined by its X and Z coordinate.
- **X coordinate:** The horizontal coordinate of a point.
- **Z coordinate:** The vertical coordinate of a point.
- **Profile sequence:** A chronologically consecutive series of profiles is called a profile sequence.
- **Measurement operation:** This describes the operation in which a profile is scanned by gapCONTROL and all the measured values are determined.
- **Series of measurements:** A chronologically consecutive series of measurement operations is called a series of measurements.
- **Scan rate:** This refers to the number of measurement operations performed per second.
- **Base gap:** The largest gap in a profile.
- **First point:** The point with minimum X coordinate.
- **Last point:** The point with maximum X coordinate.
- **Minimum point:** The point with minimum Z coordinate.
- **Maximum point:** The point with maximum Z coordinate.

1.5 Functions of the Measuring Programs

This list of functions should only be used as a brief overview. The measuring programs are divided into four groups. A detailed description of all the measuring programs can be found in Chapter 4.

- **Basic Gaps**: Programs for measuring the characteristics of simple gaps can be found in this group:
  - **Edge Points Gap**: Measurement of a gap based on the inner edge points.
  - **Top Points Gap**: Measurement of a gap based on the highest points.
  - **Bottom Points** Gap: Measurement of a gap based on the lowest points.
  - **Threshold Points Gap**: Measurement of a gap based on the intersection points of the threshold with the profile.
- **Projected Gaps**: This group contains the programs for measuring the characteristics of gap that is defined by different projection types:
  - **Single Line Projection Gap**: The gap is defined by the projection of the inner edge points onto a straight line.
  - **Double Line Projection Gap**: The gap is defined by the projection of the inner edge points onto one of two parallel straight lines.
  - **Point to Line Projection Gap**: The gap is defined by an inner edge point and its projection onto a straight line.
  - **Intersection Gap**: The gap is defined by the intersection of two straight lines and the projection of an inner edge point.
- **Groove Gaps**: This group contains the programs for measuring the characteristics of a V-shaped gap.
  - **Flat Groove Gap**: Measurement of a gap with flat edges.
  - **Parallel Lines Groove Gap**: Measurement of a gap with parallel edges.
  - **Independent Lines Groove Gap**: Measurement of a gap with independent edges.
  - **Single Line Groove Gap**: Measurement of a gap with one edge.
- **Advanced Gaps**: This group contains the programs for measuring the characteristics of a gap with extended setting options and measured values.
  - **Advanced Basic Gap**: All the setting options from the measuring programs in the "Basic Gaps" group are available to determine the gap.
  - **Advanced Projected Gap**: All the setting options from the measuring programs in the "Projected Gaps" group are available to define the gap.
  - **Advanced Groove Gap**: All the setting options from the measuring programs in the "Groove Gaps" group are available to determine the gap.
- **Tools**: Useful utilities can be found in this group:
  - **Display Image Data**: Visualization of the image data recorded by the sensor matrix.
  - **Display Profiles**: Display of the profile data.
  - **Save Profiles**: Saves profile sequences for later offline analysis.

2 Installation and Preparation for Measurement Operation

2.1 Installation Requirements

The following minimum system specification is necessary for the operation of Setup Software:

- Windows 7 (32 bit and 64 bit), Windows 8 or 8.1 (32 bit and 64 bit)
- 1-GHz or faster (32 bit and 64 bit) processor
- 1 GB RAM
- Screen resolution: 1024 x 768

Note: To be able to use gapCONTROL Setup Software, the gapCONTROL measurement system requires a firmware version ≥ 30. Check the firmware version on the status line if necessary (see Chapters 3.4 and 8.1).

To be able to use Setup Software the following steps must be followed:

1. Install the IEEE1394 and the Ethernet interface hardware respectively, if not already installed.
2. Install Setup Software (see Chapter 2.2).
3. Connect and license the ICONNECT USB dongle (if present).
4. Connect the gapCONTROL measurement system to the PC via IEEE1394 and Ethernet respectively.
5. Install the driver for the gapCONTROL measurement system (only for IEEE1394, refer to Chapters 2.5 and 2.6).

[CD]:\Documentation	Contains manuals, installation instructions and Quick Reference
[CD]:\Examples	Contains examples of profile sequences
[CD]:\License	Contains license information for gapCONTROL Setup Software
[CD]:\Program\gapCONTROL Setup Software 2.1	Contains gapCONTROL Setup Software 2.1
[CD]:\Support\Ethernet	Contains a software tool for configuration of the IP addresses of gapCONTROL devices with an Ethernet interface
[CD]:\Support\Driver-CMU1394	Contains the driver files (version 6.4.6) for the gapCONTROL measurement system
[CD]:\Support\Adobe Reader 10	Contains Adobe Reader 10
[CD]:\Support\FImageFilter	Contains filter files for integrating DirectX
[CD]:\Support\Sentinel System Driver 7.5.0	Contains the dongle driver
[CD]:\Support\VCRedist2008	Contains the "Microsoft Visual C++ 2008" Redistributable Package

Fig. 2.1: Contents of the Software CD

2.2 Installation of Setup Software

When you insert the Software CD an installation window appears which offers you a number of options. Alternatively you can start the window with the [CD]:\setup.exe file.

Before you install setup software, make sure that the gapCONTROL measurement system is not connected to the PC (only IEEE1394, only Windows 7)

Click on the "Install" button to start installing the software.

Now the installation wizard installs the software and necessary components.

Note: You need administrator rights in order to install the software and the driver for the gapCONTROL measurement system (only IEEE1394).

Note: For gapCONTROL measurement systems with an IEEE1394 interface, activate the "Disable default windows driver for IEEE1394 imaging devices" option to make the gapCONTROL driver installation easier.

Note: For gapCONTROL measurement systems with an Ethernet interface, activate the "Configure windows firewall" option in order to enable the data transfer between gapCONTROL and the PC in case of an active windows firewall.

During the installation process the driver for gapCONTROL will be installed (only IEEE1394, only Windows 8, see Chapter 2.5). You may be requested to restart the computer.

In order to license the software for operation with a dongle and to use the full version of gapCONTROL Setup Software (see Chapter 1.2), use the "License" entry in the Windows Start menu. The dialog box for licensing Setup Software appears:

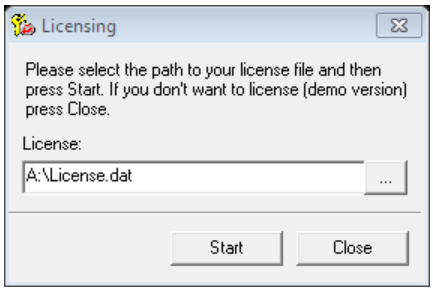


Fig. 2.2: Dialog box for licensing Setup Software

➪ To do this, insert the license CD in the drive and press the "..." button.

A standard file selection dialog appears.

➪ Select the "License.dat" file on the CD and press "OK".
➪ Then press the "Start" button on the dialog to begin licensing.

Note: To use the demonstration version of gapCONTROL Setup Software no license is required.

2.3 Connecting gapCONTROL to the PC (Ethernet)

In order to connect gapCONTROL via Ethernet to the PC, proceed as follows:

➪ Finish the installation of gapCONTROL Setup Software completely. This procedure is described in Chapter 2.2.
➪ Connect gapCONTROL via the Ethernet interface to the PC and switch on the power supply.
➪ Please wait until the device is recognized by the PC. This may take a few seconds.

The system is now ready to operate the gapCONTROL measurement system with gapCONTROL Setup Software.

Note: gapCONTROL must be connected directly with the PC. Do not use hubs or switches.

Note: In case of using a network adapter which supports the "VLAN" option, this option must be inactive in order to use the gapCONTROL measurement system.

Note: The PC and the measurement system must be located in the same subnet in order to operate the gapCONTROL measurement system with Setup Software. Use the "Ethernet configurator" dialog box (see Chapter 3.20) in order to adjust the network settings of the measurement system, if necessary.

2.4 Connecting gapCONTROL to the PC (IEEE1394)

In order to connect gapCONTROL via IEEE1394 to the PC, proceed as follows:

Using Windows 8:

- Connect gapCONTROL via the IEEE1394 interface to the PC and switch on the power supply.
- Start the installation of gapCONTROL Setup Software. This procedure is described in Chapter 2.2.
- During the installation process the driver for gapCONTROL will be installed (see Chapter 2.5).

Using Windows 7:

- Finish the installation of gapCONTROL Setup Software completely. This procedure is described in Chapter 2.2.
- Connect gapCONTROL via the IEEE1394 interface to the PC and switch on the power supply.
- Install the driver for gapCONTROL (refer to Chapter 2.6).

The system is now ready to operate the gapCONTROL measurement system with gapCONTROL Setup Software.

Note: You need administrator rights in order to install the driver for the gapCONTROL measurement system.

2.5 Installation of the Driver for IEEE1394 on Windows 8

Note: The driver only has to be installed for using the IEEE1394 interface. No driver is required for gapCONTROL devices with an Ethernet interface.

Preparing the installation:

➨ Start the installation of gapCONTROL Setup Software. This procedure is described in Chapter 2.2.

During the installation process you will be requested to connect gapCONTROL to the PC (see Fig. 2.3):

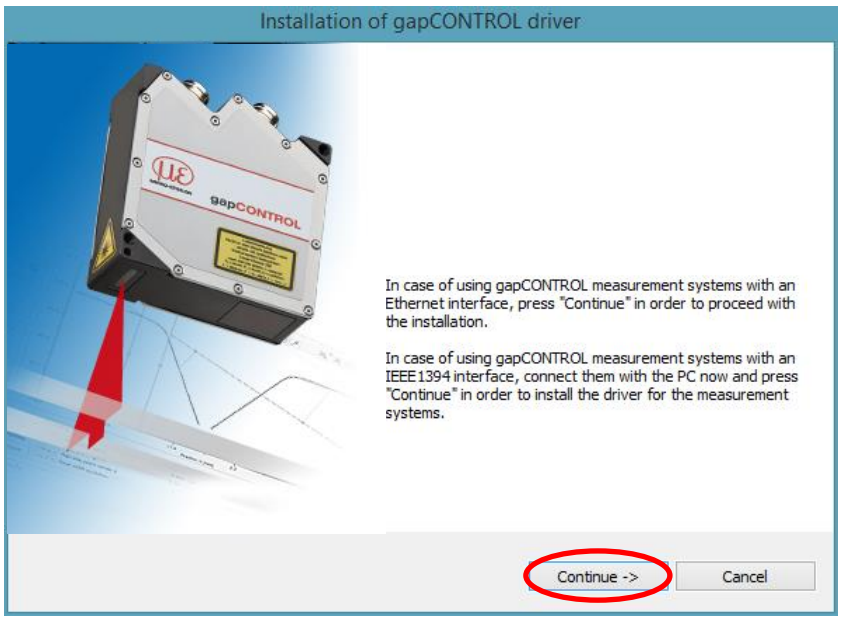


Fig. 2.3: Windows 8 automatic driver installation - step 1

➨ Connect gapCONTROL to the PC and click on "Continue" to confirm (see Fig. 2.3).

First, the driver files will be installed. A dialog is displayed during this process (see Fig. 2.4):

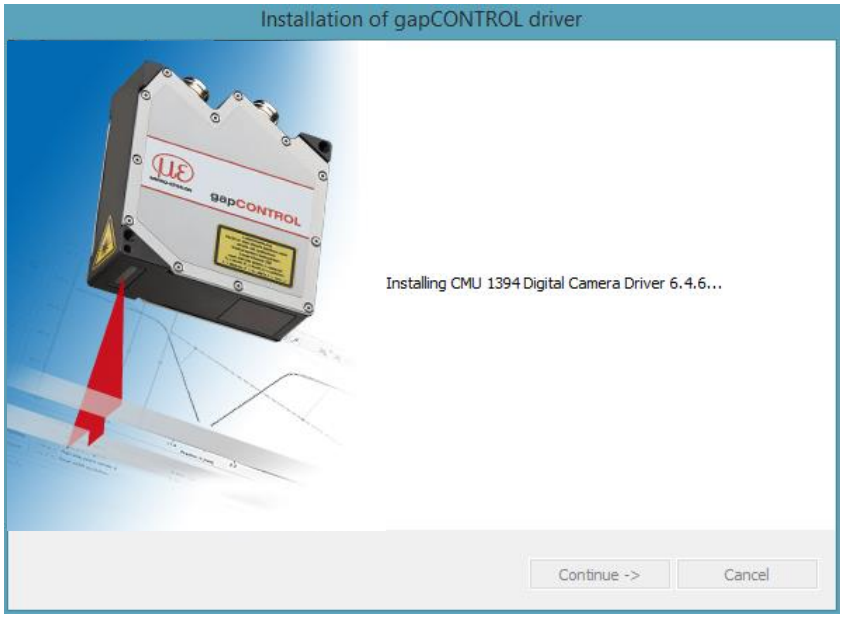


Fig. 2.4: Windows 8 automatic driver installation - step 2

The "Windows Security" dialog appears:

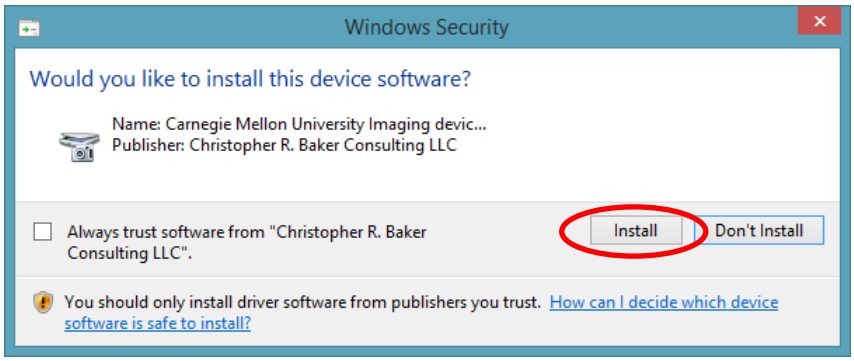


Fig. 2.5: Windows 8 automatic driver installation - step 3

➡ Click on "Install" to confirm this dialog (see Fig. 2.5).

Now, the installation of the driver will be finished. After completing the installation of the driver the installation of Setup Software will be continued.

If you want to install the driver at a later date or in case of an incorrect installation of the driver, you may install the driver subsequently. This procedure is described in Chapter 8.4.1.

You also have the possibility to install the driver manually. This procedure is described in Chapter 8.4.2.

Note: Only use version 6.4.6 of the CMU driver which is delivered on the CD. If a different driver or a different version of the CMU driver for gapCONTROL is installed later, it will not be possible to operate the gapCONTROL measurement system with gapCONTROL Setup Software.

2.6 Installation of the Driver for IEEE1394 on Windows 7

Note: The driver only has to be installed for using the IEEE1394 interface. No driver is required for gapCONTROL devices with an Ethernet interface.

Preparing the installation:

- Finish the installation of Setup Software completely. This procedure is described in Chapter 2.2.
- Connect gapCONTROL via the IEEE1394 interface to the PC.
- Switch on gapCONTROL and the power supply.

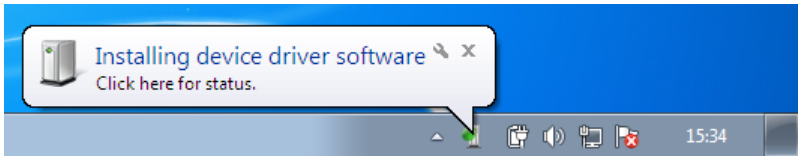


Fig. 2.6: Windows 7 automatic driver installation - step 1

The operating system automatically installs the driver for gapCONTROL. The installation process is displayed in the task bar (see Fig. 2.6). The following message is displayed after completing the installation successfully (see Fig. 2.7):

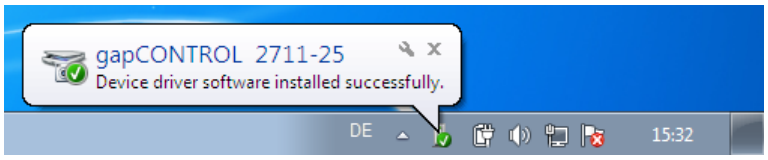


Fig. 2.7: Windows 7 automatic driver installation - step 2

In case of an incorrect installation of the driver, you have to install the driver manually. This procedure is described in Chapter 8.4.3.

Note: Only use version 6.4.6 of the CMU driver. If a different driver or a different version of the CMU driver for gapCONTROL is installed later then it will not be possible to operate the gapCONTROL measurement system with gapCONTROL Setup Software.

3 Working with gapCONTROL Setup Software

3.1 Starting gapCONTROL Setup Software

Once the installation of the software and the driver is completed you can start the software. To do this, use the program shortcut on your desktop or select "gapCONTROL Setup Software" in the Startup menu.

Once you have started the program, the main window for starting the measuring programs will be displayed.

Note: If you use a dongle for Setup Software, the software control elements are barred initially (this is shown by a mouse pointer with a picture of a key). Press a mouse button or a key on the keyboard to activate the login dialog box. Now log in with the user name "ME" and the password "ME".

3.2 Elements of the Main View

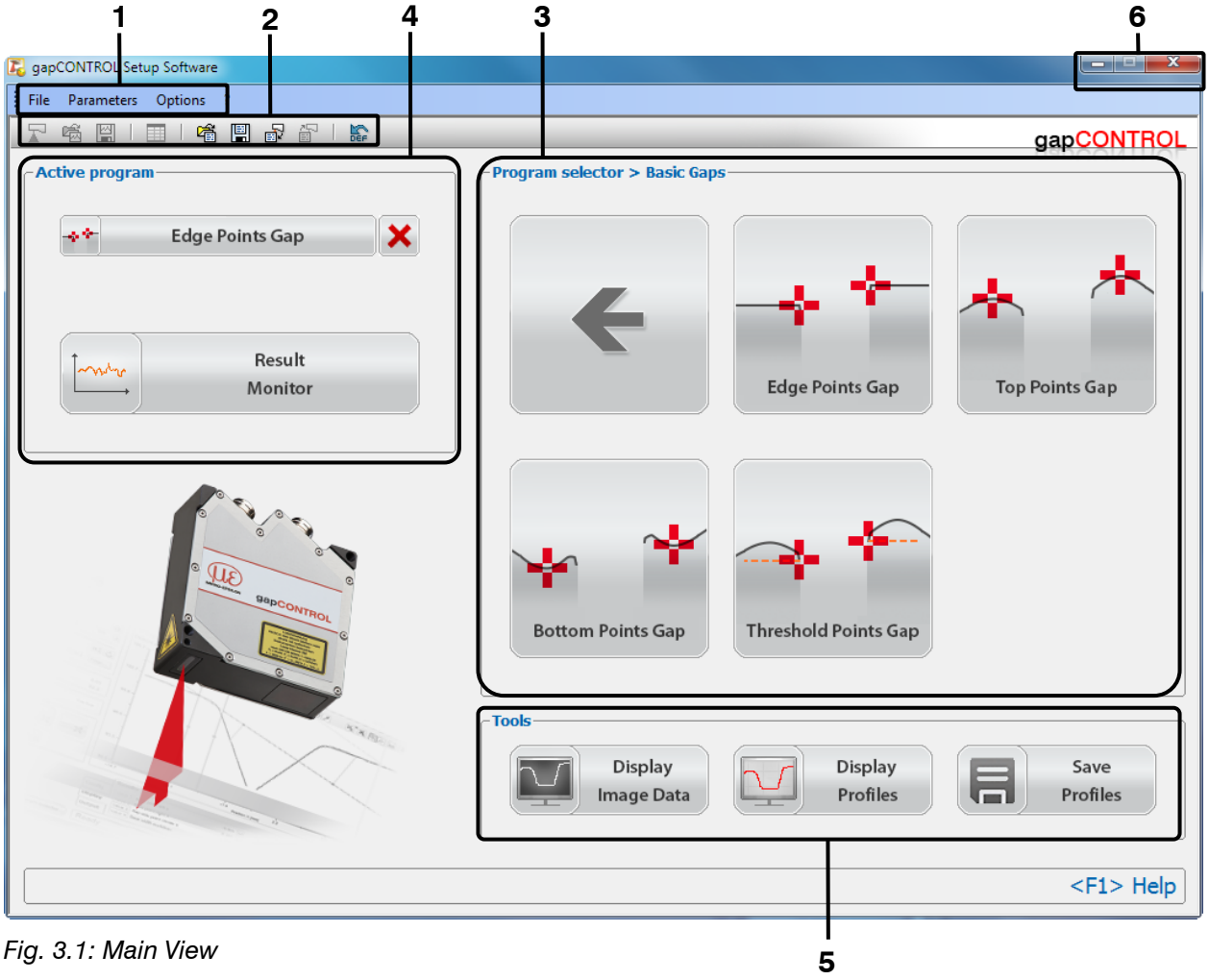


Fig. 3.1: Main View

1 Menu bar: Invoke various settings (mainly used in the individual measuring programs).

2 "General" toolbar: Using this toolbar, you can load parameters from a file or a connected gapCONTROL measuring system (see Chapter 3.15).

3 Selection panel: Select the desired measuring program. The measuring programs are split into several groups. The selected program is shown in the "Active program" input field.

4 Active program: Open the view for configuring the active measuring program and the statistical evaluation.

5 Tools: Open several useful utilities.

6 Title bar: Minimize or close the program.

Note:

- Never disconnect the IEEE1394 or Ethernet connection between gapCONTROL and the PC while using the software.
- Never disconnect the power supply of gapCONTROL while the software is running.
- Never activate the standby mode or hibernation of your computer when the measurement system is connected to the computer.

This may cause the operating system to shut down unintentionally.

3.3 Configuring gapCONTROL Step by Step

The basic steps for configuring gapCONTROL in order to solve a measurement task are described below:

- In the "Program selector" input field (see Fig. 3.1) select the desired measuring program for your measurement task. The selected program is shown in the "Active program" input field.
- Parameterize the selected measuring program (see Chapter 4). To do this, press the according button in the "Active program" input field. The view of the selected measuring program will be shown.
- Configure the gapCONTROL output ports (see Chapter 5).
- After completing the configuration of gapCONTROL, save the parameters to file (see Chapter 3.13.14). You will be able to load the stored file again later on.
- Store the parameters permanently on gapCONTROL (see Chapter 3.13.17). gapCONTROL always starts with the configuration stored last.
- Exit Setup Software and disconnect gapCONTROL from the PC.

gapCONTROL continues to operate as an independent unit and performs the measurements using your defined settings.

3.4 Structure of the Measuring Programs

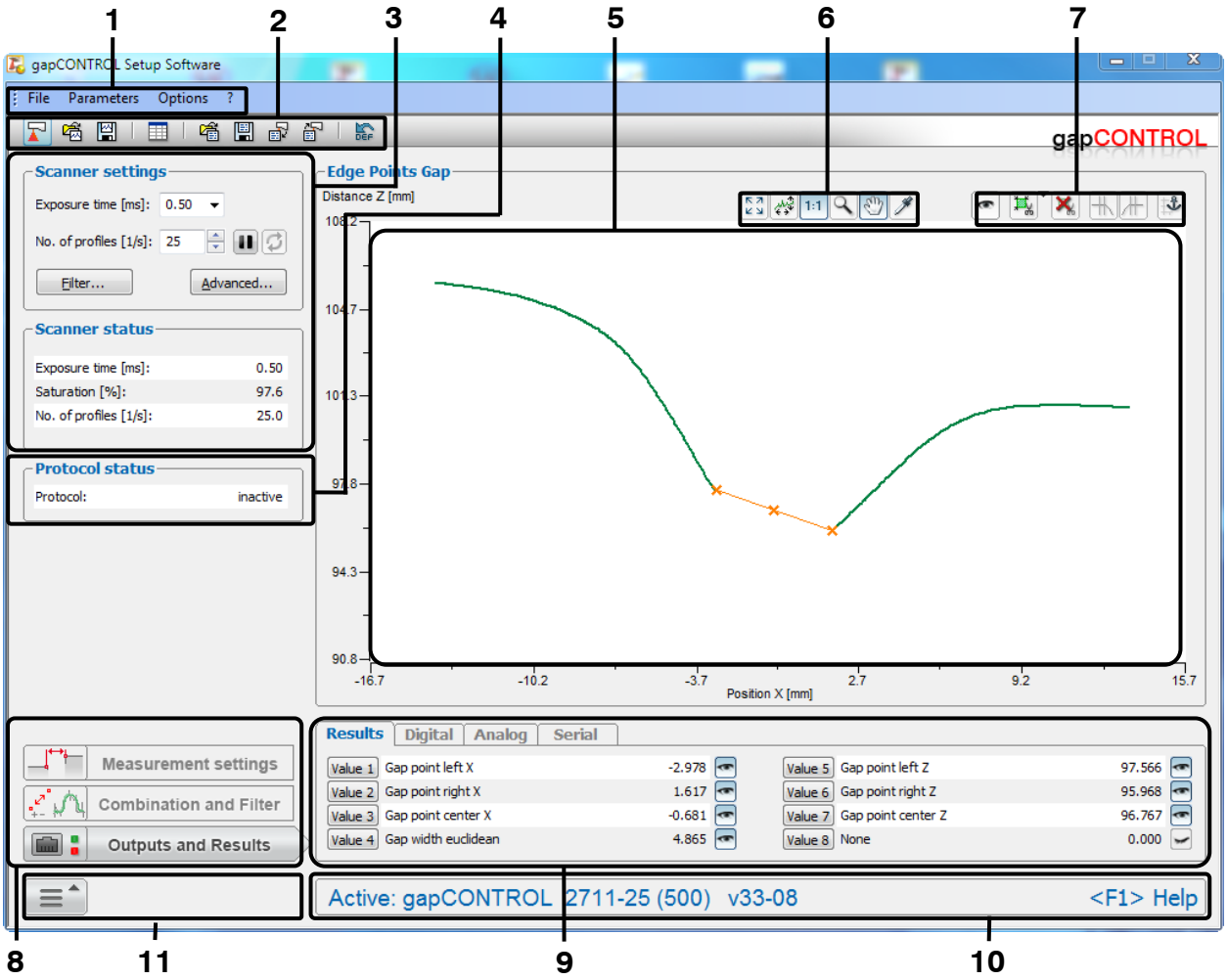


Fig. 3.2: Structure of a measuring program

Figure 3.2 shows the typical structure of a measuring program and the common input and display fields of the measuring programs. Each field is described in detail later in this user manual.

1 Menu bar: Using the menu bar, you can select the data source, return to the Main View, close Setup Software, save and load parameters, reset selected parameters to default settings, access the help and make basic settings (see Chapter 3.14).

2 "**General**" **toolbar:** Using this toolbar, you can select the data source, save profile sequences, save and load parameters and reset selected parameters to default settings (see Chapter 3.15).

3 Scanner settings: You change the settings of gapCONTROL with these values (see Chapter 3.7). In offline mode (see Chapter 3.5) this input field will be replaced by the "File settings" input field (see Chapter 3.10).

4 Protocol status: Indicates whether logging is active.

5 2D-display: This display shows the last measured profile. Either a gapCONTROL measurement system which transfers data to the PC or a file in which profiles of a gapCONTROL measurement system have been recorded previously is used as data source for the profile. Using the toolbars (see below), you can adjust search areas in the 2D-display directly with the mouse and scale the display.

6 "**Display**" **toolbar:** Using this toolbar, you can scale the 2D-display and activate various options for mouse interaction (see Chapter 3.16).

7 "**Measurement**" **toolbar:** Using this toolbar, you can adjust the various search areas and limits for the measurement, and activate or disable the dynamic tracking of the search areas (see Chapter 3.17).

8 Measurement setting: Activate various input fields for configuration of the settings described in field "9".

9 Configuration of the measured values: In this field, you can specify the measurement algorithms, make settings to combine and filter the measured values and select the results that appear in the 2D-display. Select the measured values to be output at the available interfaces (see Chapter 1.2) of gapCONTROL (see Chapter 5).

10 Status line: Status and error messages are displayed on the status line. Refer to Chapter 8.1 "Status and Error Messages, Error Codes" for more detailed information.

11 Menu "Navigation": Press this button in order to display the "Navigation" menu (see Chapter 3.18).

Note: The individual display elements vary depending on the measuring program.

Note: The settings in a measuring program are saved and are used again when restarting the measuring program. You can reset the parameters back to the factory settings by selecting the function "Parameters → Reset..." from the menu bar or by pressing the corresponding button (see Fig. 3.3) in the "General" toolbar.

Fig. 3.3: "Reset" button

Note: The settings for gapCONTROL in the "Scanner settings" area of the current measuring program used are applied in all other measuring programs.

3.5 Selecting the Data Source

When starting a measuring program, the measuring program uses the currently connected gapCONTROL measurement system as data source. In order to load and display profiles from a file offline, either select the menu item "File → Load profiles" or press the corresponding button (see Fig. 3.4) in the "General" toolbar.

Fig. 3.4: "Load profiles" button

A standard Windows dialog is displayed for selection of the path and file name. The profile sequence is loaded after confirmation of the dialog. The measurement system now uses the loaded profile sequence as data source. The "Scanner settings" input field will be replaced by the "File settings" input field. You can control the playback of the loaded profile sequence in the File Settings input field (see Chapter 3.10).

In order to use the connected gapCONTROL measurement system as data source again, either select the menu item "File → gapCONTROL" or press the corresponding button (see Fig. 3.5) in the "General" toolbar.

Fig. 3.5: "gapCONTROL" button

The measuring program now uses the connected gapCONTROL measurement system as data source again. The "File settings" input field will be replaced by the "Scanner settings" input field. You can make settings for the measurement system in the "Scanner settings" input field (see Chapter 3.7).

3.6 Saving Profile Sequences

In order to save profile sequences for later offline analysis (see Chapter 3.5) either select the menu item "File → Save profiles" or press the corresponding button (see Fig. 3.6) in the "General" toolbar.

Fig. 3.6: "Save profiles" button

A standard Windows dialog is displayed for selection of the path and file name for saving the profile sequence. After confirmation, the profiles transferred from gapCONTROL to the PC are stored in the selected file. This process is displayed in a status dialog (see Fig. 3.7).

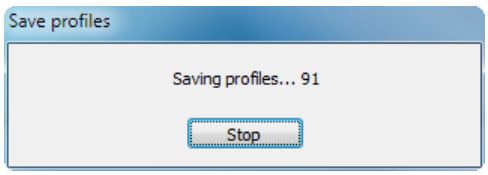


Fig. 3.7: "Save profiles" status dialog box

Press the "Stop" button to finish the saving process.

Note: In order to save profile sequences at high speed or to reduce the size of the target file, select the "Save Profiles" measuring program (see Chapter 4.5.3).

3.7 Scanner Settings

The parameters in this input field are used to configure the gapCONTROL measurement system for your measuring task.

Note: The parameters "Exposure time"/"No. of profiles" are dependent on each other. E.g. setting the "No. of profiles" parameter to 50 profiles per second limits the "Exposure time" parameter to a maximum value of 20 ms.

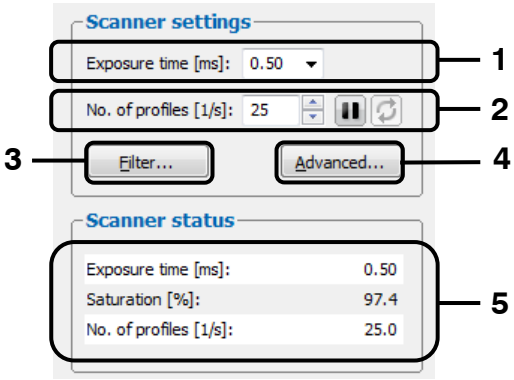


Fig. 3.8: "Scanner settings" input field

Parameters in the "Scanner settings" dialog box:

1 Exposure time [ms]: With this parameter you select the exposure time for gapCONTROL. In the bottom area of the dialog the saturation is displayed. This is influenced by the exposure time and should be between 60 % and 80 % for a measurement.

- Minimum: 0.01 ms
- Maximum: 40.0 ms

2 No. of profiles [1/s]: This parameter regulates the number of measurements per second. This value has priority over the entry in the "Exposure time" box.

- Minimum: 25
- Maximum, depends on the type of sensor:
  - **gapCONTROL 2611/2911:** 300
  - **gapCONTROL 2711:** 100
- **Start/Stop data transfer from scanner:** Starts/stops the data transfer from the scanner.
- **Refresh profile data:** Use this button in order to transfer a current profile from the scanner in case of an interrupted data transfer.

3 Filter...: With this button you access the "Filter settings" dialog (see Chapter 3.8).

4 Advanced...: With this button you access the "Advanced scanner settings" dialog (see Chapter 3.9).

5 Scanner status: In the bottom area of the "Scanner settings" input field status information of the gapCONTROL measurement system are displayed:

- **Exposure time [ms]:** The currently used exposure time.
- **Saturation [%]:** The saturation of the current signal in the region of interest marked green in the 2D-display (see Chapter 3.13.1). This can be precisely adjusted by changing the parameter "Exposure time". A saturation value between 60 % and 80 % is recommended.
- **No. of profiles [1/s]:** This display shows the effective scan rate being used for evaluation of the scanner data. The scan rate may deviate from the "No. of profiles [1/s]" parameter if the computer does not have sufficient processing power.

Note: The "Scanner settings" input field is only available when using a gapCONTROL measurement system (see Chapter 3.5).

Note: For further information on the configuration of the measurement system, please refer to the Instruction Manual gapCONTROL and to the document "Quick Reference gapCONTROL" (see Chapter 3.14, Section 4 "Documentation").

3.8 Profile Filter Settings

In combination with the gapCONTROL measurement system Setup Software offers you the possibility of equidistantly resampling the profile data in the X direction and of filtering the profile data. If you want to use the filter functions, it is recommended to activate the equidistantly resampling.

➡ Use the "Filter..." button in the "Scanner settings" box (see Chapter 3.7) to open the "Filter settings" dialog box.

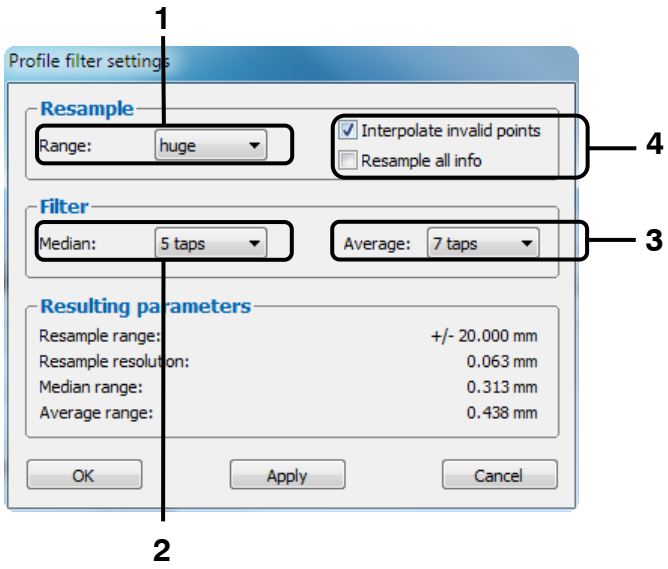


Fig. 3.9: "Profile filter settings" dialog box

Parameters in the "Filter settings" dialog box:

1 Range: The range which is equidistantly resampled.

Setting	Resampled range			
	2611-10 2911-10	**2611-25 2711-25 2911-25**	**2611-50 2711-50 2911-50**	**2611-100 2711-100 2911-100**
none	deactivated	deactivated	deactivated	deactivated
tiny	±0.4 mm	±0.8 mm	±1.6 mm	±4.0 mm
very small	±0.5 mm	±1.0 mm	±2.0 mm	±5.0 mm
small	±1.0 mm	±2.0 mm	±4.0 mm	±10.0 mm
medium	±2.0 mm	±4.0 mm	±8.0 mm	±20.0 mm
large	±4.0 mm	±8.0 mm	±16.0 mm	±40.0 mm
very large	±5.0 mm	±10.0 mm	±20.0 mm	±50.0 mm
huge	±10.0 mm	±20.0 mm	±40.0 mm	±100.0 mm

2 Median: With this parameter you activate a median filter.
- **none:** The median filter is not used.
- **3 taps:** You use a median filter with a filter size of three.
- **5 taps:** You use a median filter with a filter size of five.
- **7 taps:** You use a median filter with a filter size of seven.

3 Average: With this parameter you activate an average filter.
- **none:** The average filter is not used.
- **3 taps:** You use an average filter with a filter size of three.
- **5 taps:** You use an average filter with a filter size of five.
- **7 taps:** You use an average filter with a filter size of seven.

4 Interpolate invalid points: If equidistantly resampling is active, this specifies whether invalid points will be replaced by neighboring valid points using linear interpolation. Gaps will be closed if this parameter is active. In order to leave gaps open you must not activate this parameter.

Resample all info: If equidistantly resampling is active, this parameter specifies which data will be recalculated according to the equidistantly resampling. Deactivate this parameter to recalculate the X and Z coordinates only. Activate this parameter to recalculate all data (X / Z coordinates, width, intensity, threshold, moment 0th and 1st order). This parameter has no influence on the 2D-display.

Note: Activate the "Resample all info" parameter to store a profile sequence (see Chapter 3.6) and analyze it later with the "scanCONTROL 3D-View" software.

➪ Confirm your settings with the "OK" button.

Note: When using a file as data source (see Chapter 3.5), the filter functions are only available if the filter and resampling functions have been disabled during saving the profile sequence.

3.9 Advanced Scanner Settings

The "Advanced scanner settings" dialog box offers you extended settings for the gapCONTROL measurement system.

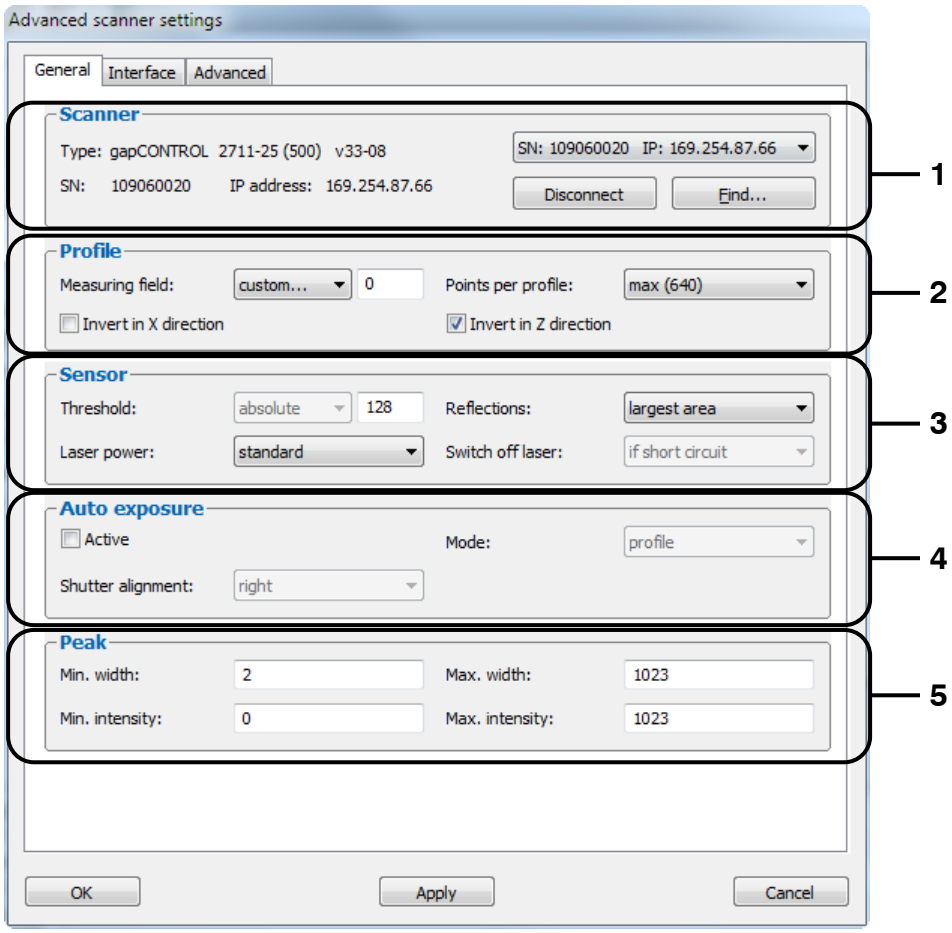


Fig. 3.10: "General" tab sheet in the "Advanced scanner settings" dialog box

Note: Only experienced users of the gapCONTROL measurement system should adjust any settings in this dialog box.

Parameters in the "General" tab sheet in the "Advanced scanner settings" dialog box:

1

- **Type:** The currently used type of measurement system and the associated firmware version are displayed.
- **SN:** The serial number of the currently used measurement system is displayed.
- **IP address:** In case of using gapCONTROL with an ethernet interface, the IP address of gapCONTROL is displayed.
- **Scanner selection:** This list contains all gapCONTROL measurement systems connected to the PC via Ethernet and IEEE1394. Use this selection and the Connect/Disconnect button (see below) in order to activate a desired measurement system.
- **Connect/Disconnect:** Dependent on the selection of the scanner list this button behaves as follows:
  - **Disconnect:** If the currently active measuring system is selected in the scanner selection, you may disconnect the selected measuring system using the "Disconnect" button.
  - **Connect:** If a measuring system is selected which isn't currently connected to Setup Software, you may use the button "Connect" in order to connect to the selected measuring system. In doing so, the previously connected measuring system gets disconnected.
- **Find...:** Press this button in order to identify all gapCONTROL measurement systems which are connected to the PC via Ethernet and IEEE1394. This function is performed automatically with starting the software. After completing this procedure the scanner selection list will be refreshed and you may change between the individual measurement systems.

2

- **Measuring field:** Select one of the values to set the measuring field of gapCONTROL. For detailed information please refer to the instruction manual of the measurement system used. The following values are available, depending on the type of sensor:
  - **gapCONTROL 2611/2711:**
    - **small:** Measuring field index 7, 640 x 120 pixels.
    - **standard:** Measuring field index 2, 640 x 360 pixels.
    - **large:** Measuring field index 0, 640 x 480 pixels.
    - **custom...:** You can select the measuring field index (0 - 127).
  - **gapCONTROL 2911:**
    - **small:** Measuring field index 7, 1280 x 256 pixels.
    - **standard:** Measuring field index 2, 1280 x 768 pixels.
    - **large:** Measuring field index 0, 1280 x 1024 pixels.
- **Points per profile:** This parameter defines the number of points that make up a profile. Depending on the type of sensor you can choose between the following values:
  - **gapCONTROL 2611/2711:**
    - **80**
    - **160**
    - **320**
    - **640**
    - **max (640):** The maximum number of points per profile, which is provided by the measurement system used.
  - **gapCONTROL 2911:**
    - **160**
    - **320**
    - **640**
    - **1280**
    - **max (1280):** The maximum number of points per profile, which is provided by the measurement system used.

  With this parameter you specify the resolution in the direction of the X axis. This value is also influenced by the "Measuring field" parameter!
- **Invert in X direction:** The signal is inverted on the Z axis.
- **Invert in Z direction:** The signal is inverted in the middle of the measurement range parallel to the X axis. This function is enabled in the default settings.

3

- **Threshold:** This value specifies the level of intensity at which gapCONTROL recognizes a reflection. In the bottom area of the "Scanner settings" input field the saturation is displayed (see Chapter 3.7). The saturation is influenced mainly by the threshold and should be between 60 % and 80 % for a measurement.
  - **absolute:** The chosen threshold (0-1023) is used as absolute threshold.
  - **dynamic:** The chosen threshold (0-1023) is used as a percentage of the maximum intensity of a reflection (value[%] = 100*threshold/1024). If you want to use a threshold which corresponds to 25 % of the maximum intensity, for example, you have to set the threshold parameter to 256.
- **Reflections:** This parameter is for specifying which reflection is recognized as a profile point and is only of importance for multiple reflections.
  - **first:** The reflection closest to the scanner.
  - **last:** The reflection furthest away from the scanner.
  - **largest area:** The reflection with the largest area. This function is enabled in the default settings.
  - **highest intensity:** The reflection with the highest intensity.
  - **only single:** The reflection is processed only if there is only a single reflection for this profile point.
- **Laser power [mW]:** You can operate the laser of gapCONTROL at two different power levels or switch it off. Depending on the type of sensor the following options are available:
  - **gapCONTROL 2611/2911:**
    - **off:** Laser is switched off.
    - **reduced:** 2 mW, if not specified otherwise.
    - **standard:** 8 mW, if not specified otherwise.

- **reduced (pulsed):** pulsating with 2 mW, if not specified otherwise. This option is used to synchronize two gapCONTROL measurement systems with alternately pulsed lasers. The "RS422 mode" parameter must be set to "ext. trigger input" or "ext. trigger output".
- **standard (pulsed):** pulsating with 8 mW, if not specified otherwise. This option is used to synchronize two gapCONTROL measurement systems with alternately pulsed lasers. The "RS422 mode" parameter must be set to "ext. trigger input" or "ext. trigger output".

▪ **gapCONTROL 2711:**
- **off:** Laser is switched off.
- **reduced:** 2 mW, if not specified otherwise.
- **standard:** 10 mW, if not specified otherwise.

- **Switch off laser:** With this parameter you configure the laser safety interlock of gapCONTROL.
  ▪ **if left open:** The laser is switched off with the pins open.
  ▪ **if short circuit:** The laser is switched off with the pins connected. This parameter is only effective for laser class 2M (IIM).

4
- **Auto exposure:** Use these parameters to configure the automatic exposure time control.
  ▪ **Active:** Select this input field to activate the automatic exposure time control of the gapCONTROL measurement system. This setting is recommended for scanning single-colored, alternating surfaces.
  ▪ **Mode:** Use this parameter to specify the algorithm for the automatic exposure time control:
    - **raw data:** The automatic exposure time control is computed based on the raw data (Sensor matrix).
    - **profile:** The automatic exposure time control is computed based on the profile data.
    - **filtered profile:** The automatic exposure time control is computed based on the filtered profile data.
  ▪ **Shutter alignment:** With this parameter you determine how the specified scan rate is maintained with active automatic exposure time control:
    - **center:** The intervals are in each case aligned to the center of the interval.
    - **right:** The intervals are in each case aligned to the end of the interval.
    - **left:** The intervals are in each case aligned to the start of the interval.
    - **none:** The intervals are not aligned.

5
- **Peak Min. width:** Minimum width of a reflection to be detected as a valid profile point.
- **Peak Max. width:** Maximum width of a reflection to be detected as a valid profile point.
- **Peak Min. intensity:** Minimum intensity of a reflection to be detected as a valid profile point.
- **Peak Max. intensity:** Maximum intensity of a reflection to be detected as a valid profile point.

➡ Confirm your settings with the "OK" button.

Note: The "Switch off laser" parameter is not available using the gapCONTROL measurement system.

Note: The "raw data" option of the "Auto exposure - Mode" parameter is only available using a gapCONTROL 2611 or 2911 measurement system.

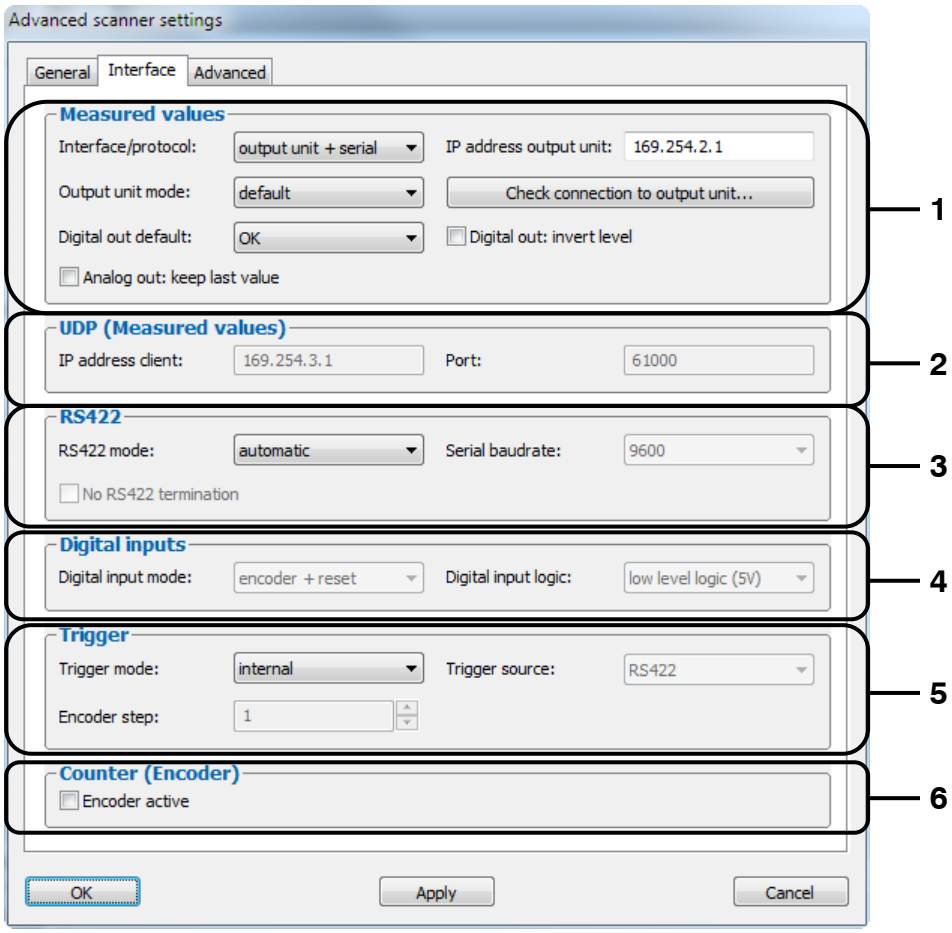


Fig. 3.11: "Interface" tab sheet in the "Advanced scanner settings" dialog box

Parameters in the "Interface" tab sheet in the "Advanced scanner settings" dialog box:

1

- **Interface/protocol:** With this parameter you select which interface is used for output of measured values (see Chapter 1.2):
  - **output unit + serial:** The measured values are supplied via gapCONTROL Output Unit (digital and analog) and the serial interface (ASCII) (see Chapters 5.4, 5.5 and 5.6).
  - **output unit + UDP:** The measured values are supplied via gapCONTROL Output Unit (digital and analog) and via Ethernet (UDP) (see Chapters 5.4, 5.5 and 5.7).
  - **modbus:** The Modbus protocol is used to output the measured values (see Chapter 5.8). The measured values are supplied via serial output and Ethernet.
- **IP address output unit:** In case of using gapCONTROL Output Unit with an ethernet interface, you specify the IP address of gapCONTROL Output Unit with this parameter.

Note: The "IP address output unit" parameter is used to establish a connection between the measurement system and Output Unit and is not used to set the IP address of the gapCONTROL Output Unit.

Note: For detailed information on the configuration of the IP address of gapCONTROL Output please refer to the documentation of the Output Unit (see Chapter 3.14, Section 4 "Documentation", Ethernet fieldbus coupler) used.

- **Output unit mode:** With this parameter you activate or deactivate gapCONTROL Output Unit for supplying digital and analog signals (see Chapter 5.4 and 5.5). Selecting the "default" setting you use the default setting of gapCONTROL (gapCONTROL 2611/2711/2911: active).
- **Check connection to output unit...:** Use this button in order to check the connection of the gapCONTROL measuring system to the Output Unit. This function is only available in the measurement programs.

- **Digital out default:** Specifies the behavior of the criteria set to "None".
  - **OK:** The criterion is evaluated as OK.
  - **nOK:** The criterion is evaluated as nOK.
  - **keep last value:** The previous valid value is used.
- **Digital out: invert level:** In case of activating this parameter, the electrical signal, output at the digital outputs, is inverted (OK = low level, nOK = high level). In case of deactivating this parameter, the logical value corresponds to the electrical level (OK = high level, nOK = low level).
- **Analog out: keep last value:** Specifies the behavior of the analog outputs in case of an erroneous measurement. On activating this parameter the result of the previous valid measurement is output. When deactivating this parameter the signal is pulled to the lower limit of the voltage/current range.

2

- **IP address client:** In case of transferring the measured values using UDP, you specify the IP address of the receiver (client) with this parameter.
- **Port:** Specifies the UDP port of the receiver (client).

3

- **RS422 mode:** Use this parameter to configure the function of the RS422 interface of gapCONTROL. Depending on the type of sensor you can choose between the following values:
  - **gapCONTROL 2611/2911**
    - **serial:** The RS422 interface is used as serial port. Measured values are output and commands are received (see Chapter 5.6).
    - **ext. trigger input:** The RS422 interface is used as synchronization and trigger input (see below, parameter "Trigger mode").
    - **ext. trigger output:** The RS422 interface is used as synchronization and trigger output.
    - **CMM trigger:** Activate this setting in order to use the RS422 interface as programmable trigger output (see below, parameter "Enable CMM trigger").
  - **gapCONTROL 2711**
    - **automatic:** gapCONTROL configures the function of the RS422 interface automatically.
    - **serial:** The RS422 interface is used as serial port. Measured values are output and commands are received (see Chapter 5.6).
    - **external trigger:** The RS422 interface is used to synchronize and trigger the gapCONTROL measurement system (see below, parameter "Trigger mode").
    - **CMM trigger:** Activate this setting in order to use the RS422 interface as programmable trigger output (see below, parameter "Enable CMM trigger").
    - **encoder/counter:** Activate this function in order to access the internal counter of gapCONTROL via the RS422 interface (see below, input field "Counter (Encoder)").
    - **pulsed laser:** The RS422 interface is used to synchronize two gapCONTROL measurement systems. The lasers are alternately pulsed.
- **Serial baudrate:** The baudrate at which the serial port is operated. This parameter is only available if the "RS422 mode" parameter is set to "serial":
  - **9600**
  - **19200**
  - **38400**
  - **57600**
  - **115200**
- **No RS422 termination:** Disables the termination resistor of the RS422 circuit. When deactivating this parameter, the default termination is used (serial: Termination active; ext. trigger input: Termination active; ext. trigger output: Termination inactive; CMM trigger: Termination inactive).

4

- **Digital input mode:** Use this parameter to configure the function of the digital inputs of gapCONTROL.
  - **encoder + reset:** Inputs 2 (A) and 3 (B) are used to access the internal counter of gapCONTROL. Input 1 (index N) is used to reset the counter.
  - **encoder + trigger:** Inputs 2 (A) and 3 (B) are used to access the internal counter of gapCONTROL. Input 1 is used as trigger input.
  - **trigger:** Input 1 is used as trigger input.

  - **user modes + trigger:** Input 1 is used as trigger input. Inputs 2 (bit 0) and 3 (bit 1) are used to load user modes.
  - **user modes:** Inputs 1 (bit 0), 2 (bit 1) and 3 (bit 2) are used to load user modes.
  - **timestamp:** The state of the digital inputs is included as bit sequence in the timestamp of the profiles.
- **Digital input logic:** Defines the logic of the digital inputs:
  - **low level logic (5V):** TTL.
  - **high level logic (24V):** HTL.

5 - **Trigger mode:** This function enables you to control the gapCONTROL measurement system via the RS422 interface (gapCONTROL 2611/2711/2911) and via the digital inputs (gapCONTROL 2611/2911) respectively.
  - **internal:** gapCONTROL transfers continuously according to the setting "No. of profiles [1/s]".

  Please use the following trigger settings only when you control gapCONTROL externally:
  - **pos. edge:** gapCONTROL is triggered with positive edges whereas the exposure time corresponds to the parameter "Exposure time".
  - **neg. edge:** gapCONTROL is triggered with negative edges whereas the exposure time corresponds to the parameter "Exposure time".
  - **pos. pulse:** gapCONTROL is triggered with positive edges whereas the exposure time corresponds to the length of the positive trigger-pulse.
  - **neg. pulse:** gapCONTROL is triggered with negative edges whereas the exposure corresponds to the length of the negative trigger-pulse.
  - **pos. gate:** On applying a logical "1" signal to the trigger input gapCONTROL transfers continuously according to the setting "No. of profiles [1/s]". When applying a logical "0" signal to the trigger input no profiles are transferred.
  - **neg. gate:** On applying a logical "0" signal to the trigger input gapCONTROL transfers continuously according to the setting "No. of profiles [1/s]". When applying a logical "1" signal to the trigger input no profiles are transferred.
  - **encoder:** gapCONTROL is triggered using the internal counter (encoder). A measurement operation is triggered after N encoder steps (N is defined by the "Encoder step" parameter, see below).

Note: The maximum frequency available for triggering corresponds to the "No. of profiles [1/s]" parameter.

Note: More information about the trigger function of gapCONTROL can be found in the instruction manual of the measurement system used.

- **Trigger source:** Select the type of inputs used for synchronization and triggering:
  - **RS422**
  - **digital inputs**
- **Encoder steps:** Specifies the number of encoder steps being necessary to trigger a measurement operation. This parameter is only available if the "Trigger mode" parameter is set to "encoder".

6 - **Counter (Encoder):** Use this parameters to activate the internal counter of gapCONTROL.
  - **Encoder active:** Activates the encoder input of gapCONTROL. It is possible to increment and decrement the counter.

➪ Confirm your settings with the "OK" button.

Note: The "keep last value" option of the "Digital out default" parameter is not available using the Modbus protocol.

Note: The "Output unit mode", "IP address output unit" and "Analog out: keep last value" parameters are not available using the Modbus protocol.

Note: The "No RS422 termination", "Digital input mode", "Digital input logic" and "Trigger source" parameters are only available using a gapCONTROL 2611 or 2911 measurement system.

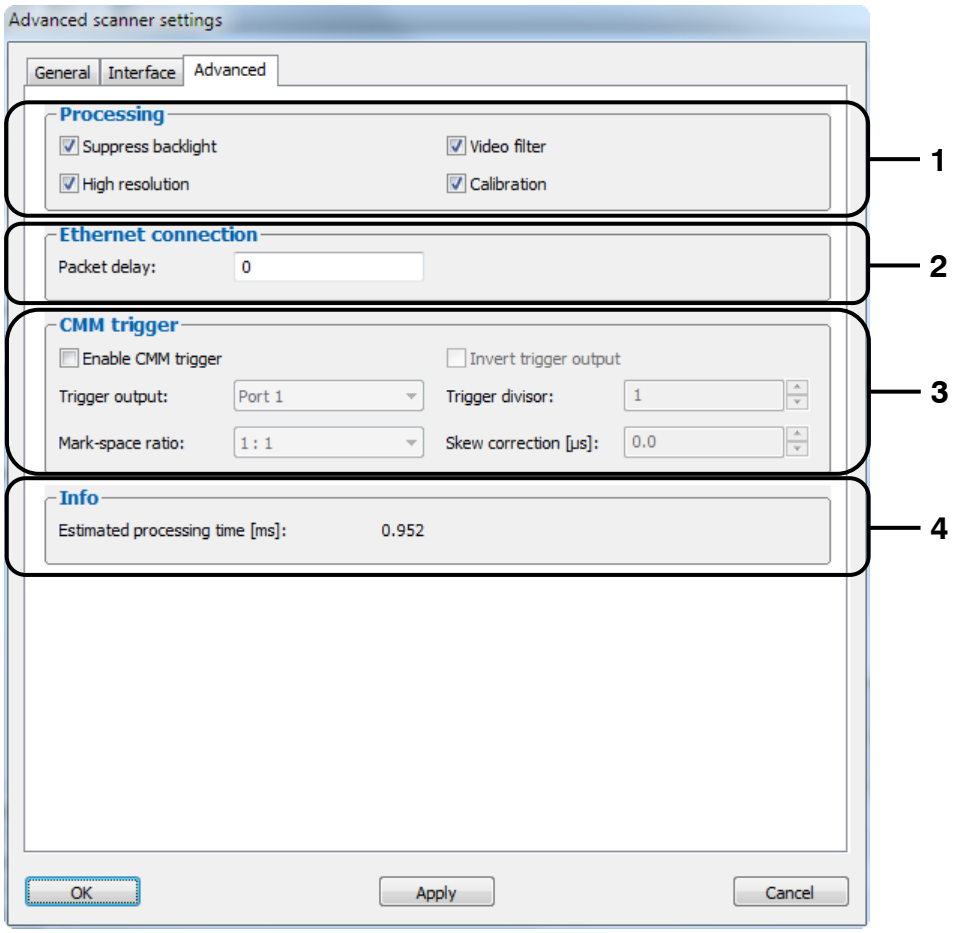


Fig. 3.12: "Advanced" tab sheet in the "Advanced scanner settings" dialog box

Parameters in the "Advanced" tab sheet in the "Advanced scanner settings" dialog box:

1

- **Suppress backlight:** With this entry field you activate the automatic backlight compensation.
- **Video filter:** Activate this parameter to improve the image quality.
- **High resolution:** With this parameter you activate the subpixel resolution for the Z values.
- **Calibration:** Use this parameter to activate the calibration.

2

- **Packet delay:** Specifies the delay time of transferred data packets via Ethernet. This parameter is of importance in case of synchronizing multiple sensors in one subnet.

3

- **Enable CMM trigger:** Select this box to activate the programmable trigger output of gapCONTROL.
- **Invert trigger output:** With this parameter you invert the trigger output.
- **Trigger output:** The port at which the trigger signal is issued.
  - **Port 1**
  - **Port 2**
  - **Port 3**
  - **Port 4**
- **Trigger divisor:** This gives the division ratio between the trigger signals and the profiles. Select a value "n" to issue one trigger signal for every nth profile.
  - Minimum: 1
  - Maximum: 255
- **Mark-space ratio:** This gives the mark-space ratio for the decreasing edge.
  - **1:4**
  - **1:3**
  - **1:2**
  - **1:1**
  - **2:1**
  - **3:1**
  - **4:1**
- **Skew correction [µs]:** This parameter provides a time correction of the trigger signal in increments of 0.5 µs.
  - Minimum: -256.0 µs

- Maximum: 255.5 μs

4 - **Estimated processing time [ms]:** Shows an estimation of the required time for a measurement operation. This information is only available in the individual measuring programs.

➡ Confirm your settings with the "OK" button.

Note: The "Advanced scanner settings" dialog box is only available when using a gapCONTROL measurement system (see Chapter 3.5).

Note: For further information on the parameters for the measurement system described here, please refer to the document "Quick Reference gapCONTROL" (see Chapter 3.14, Section 4 "Documentation").

3.10 File Settings

When using a saved profile sequence as data source the "File settings" input field is used to control the playback of the profile sequence.

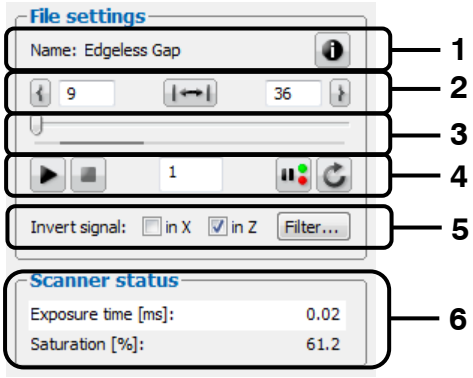


Fig. 3.13: "File settings" input field

Parameters and information in the "File settings" input field:

1
- **Name:** The name of the profile sequence.
- **Info:** You press this button to display the gapCONTROL settings selected when the profile sequence was saved (see Chapter 3.6).

2
- **Mark profile sequence:** You may mark a partial range of the loaded profile sequence using these input fields. When starting the playback only the marked range is played back.
  - 9 : Use this button in order to use the profile currently displayed as lower limit of the marked range. Use the edit field in order to change the lower limit manually.
  - : Resets the marked range. When starting the playback the complete profile sequence is played back.
  - 36 : Use this button in order to use the profile currently displayed as upper limit of the marked range. Use the edit field in order to change the upper limit manually.

3
- **Slider control:** Shows the progress of the playback of the profile sequence. When the playback is stopped you can activate individual profiles by dragging the slider. The display bar below represents the marked range for the playback of the profile sequence. The partial range may be modified using the parameters described in section 2.

4
- **Play/Pause** / **:** This starts/pauses the playback of the selected profile sequence.
- **Stop** **:** This stops the playback of the selected profile sequence.
- **Current profile** 1 **:** While a profile sequence is being played you will see a run-through of the profile numbers in this box. If you stop the playback you can activate any individual profile directly by entering the profile number.
- **Pause if nOK** **:** If you activate this option, the playback of the profile sequence is paused if at least one digital output is evaluated as nOK (see Chapter 5.4) in the displayed profile.
- **Endless mode** **:** Use this button in order to activate the endless playback mode. After reaching the upper limit of the partial range for playback, the playback restarts automatically at the lower limit of the range.

5
- **Invert signal in X:** The signal is inverted on the Z axis.
- **Invert signal in Z:** The signal is inverted in the middle of the measurement range parallel to the X axis.
- **Filter…:** With this button you access the "Filter settings" dialog for configuring the profile filter (see Chapter 3.8).

6
- **Scanner status:** In the bottom area of the "File settings" input field the following information of the actual profile is shown:
  - **Exposure time [ms]:** The used exposure time of gapCONTROL when the profile sequence was saved.
  - **Saturation [%]:** The saturation of the current signal in the region of interest marked green in the 2D-display (see Chapter 3.13.1). A saturation value between 60 % and 80 % is recommended.

Note: The "File settings" input field is only available with loading a profile sequence (see Chapter 3.5).

3.11 Displaying gapCONTROL Parameters in Offline Mode

When playing back saved profile sequences, you have the possibility of displaying the gapCONTROL settings used during saving.

➡ Press the info button in the "File settings" input field (see Chapter 3.10). You then access the "Scanner settings" dialog box (see Fig. 3.14).

In the dialog box you can choose between the following tabs:

Scanner: The standard settings of the measurement system are displayed. You will find a detailed description of the individual parameters in Chapter 3.7. Additionally the following information is shown:

- **Name:** The name of the profile sequence.
- **Path:** The path of the file.
- **Type:** The type of measurement system used for recording the profile sequence.
- **SN:** The serial number of the measurement system used for recording the profile sequence.
- **File format:** This indicates which information is contained in the saved profile sequence.
  - **x/z only:** The X and Z coordinates of the individual measurement points are saved.
  - **x/z + data:** A complete reflection is saved in the profile sequence. In a reflection the following information is contained for each measurement point: X/Z coordinates, width, intensity, threshold, moment of 0th and 1st order.
  - **x/z + [texture]:** The X and Z coordinates of the individual measurement points, their textures (e.g. "intensity") and the parameters used while saving the profile sequence have been saved.
  - **full set:** All four reflections, the time stamp and, where applicable, the measurement system parameters used during saving.
- **Changed:** The modification date of the profile sequence.
- **Buffered profiles:** The number of profiles contained in the loaded profile sequence.

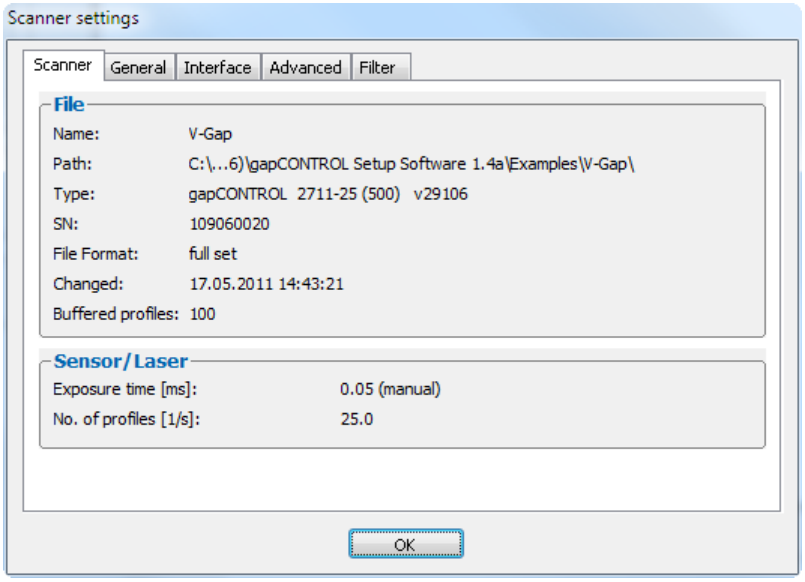


Fig. 3.14: "Scanner" tab sheet in the "Scanner settings dialog"

General: The general settings of gapCONTROL are displayed. You will find a detailed description of the individual parameters in Chapter 3.9.

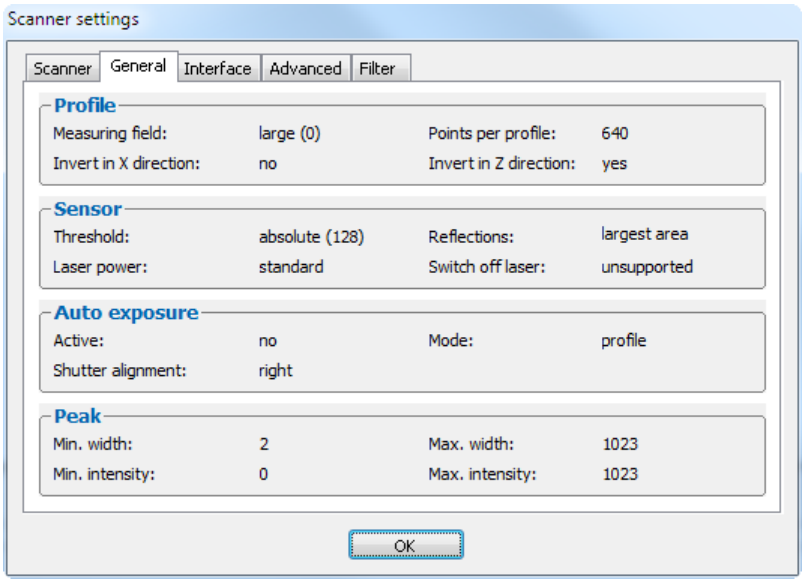


Fig. 3.15: "General" tab sheet in the "Scanner settings" dialog

Interface: The interface settings of gapCONTROL are displayed. You will find a detailed description of the individual parameters in Chapter 3.9.

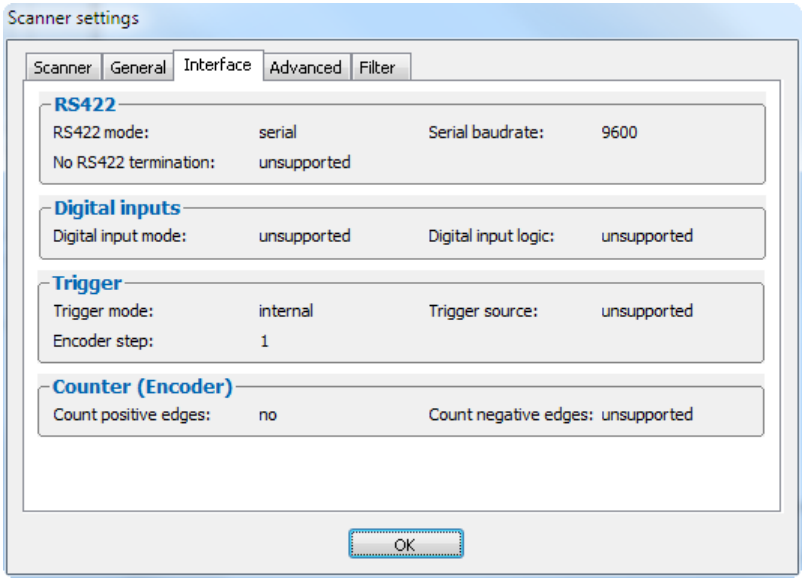


Fig. 3.16: "Interface" tab sheet in the "Scanner settings" dialog

Advanced: The extended settings of gapCONTROL are displayed. You will find a detailed description of the individual parameters in Chapter 3.9.

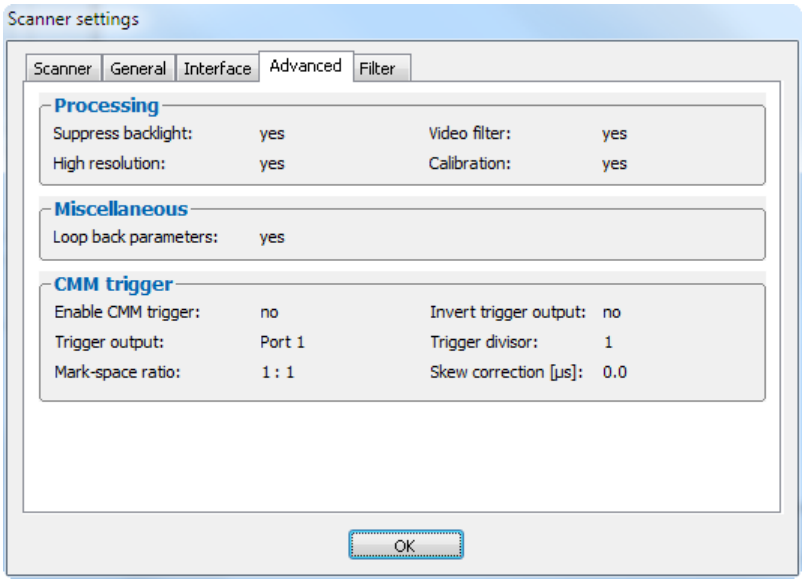


Fig. 3.17: "Advanced" tab sheet in the "Scanner settings" dialog

Filter: The profile filter settings of gapCONTROL are displayed. You will find a detailed description of the individual parameters in Chapter 3.8.

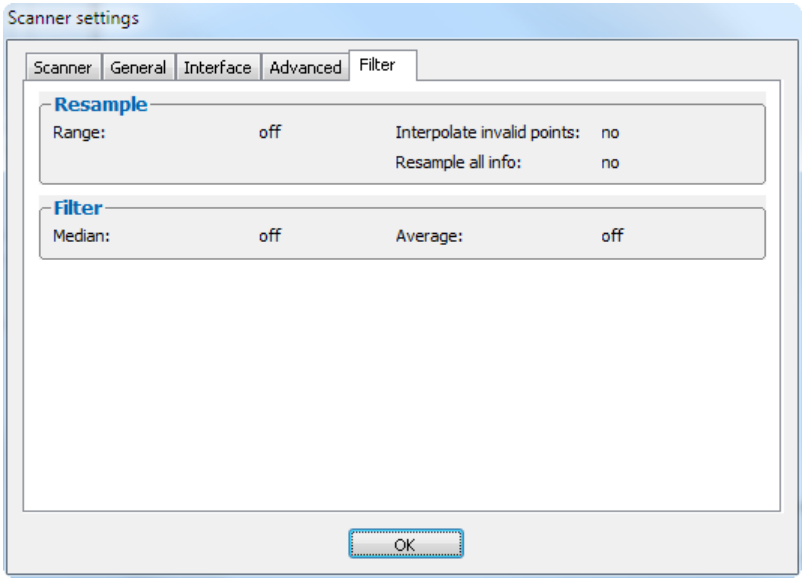


Fig. 3.18: "Filter" tab sheet in the "Scanner settings" dialog

Note: The following software packages save the measurement system parameters:
- gapCONTROL Setup Software
- scanCONTROL Configuration Tools
- scanCONTROL Setup-Software 2X10
- DeveloperDemo (version 2.0 and above; option must be activated)

3.12 Mouse Interaction in the 2D-Display

gapCONTROL Setup Software offers several functions for mouse interaction in the 2D-display. Thus you have the possibility of scaling the 2D-display or getting detailed information about a profile point, for example. The individual modes are activated via the "Display" toolbar (see Chapter 3.16). You will find detailed descriptions of the individual options in the following.

3.12.1 Reset 2D-Display

Fig. 3.19: "Reset view" button

Press this button in order to reset the 2D-display. Thus the settings of the 2D-display are reset so that the complete measuring field is shown and the profiles transferred by gapCONTROL are displayed.

3.12.2 Automatic Scaling of the 2D-Display

Fig. 3.20: "Auto scaling" button

You activate or deactivate the automatic scaling of the 2D-display by pressing this button. If automatic scaling is activated, the 2D-display will be automatically adapted to the minimum and maximum coordinates of the displayed profile.

3.12.3 Keep Aspect Ratio

Fig. 3.21: "Keep aspect ratio" button

Press this button in order to activate or deactivate the "Keep aspect ratio" option. Activating this option the display is scaled so that the real aspect ratio of the displayed profile is retained. Deactivating this option the scaling is adapted separately to the actual values for the X and Y axes.

3.12.4 Zoom 2D-Display

Fig. 3.22: "Zoom" button

You activate or deactivate the "Zoom" mode by pressing this button. In the "Zoom" mode you can zoom in parts of the 2D-display and so directly set the scaling of the 2D-display with your mouse. Proceed as follows:

- Move the mouse pointer to any corner of the desired range to be zoomed in.
- Now mark the range to be zoomed in. Hold the left mouse button pressed and move the mouse pointer to the opposite corner of the range to be zoomed in.
- Release the mouse button. The marked range will be zoomed in.

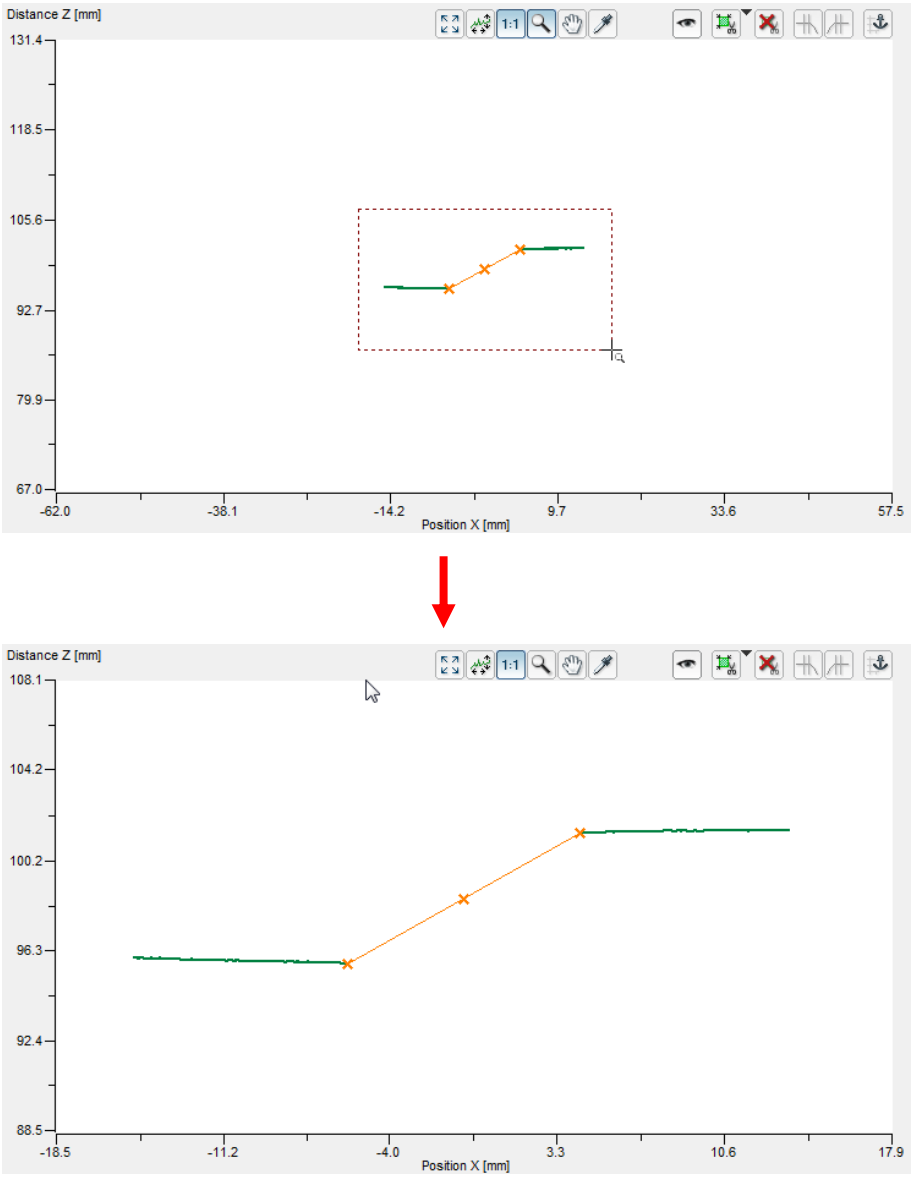


Fig. 3.23: Zoom 2D-display

Note: Alternatively you may use the mouse wheel in order to zoom in and out the 2D-display.

3.12.5 Move Profile

Fig. 3.24: "Move" button

You activate or deactivate the "Move profile" mode by pressing this button. You can move the profile on the 2D-display with an active "Move profile" mode. Proceed as follows:

- Move the mouse pointer into the 2D-display.
- Press the left mouse button and keep it pressed.
- Now move the mouse pointer in order to move the profile.

3.12.6 Display Extended Information of a Profile Point

Fig. 3.25: "Point information" button

Press this button to activate or deactivate the "Display extended information of a profile point" mode. Proceed as follows:

- Move the mouse pointer onto the desired profile point.
- Hold the left mouse button pressed on the profile point.

The information for the point will now be displayed in a tooltip next to the mouse pointer.

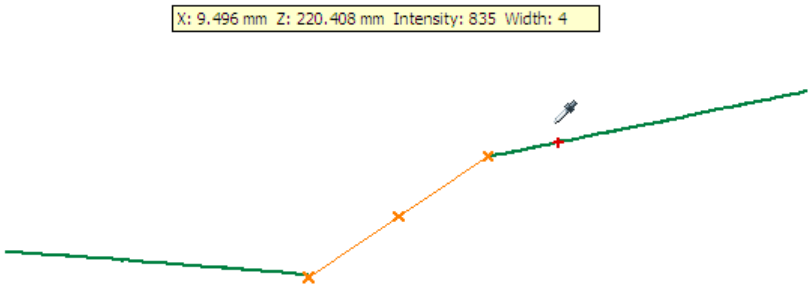


Fig. 3.26: Extended information of a profile point

The following information is displayed:

- **X:** The X coordinate of the point.
- **Z:** The Z coordinate of the point.
- **Intensity:** The maximum intensity of the reflection from which the point has been calculated.
- **Width:** The width of the reflection from which the point has been calculated.

3.13 Configuring the Measurement

In order to perform the desired measurements in the individual measuring programs, you must set measuring ranges and threshold values. The setting options in the individual measuring programs vary. The configuration of the measurement can basically be subdivided into seven steps:

- Cutting out (optional): Selection of a range in which the measurement should be performed (see Chapter 3.13.1).
- Setting the minimum width and alignment of the base gap: Defining the minimum width and alignment that the base gap needs to have (optional, depending on the measuring program, see Chapter 3.13.4).
- Specifying the measuring algorithm for the start and end gap points (optional, depending on the measuring program, see Chapter 3.13.5).
- Specifying the flush algorithm (optional, depending on the measuring program, see Chapter 3.13.8).
- Specifying the projection algorithm (optional, depending on the measuring program, see Chapter 3.13.9).
- Setting and activating the dynamic tracking of the ranges (optional, depending on the measuring program, see Chapter 3.13.10).
- Combining, filtering and evaluating the measured values and configuring the outputs (see Chapter 3.13.12).

3.13.1 Cutting Out

The individual measuring programs provide the possibility to specify a range in which the measurement should take place and to hide the rest of the measuring field. Profile points which are outside the range will not be considered for the measurement and are displayed in grey. This step is necessary, for example, if parts of the mounting of the measurement object or the supporting surface of the target are located in the measuring field or if reflections occur which do not originate from the target. There are two modes available:

- **Select inside points:** Define a rectangular range in the 2D-display. Profile points which are inside the range will be considered for the measurement. Profile points which are outside the range will not be considered.
- **Select outside points:** Define a rectangular range in the 2D-display. Profile points which are outside the range will be considered for the measurement. Profile points which are inside the range will not be considered.

If there are no interfering influences in the profile, you can skip this step and use the complete measuring range for the measurement.

Proceed as follows to select the mode (Select inside/outside points) for cutting out:

- Open the "Options for region of interest" context menu. To do this, press the corresponding button located right to the "Set region of interest" button (see Fig. 3.27)
- Use the context menu to select the desired mode (see Fig. 3.27)

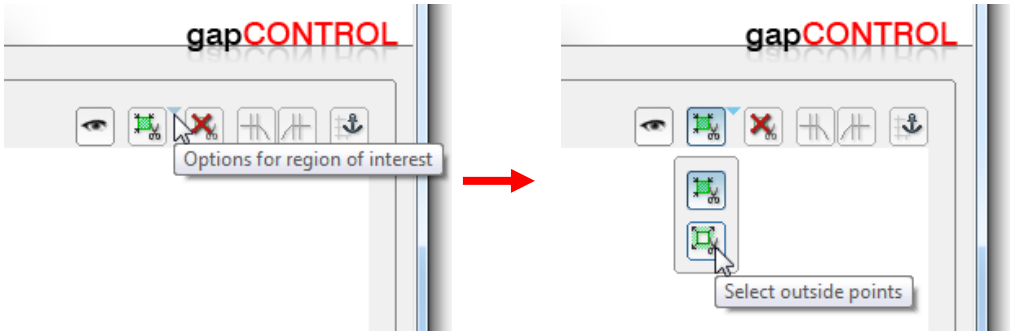


Fig. 3.27: "Options for region of interest" context menu (Select inside/outside points)

Note: The "select inside points" mode is active in the default settings.

After selecting the mode for cutting out you may specify the range for the measurement:

If not already done, press the button "Set region of interest" (see Fig. 3.28) in the "Measurement" toolbar. You are now in the "Set region of interest" mode. The button remains pressed and the measuring range is shown dark green in the 2D-display if it is located in the displayed range.

Fig. 3.28: "Set region of interest" button (Select inside points/Select outside points)

Note: The default setting is that the range for the measurement is larger than the range shown in the 2D-display. Thus, the range for the measurement is initially not visible after activating the "Set region of interest" mode.

You can now set the measuring range in the 2D-display with the mouse. There are two possibilities for doing this:

- Setting the complete range:

  ➡ Move the mouse pointer to any corner of the range you want to set.
  ➡ Now mark the range to be modified. Press the left mouse button and keep it pressed. Move the mouse pointer to the opposite corner of the range you want to set.
  ➡ Release the mouse button. The selected range will now be applied.

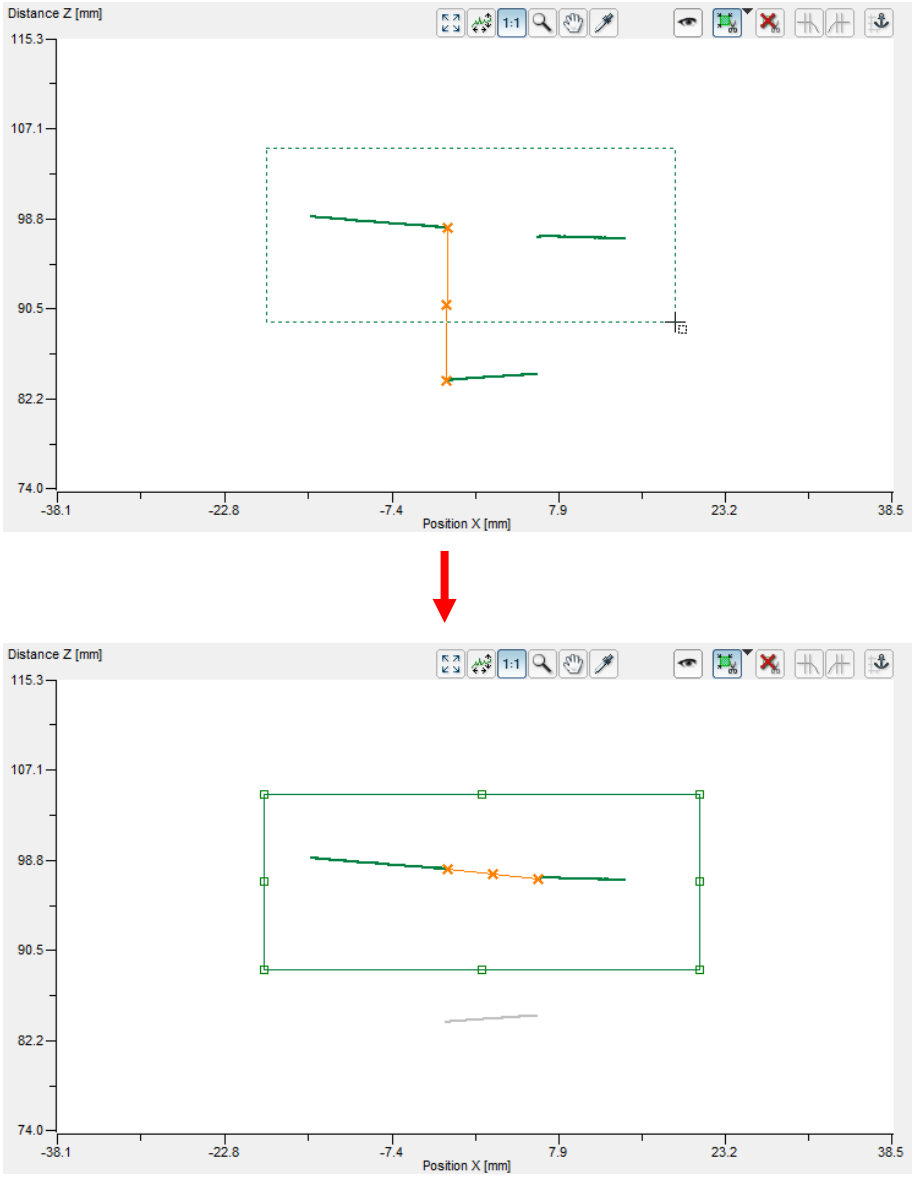


Fig. 3.29: Setting complete measuring range

- Changing the range (drag and drop):

  - Move the mouse pointer to any corner or side of the displayed range so that the mouse pointer is shown as a double-sided arrow.
  - Press the left mouse button and keep it pressed. Now move the mouse pointer to the desired position. The side or corner of the range changes with the position of the mouse pointer.
  - Release the mouse button.

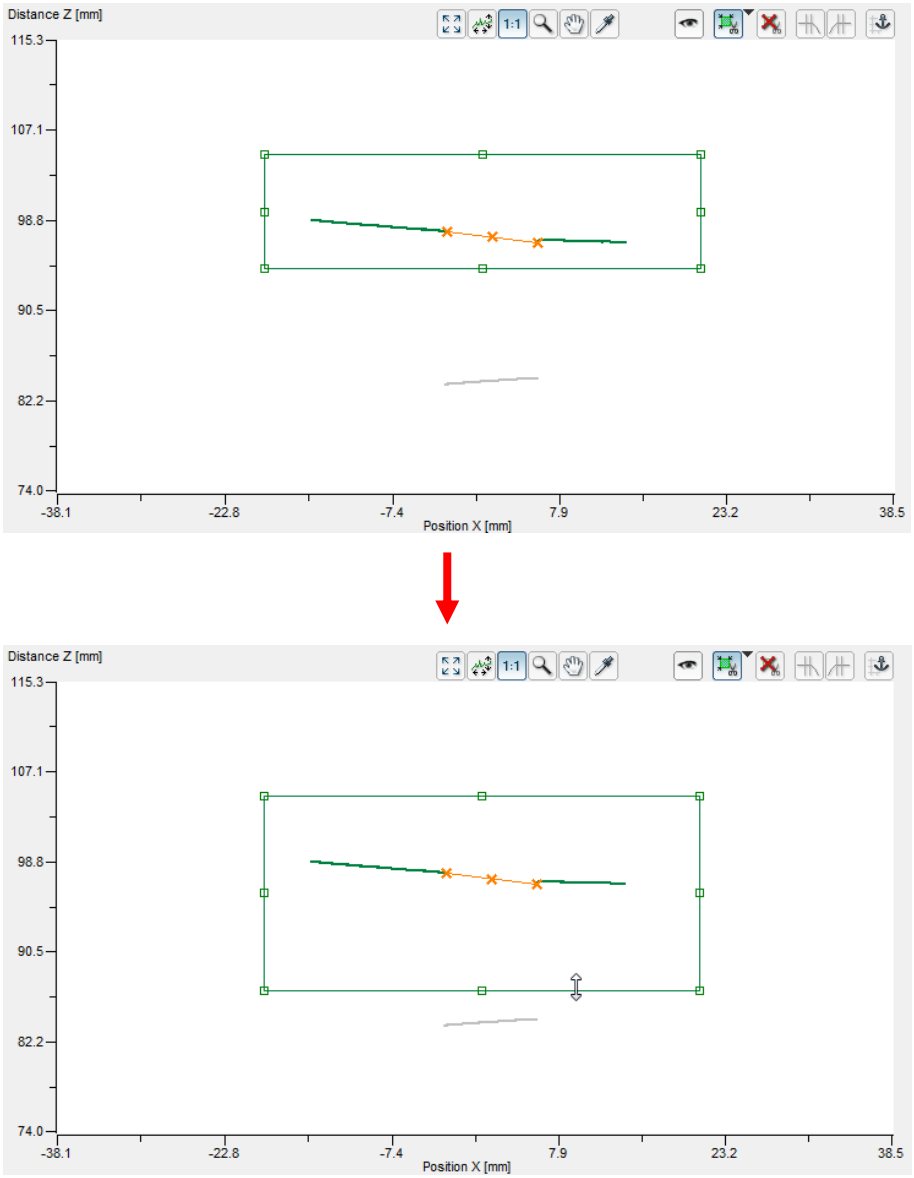


Fig. 3.30: Changing measuring range

As well as the mouse interaction, you also have the possibility to manually edit the values for the range in which the measurement should take place.

- If not already done so, activate the "Set Region of Interest" mode (see Fig. 3.28).
- Press the right mouse button in the 2D-display.

The "Edit region of interest" dialog is displayed where you can manually edit the values of the range.

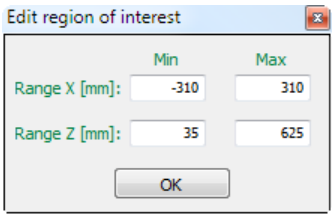


Fig. 3.31: "Edit region of interest" dialog box

3.13.2 Remove Range for Cutting Out

By using the "Reset region of interest" button (see Fig. 3.32) you will remove the range for cutting out and use the complete measuring range for the measurement again (see Chapter 3.13.1).

Fig. 3.32: "Reset region of interest" button

3.13.3 Specifying the Measuring Algorithm

Some measuring programs require a more detailed specification of the algorithm for calculating the gap points. You can enter this specification in the "Measurement settings" area (see Fig. 3.33).

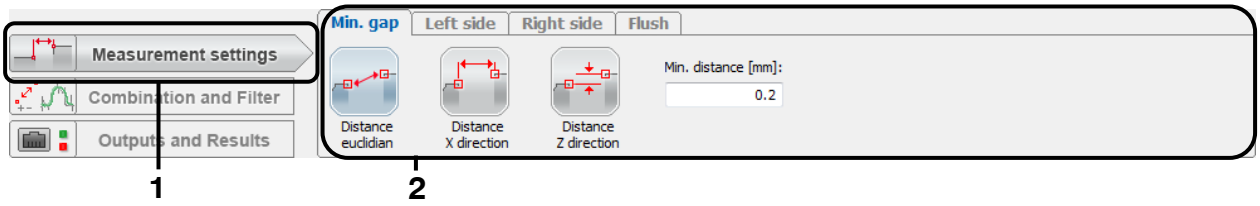


Fig. 3.33: "Measurement settings" input field in the "Advanced Basic Gap" measuring program

1 Button "Measurement settings": Activate the input field "Measurement settings" with this button.

2 Input field "Measurement settings": In this field the measurement algorithm can be defined.

The individual measuring settings are explained respectively in the chapters on the individual measuring programs.

3.13.4 Setting the Minimum Width and Alignment of the Base Gap

Some measuring programs provide the possibility to define the minimum width and the alignment that the base gap needs to have.

Proceed as follows:

- If not already done, press the "Measurement settings" button (see Fig. 3.34).
- If not already done, press the "Min. gap" tab sheet (see Fig. 3.34).

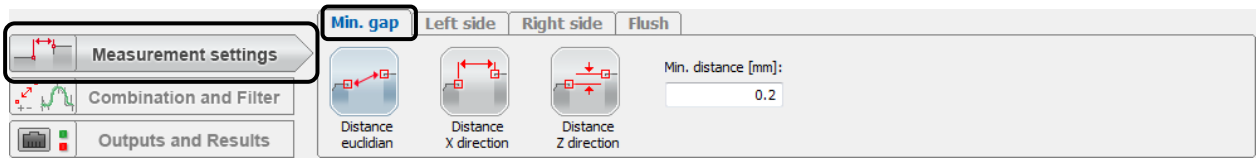


Fig. 3.34: "Measurement settings" input field, "Min. gap" tab sheet

In the "Min. gap" tab sheet you can set the alignment and the absolute value of the minimum width.

Base gap direction:

- **Distance euclidian:** The largest gap in the profile is detected.
- **Distance X direction:** The largest gap in the X direction in the profile is detected.
- **Distance Z direction:** The largest gap in the Z direction in the profile is detected.

3.13.5 Specifying the Start and End Gap Points ("Side points")

Some programs provide the possibility to define the algorithm for determining the start and end points of a gap.

Proceed as follows:

- If not already done so, click on the "Measurement settings" button (see Fig. 3.35).
- If not already done so, click on the "Left side" tab (see Fig. 3.35).

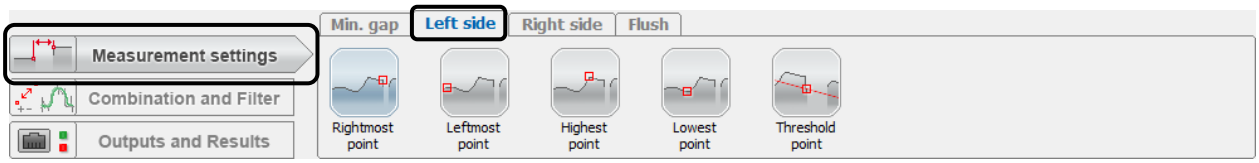


Fig. 3.35: "Measurement settings" input field, "Left side" tab sheet

In the „Left side“ tab sheet, you can set the algorithm for setting the start point of a gap.

- Start point (Left side):
  - **Rightmost point:** The last point of the left profile section.
  - **Leftmost point:** The first point of the left profile section.
  - **Highest point:** The highest point of the left profile section.
  - **Lowest point:** The lowest point of the left profile section.
  - **Threshold point:** The intersection point of the threshold with the left profile half.

- If necessary, set the areas for determining the straight lines and thresholds (see Chapters 3.13.6, 3.13.7).
- Repeat the procedure on the "Right side" tab (see Fig. 3.36).

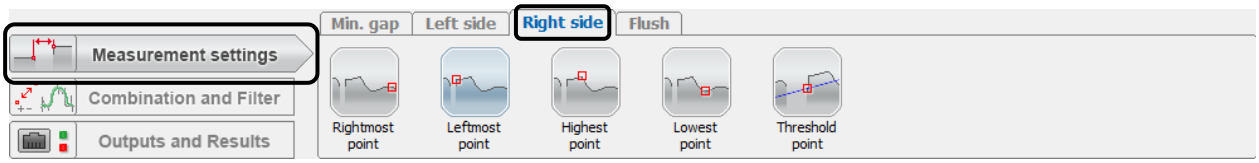


Fig. 3.36: "Measurement settings" input field, "Right side" tab sheet

In the „Right side“ tab sheet, you can set the algorithm for setting the end point of a gap.

- End point (Right side):
  - **Rightmost point:** The last point of the right profile section.
  - **Leftmost point:** The first point of the right profile section.
  - **Highest point:** The highest point of the right profile section.
  - **Lowest point:** The lowest point of the right profile section.
  - **Threshold point:** The intersection point of the threshold with the right profile half.

Note: The available options in the "Left side" and "Right side" tab sheet depend on the current measuring program.

3.13.6 Setting Straight Lines

In order to be able to make measurements in the individual measuring programs, you must define ranges in which straight lines can be fitted to the points from the profile. These straight lines are used as reference or projection lines. At a distance to the reference line, the gap points (for example) are determined, and these points are then projected onto the projection line. You can find a detailed description in the chapters on the respective measuring programs. For example, proceed as follows to specify the range or ranges for the line fitting using the "Threshold point" algorithm:

- If not already done so, click on the "Measurement settings" button (see Fig. 3.35).
- Select the algorithm for determining the start point of a gap, for example by clicking in the "Left side" tab sheet (see Fig. 3.37).

The selection buttons with the algorithms available will appear at the bottom (see Fig. 3.37).

- Select the "Threshold point" algorithm (see Fig. 3.37).

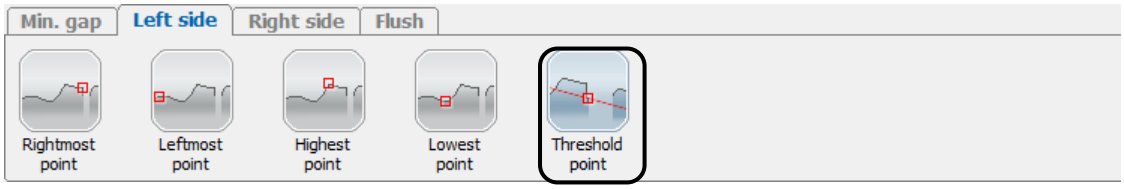


Fig. 3.37: "Threshold point" algorithm for the left point of a gap, "Left side" tab sheet

➡ Press the "Set reference line" button (see Fig. 3.38) on the "Measurement" toolbar (see Fig. 3.2).

Note: The available options in the "Left side" and "Right side" tab sheet depend on the current measuring program.

Once you have pressed the button, you will enter the "Set reference line" mode. The button remains pressed and the range for line fitting is shown with red, blue or orange vertical lines in the 2D-display, if it is located in the displayed range.

Note: The appearance of the "Set reference line" button depends on the current selection in the "Left side" of "Right side" tab sheet in the current measuring program.

Fig. 3.38: "Set reference line" button

You can now set the range for the line fitting in the 2D-display with the mouse. There are two possibilities for doing this:

- Setting the complete range:

  - Move the mouse pointer to the left or right side of the range you want to set.
  - Now mark the range to be modified. Press the left mouse button and keep it pressed. Move the mouse pointer to the opposite side of the range you want to set.
  - Release the mouse button. The selected range will now be applied.

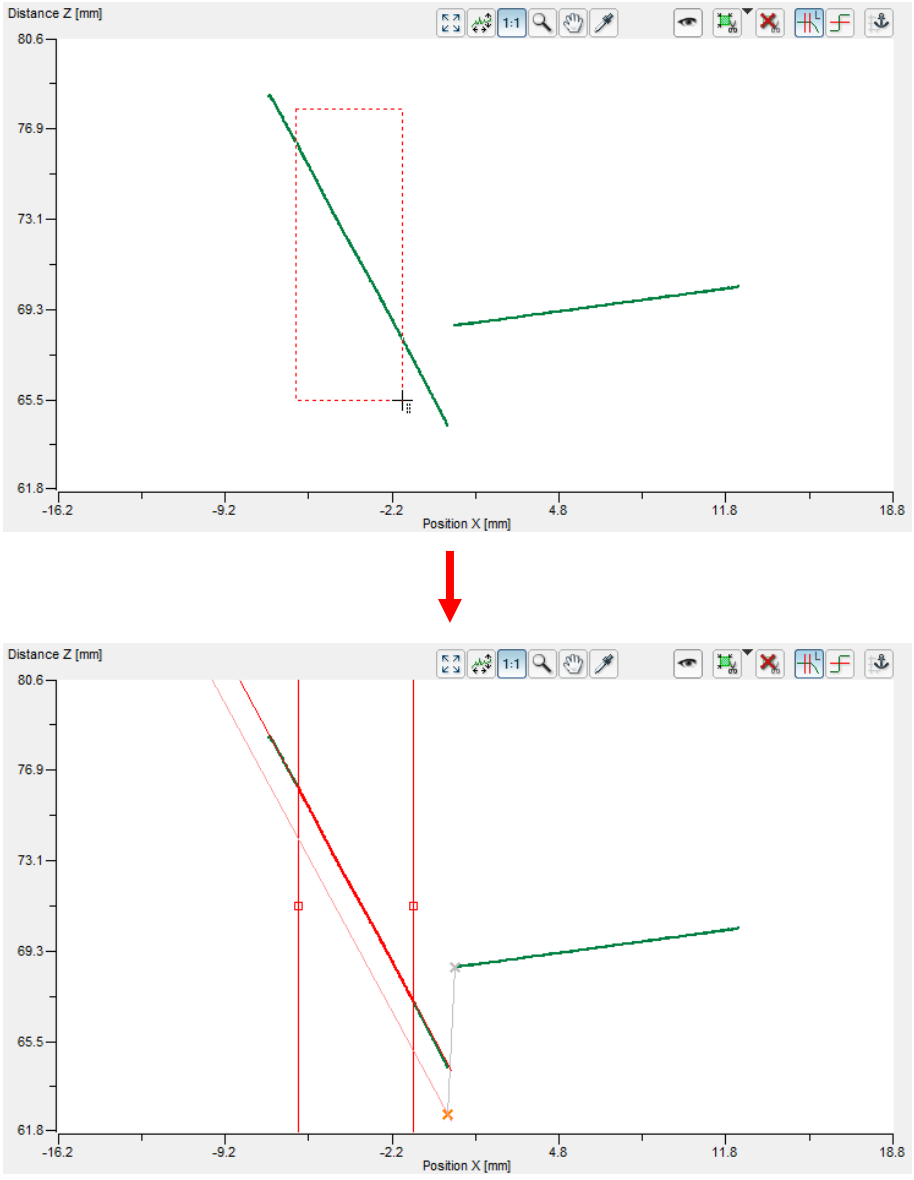


Fig. 3.39: Setting complete range for the line fitting

- Changing the range (drag and drop):

  - Move the mouse pointer to the right or left side of the displayed range so that the pointer is shown as a double-sided arrow.
  - Press the left mouse button and keep it pressed. Now move the mouse pointer to the desired position. The side of the range will be moved with the mouse pointer.
  - Release the mouse button.

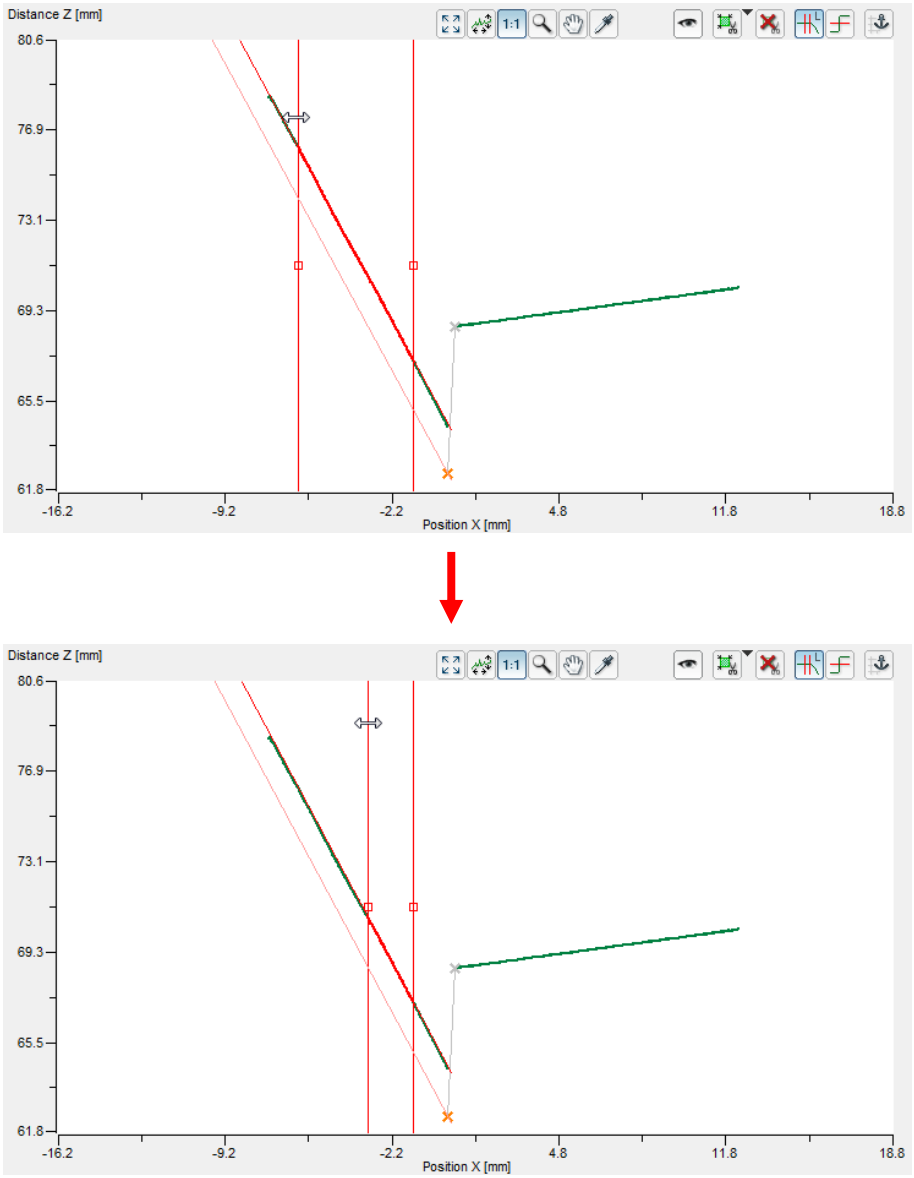


Fig. 3.40: Changing the range for the line fitting

As well as the mouse interaction, you have the possibility to manually edit the values for the range for the line fitting.

- If you have not already done so, activate the "Set reference line" mode (see Fig. 3.38).
- Press the right mouse button in the 2D-display.

The "Edit reference line" dialog box will be displayed, where you can manually edit the values of the ranges for the line fitting.

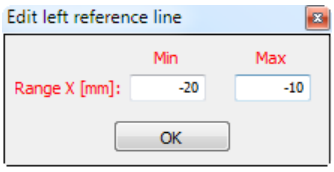


Fig. 3.41: "Edit reference line" dialog box

3.13.7 Setting a Threshold

It is necessary to specify a threshold line parallel to the reference line in some measuring programs. For example, begin and end point of a gap may be determined by intersecting the profile and threshold line. A more detailed description can be found in the respective chapters for the individual measuring programs. For example, proceed as follows in order to specify the minimum height for the measurement using the "Threshold point" algorithm:

- If not already done so, click on the "Measurement settings" button (see Fig. 3.35).
- Select the algorithm for determining the start point of a gap, for example by clicking on the "Left side" tab sheet (see Fig. 3.37).

The selection buttons with the algorithms available will appear at the bottom (see Fig. 3.37).

- Select the algorithm "Threshold point" (see Fig. 3.37).
- If not already done, press the button "Set threshold" (see Fig. 3.42) in the "Measurement" toolbar. You are now in the "Set threshold" mode.

The button remains pressed and the threshold line is shown in the 2D-display as a red or blue line parallel to the reference line.

Note: The appearance of the "Set threshold" button depends on the current selection in the "Measurement task" input field.

Fig. 3.42: "Set threshold" button

You can now set the threshold for the measurement with the mouse. Proceed as follows:

- Move the mouse pointer on the red or blue line which represents the threshold line so that the mouse pointer is shown as a double-sided arrow.
- Press the left mouse button and keep it pressed. Now move the mouse pointer to the desired position. The minimum height is moved with the mouse pointer.
- Release the mouse button.

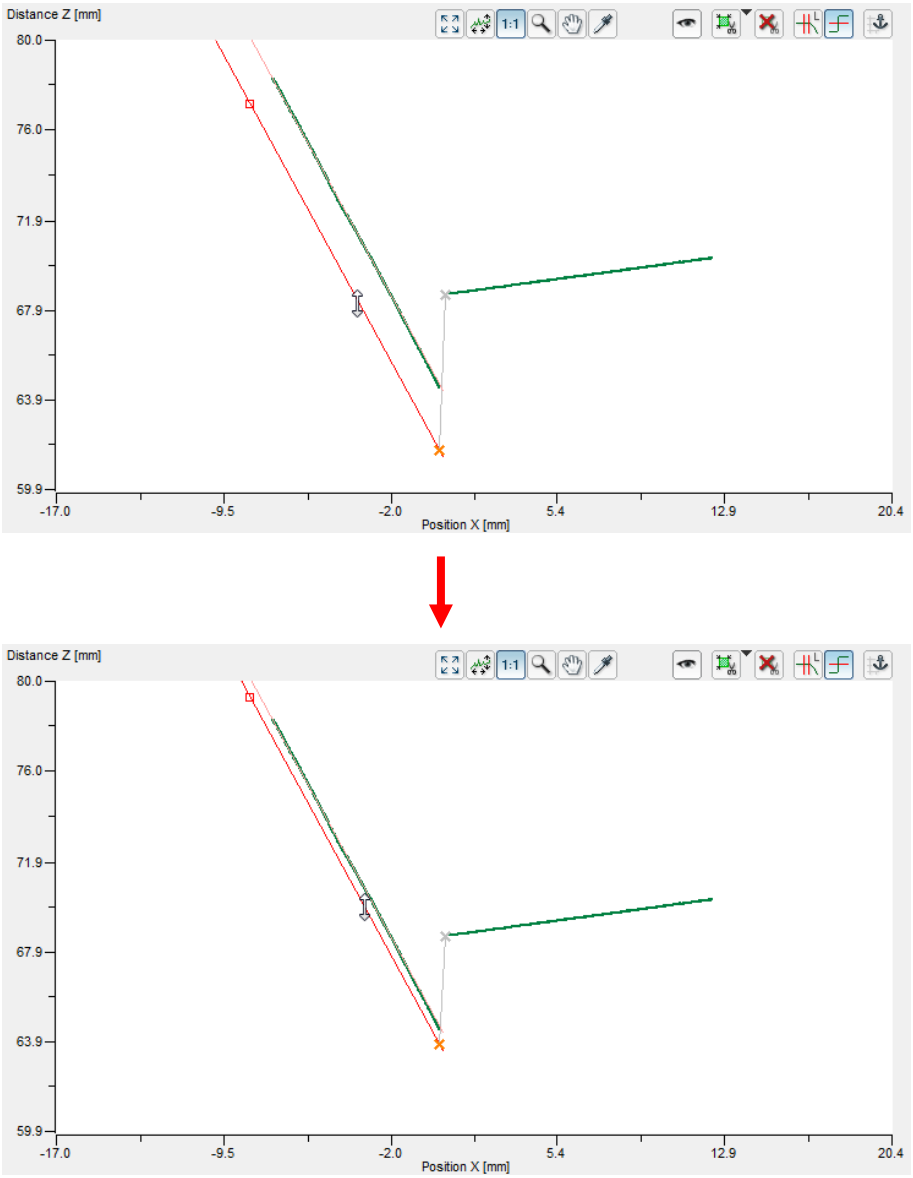


Fig. 3.43: Setting threshold

As well as the mouse interaction, you have the possibility to manually edit the threshold.

- If not already done so, activate the "Set threshold" mode (see Fig. 3.44).
- Press the right mouse button in the 2D-display.

The "Edit threshold" dialog is displayed where you can manually edit the threshold.

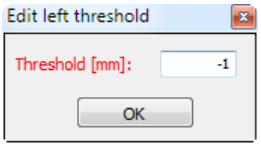


Fig. 3.44: "Edit threshold" dialog box

3.13.8 Specifying the Flush Algorithm

Some measuring programs require a more detailed specification of the algorithm for determining the flushness.

Proceed as follows:

- If not already done so, click on the "Measurement settings" button (see Fig. 3.45).
- If not already done so, click on the "Flush" tab (see Fig. 3.45).
- Set the areas for determining the centers of gravity or straight lines (see Chapter 3.13.6).

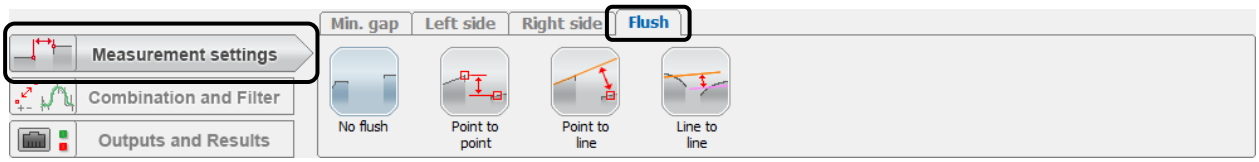


Fig. 3.45: "Measurement settings" input field, "Flush" tab sheet

in the "Flush" tab sheet, you can define the algorithm for the flushness value.

- Algorithm (see Fig. 3.46):
  - **No flush:** No flushness is calculated.
  - **Point to point:** The difference of the Z coordinates of the centers of gravity is calculated.
  - **Point to line:** The distance from the center of gravity to the straight line is calculated.
  - **Line to line:** The distance of two parallel straight lines is calculated.

Note: The available options in the "Flush" tab sheet depend on the current measuring program.

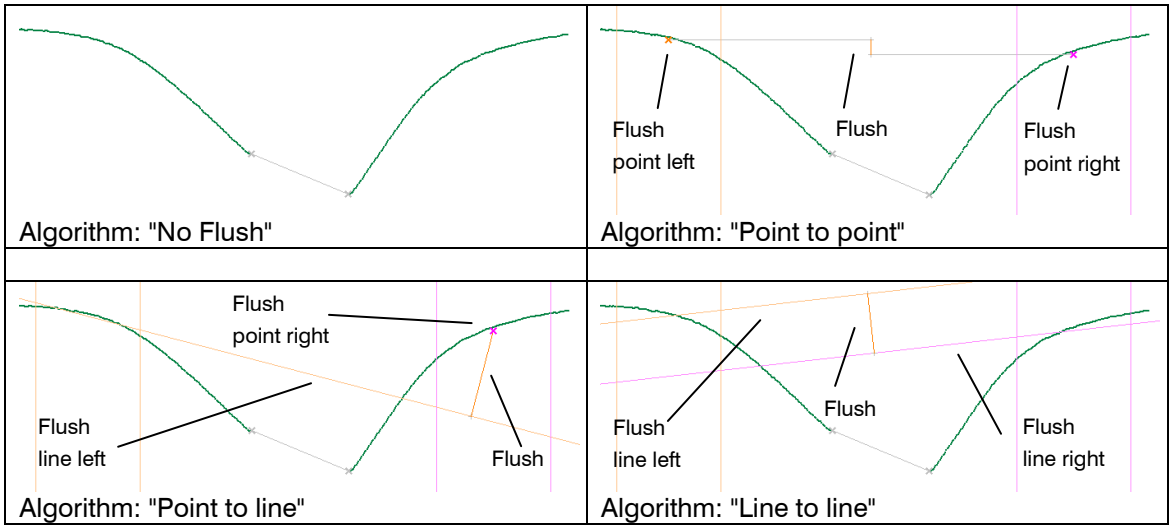


Fig. 3.46: Flush algorithms

3.13.9 Specifying the Projection Algorithm

Some measuring programs require a more detailed specification of the algorithm for calculating the gap points.

Proceed as follows:

- If not already done so, click on the "Measurement settings" button (see Fig. 3.47).
- If not already done so, click on the "Projection" tab (see Fig. 3.47).
- Set the areas for determining the straight lines (see Chapter 3.13.6).

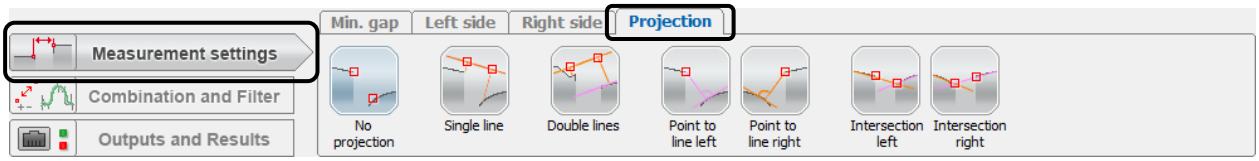


Fig. 3.47: Measurement settings" input field, "Projection" tab sheet

On the "Projection" tab, you set the projection algorithm.

- Algorithm (see Fig. 3.48):
  - **No projection:** No points are projected.
  - **Single line:** The gap points are determined by projecting the start and end points onto a straight line.
  - **Double lines:** The gap points are determined by projecting the start and end points onto one of two straight lines.
  - **Point to line left:** The right gap point is determined by projecting the start point onto a straight line. The left gap point matches the start point. The end point is irrelevant to the measurement.
  - **Point to line right:** The left gap point is determined by projecting the end point onto a straight line. The right gap point matches the end point. The start point is irrelevant to the measurement.
  - **Intersection left:** The right gap point is defined as the intersection point between two straight lines. The left gap point is determined by projecting the start point onto a straight line. The end point is irrelevant to the measurement.
  - **Intersection right:** The left gap point is defined as the intersection point between two straight lines. The right gap point is determined by projecting the end point onto a straight line. The start point is irrelevant to the measurement.

Note: The available options in the "Projection" tab sheet depend on the current measuring program.

Fig. 3.48: Projection algorithms

3.13.10 Activating the Dynamic Tracking of the Ranges

gapCONTROL Setup Software makes it possible for you to dynamically track the ranges for the line fitting. In this way, the measurement can also be performed correctly in case of position change in the X/Z direction, e.g. for curves of the beading track or bulges and indentations in the material. The ranges are coupled to an assigned point of the profile, the so-called anchor point, for the dynamic tracking. This point is also used as a reference characteristic in order to create orientation at the target.

Proceed as follows in order to parameterize and activate the dynamic tracking:

- Set the ranges for the cutting out (see Chapter 3.13.1).
- Set the ranges for the line fitting (see Chapter 3.13.6).
- Press the "Dynamic tracking" button in the "Measurement" toolbar (see Chapter 3.17).

Fig. 3.49: "Dynamic tracking" button

The "Dynamic tracking" dialog is displayed (see Fig. 3.50). The potential candidates for the anchor point are highlighted in turquoise in the 2D-display (see Fig. 3.51).

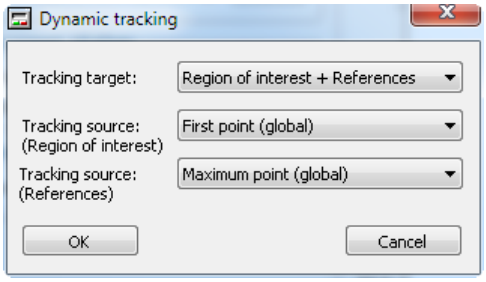


Fig. 3.50: "Dynamic tracking" dialog box

Make the following settings:

- **Tracking target:** Select the measurement ranges to be tracked:
  - **Region of interest:** The range for cutting out.
  - **References:** The ranges for line fitting.
  - **Region of interest + References:** The range for cutting out and the ranges for line fitting.
- **Tracking source (Region of interest):** Select the anchor point for cutting out. The following options are available (see Fig. 3.51):
  - **First point (global):** The first point of the Profile (1).
  - **Last point (global):** The last point of the Profile (2).
  - **Minimum point (global):** The minimum point of the Profile (3).
  - **Maximum point (global):** The maximum point of the Profile (4).
- **Tracking source (References):** Select the anchor point for line fitting. The following options are available (see Fig. 3.51):
  - **First point (global):** The first point of the Profile (1).
  - **Last point (global):** The last point of the Profile (2).
  - **Minimum point (global):** The minimum point of the Profile (3).
  - **Maximum point (global):** The maximum point of the Profile (4).
  - **First point (roi):** The first point inside the range for cutting out (5).
  - **Last point (roi):** The last point inside the range for cutting out (6).
  - **Minimum point (roi):** The minimum point inside the range for cutting out (7).
  - **Maximum point (roi):** The maximum point inside the range for cutting out (8).
  - **Base gap left point:** The start point of a base gap (optional, 9).
  - **Base gap center point:** The center point of a base gap (optional, 10).
  - **Base gap right point:** The end point of a base gap (optional, 11).

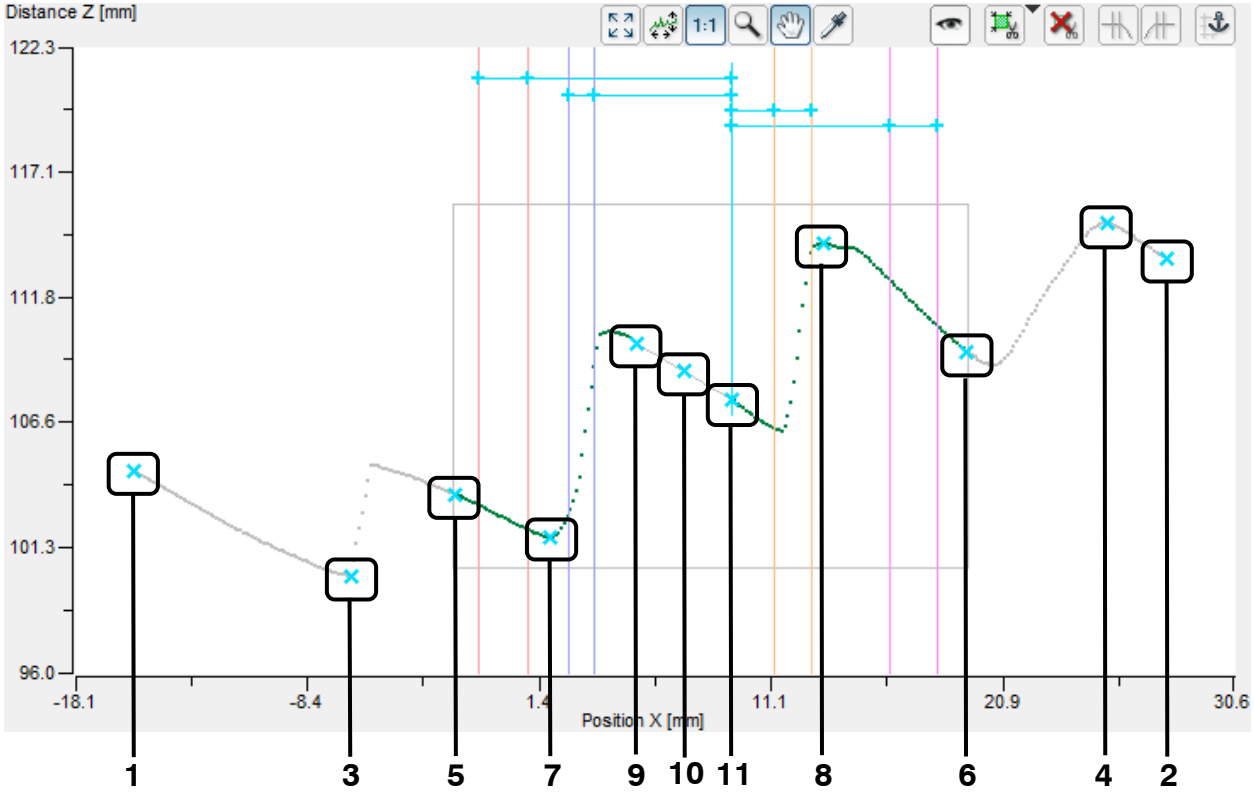


Fig. 3.51: Possible candidates for the anchor points

➡ In the "Dynamic tracking" dialog (see Fig. 3.50), select the ranges to be tracked and the desired anchor points and confirm with "OK".

The dynamic tracking is now active. The "dynamic tracking" button (see Chapter 3.17) remains pressed. The coupling of the ranges to the anchor point is symbolized with turquois lines in the 2D-display.

In order to deactivate the dynamic tracking, press the "Dynamic tracking" button again. The dynamic tracking is now deactivated (see Chapter 3.17).

3.13.11 Display Measured Values in the 2D-Display Numerically

To give you a better overview, it is possible to display the determined measured values in numeric form at the bottom edge of the 2D-display. The system displays the first two measured values that you chose on the "Results" tab. Enable of disable display of the measured values using the "Show result values" button (see Fig. 3.52).

Fig. 3.52: "Show result values" button

3.13.12 Evaluating Measured Values and Configuring Outputs

gapCONTROL Setup Software allows you to combine, to filter the measured values found over a consecutive series of measurements, to check them for acceptable tolerances and to output the results via the analog, digital, serial and Ethernet interface of the gapCONTROL measurement system (see Chapter 1.2). In addition, the selected measurement values are displayed graphically in the 2D-display.

Please refer to Chapter 5 for a detailed description of the procedure.

3.13.13 Saving and Loading Parameters

Setup Software allows you to save and load parameters. For example, you can save parameters for different measuring settings and therefore configure the measurement system for different measuring tasks. In addition, you can also specify different tolerances for a single measuring task. You can simplify the configuration of a new measuring task by making stepwise refinements.

Once you have saved all the parameters for measurement settings you can load them again later on. You can save the parameters for as many measuring tasks as you like.

3.13.14 Saving Parameters to File

In order to save the parameters of the current measuring program, either select the menu item "Parameters → Save parameters to file..." or press the corresponding button (see Fig. 3.59) in the "General" toolbar.

Fig. 3.53: "Save parameters to file" button

A standard Windows dialog is displayed for selection of the path and file name for saving the parameters. As standard, the file name has the extension ".gc1". You can use a different file extension by selecting the "All files (*.*)" option in the Windows dialog in the "File type" selection field. The parameters are saved in the selected file after confirmation of the dialog.

3.13.15 Loading Parameters from File

In order to load parameters of the current measuring program which have previously been saved, either select the "Parameters → Load parameters from file..." menu item or press the corresponding button (see Fig. 3.60) in the "General" toolbar.

Fig. 3.54: "Load parameters from file" button

A standard Windows dialog is displayed for selection of the path and file name from which the parameters should be loaded. As standard, the file name has the extension ".gc1". You can use a different file extension by selecting the "All files (*.*)" option in the Windows dialog in the "File type" selection field. The parameters are loaded into the current measuring program after confirmation of the dialog.

Note: In a measuring program only parameters which have been saved with the same or a compatible measuring program can be loaded.

If an incompatible parameter set is loaded, the following dialog will appear:

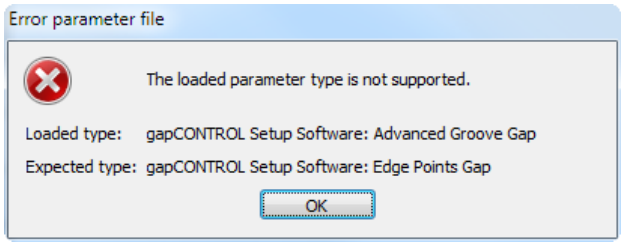


Fig. 3.55: Dialog box in the case of loading incompatible parameters

If a compatible parameter set is loaded, a message will appear with details of the program the parameter set was created with (see Fig. 3.56).

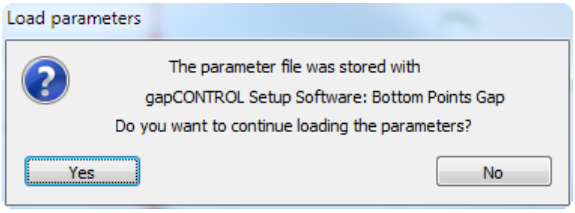


Fig. 3.56: Dialog box in the case of loading compatible parameters

➪ Confirm your settings with the button "Yes" when loading the parameter set is to be continued.

3.13.16 Reset Parameters to Default Settings

In order to reset the parameters of the current measuring program to default settings, either select the menu item "Parameters → Reset..." or press the corresponding button (see Fig. 3.57) in the "General" toolbar.

Fig. 3.57: "Reset" button

A dialog is displayed (see Fig. 3.58), where you can select which parameters should be reset.

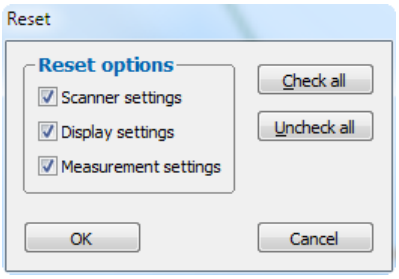


Fig. 3.58: "Reset" dialog box

The following parameters can be reset:

- **Scanner settings:** The parameters of the gapCONTROL measurement system (see Chapter 3.7).
- **Display settings:** The settings of the 2D-display (see Chapter 3.12).
- **Measurement settings:** The configuration for measurement and settings for evaluation and output of the measured values (see Chapter 3.13).

➪ Press the "Check all" button in order to select all parameter types. Press the "Uncheck all" button in order to deselect all parameter types.

➪ Press "OK" in order to reset the selected parameters.

3.13.17 Store Parameters Permanently on gapCONTROL

Setup Software makes it possible for you to permanently store the parameters of an active measuring program and the configuration of the output ports on the connected gapCONTROL measurement system. So, in combination with a gapCONTROL measurement system which operates as an independent unit and without a connected PC, measurements can also be performed after a failure and recovery of the power supply without having to connect the measurement system to the PC again.

Note: The function "Save parameters to gapCONTROL" is only available in the individual measuring programs.

In order to save the parameters of an active measuring program and the configuration of the output ports on the connected gapCONTROL measurement system, either select the menu item "Parameters → Save parameters to gapCONTROL..." or press the corresponding button (see Fig. 3.59) in the "General" toolbar.

Fig. 3.59: "Save parameters to gapCONTROL" button

The "Save parameters to gapCONTROL" dialog (see Fig. 3.60) is displayed. In this dialog, select the storage location on the gapCONTROL measurement system where the current parameters should be saved. These storage locations are called "User modes". The maximum number of "User modes" is 15. The parameters are saved in the selected user mode after confirmation of the dialog.

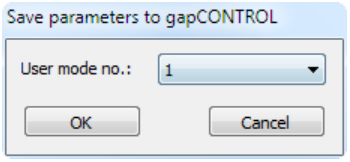


Fig. 3.60: "Save parameters to gapCONTROL" dialog box

Note: Details for loading a user mode can be found in Chapter 3.13.18 and 7.3 and in the gapCONTROL operating manual.

Note: In case of using the scanCONTROL measurement system, only the parameters located in the "Scanner settings" (see Chapters 3.7, 3.8 and 3.9) section are stored. In order to save all measurement parameters please use the gapCONTROL measurement system.

3.13.18 Load Parameters from gapCONTROL

Use the "Load parameters from gapCONTROL" function in order to read the current parameter settings or parameter settings which have been saved on the gapCONTROL measurement system (see Chapter 3.13.17) back into the software. To do this, either select the menu item "Parameters → Load parameters from gapCONTROL..." or press the corresponding button (see Fig. 3.61) in the "General" toolbar.

Fig. 3.61: "Load parameters from gapCONTROL" button

The "Read settings from gapCONTROL" dialog appears. Select the parameter set (User mode) or the current parameter settings to load. After you have confirmed the dialog with OK, the selected parameters on the gapCONTROL measurement system are activated and the software reads the parameter set from the measurement system. If the parameter set is loaded in the main view, the loaded measurement program automatically starts.

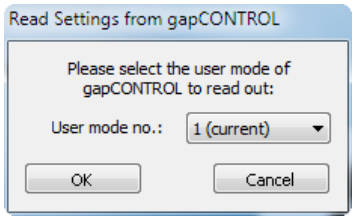


Fig. 3.62: "Read Settings from gapCONTROL" dialog box

If the parameters couldn't be read out from the selected user mode, an error message appears.

In the following possible error messages and their reasons are listed:

- The selected user mode contains no measuring parameters. You can only read user modes which were saved with the function "Save parameters to gapCONTROL" (see Chapter 3.13.17).
- You are using the scanCONTROL measurement system. Only the parameters located in the "Scanner settings" (see Chapter 3.7, 3.8 and 3.9) section are loaded. In order to load all measurement parameters please use the gapCONTROL measurement system.
- The number of points per profile stored in the user mode is too small. Only user modes stored with a sufficient number of points per profile can be read out.

3.13.19 Backup gapCONTROL Parameters

Use the "Backup usermodes to file ..." menu entry in order to save all parameter sets, which are stored on the gapCONTROL measurement system (User modes, see Chapter 3.13.17) to a file.

A standard Windows dialog is displayed for selection of the path and file name for saving the parameters. As standard, the file name has the extension ".bin". The parameters are saved in the selected file after confirmation of the dialog. The progress of the process is showed in an information dialog box.

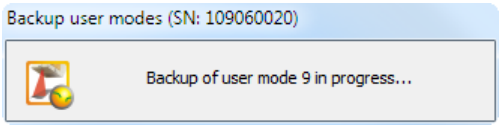


Fig. 3.63: "Backup user modes to file..." dialog box

Note: Backing up user mode is only available for gapCONTROL devices with an Ethernet interface.

3.13.20 Restore gapCONTROL Parameters

Use the "Restore user modes to gapCONTROL..." menu entry in order to restore saved parameter sets (User modes, see Chapter 3.13.19) to the gapCONTROL measurement system.

A standard Windows dialog is displayed for selection of the path and file name from which the parameters should be restored. As standard, the file name has the extension ".bin". After confirming the dialog, the parameters of the selected file is read and transferred to the connected gapCONTROL measurement system. Empty parameter sets (User modes) are filled with the factory settings. The progress of the process is showed in an information dialog box.

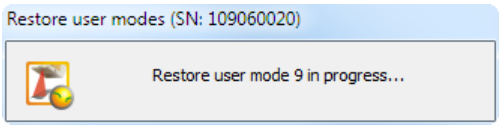


Fig. 3.64: "Restore user modes to gapCONTROL..." dialog box

Note: The settings can be restored only if the same type of measurement system was used when saving the settings.

Note: Restoring user modes is only available for gapCONTROL devices with an Ethernet interface.

3.14 Menu Bar

A summary of the menu bar functions (see Fig. 3.65) can be seen in the following.

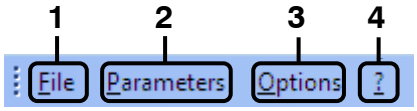


Fig. 3.65: Menu bar

1 - File:

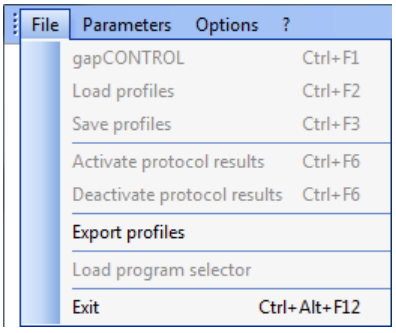


Fig. 3.66: "File" menu

- **gapCONTROL:** Selects the gapCONTROL measurement system connected to the PC as data source (see Chapter 3.5).
- **Load profiles:** Selects a file in which profiles have been saved previously as data source (see Chapter 3.5).
- **Save profiles:** Saves profiles which are transferred by gapCONTROL to a file (see Chapter 3.6).
- **Activate protocol results:** Activates the logging of measured values (see Chapter 5.9).
- **Deactivate protocol result:** Deactivates the logging of measured values (see Chapter 5.9).
- **Export profiles:** Starts the "Export profiles" program (see Chapter 4.6).
- **Load program selector:** Closes the current measuring program and returns to the Main View.
- **Exit:** Closes gapCONTROL Setup Software (see Chapter 3.21).

2 - Parameters:

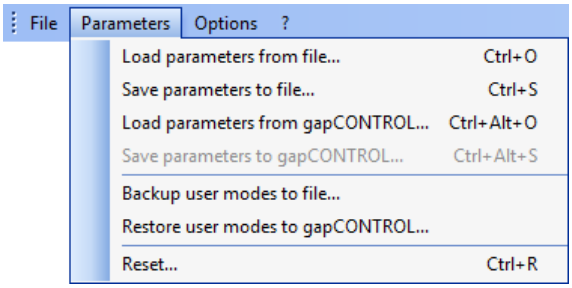


Fig. 3.67: "Parameters" menu

- **Load parameters from file...:** Loads parameters of the current measuring program from a file (see Chapter 3.13.15).
- **Save parameters to file...:** Saves parameters of the current measuring program to a file (see Chapter 3.13.14).
- **Load parameters from gapCONTROL...:** Loads parameters which have been saved on the gapCONTROL measurement system (see Chapter 3.13.18).
- **Save parameters to gapCONTROL...:** Saves the parameters of an active measuring program permanently on the gapCONTROL measurement system (see Chapter 3.13.17).
- **Backup user modes to file...:** Backs up all parameter sets stored on the measuring system (user modes) to a file (see Chapter 3.13.19).
- **Restore user modes to gapCONTROL...:** Restores saved parameter sets (User modes) from a file to the gapCONTROL measurement system (see Chapter 3.13.20).

- **Reset...:** Resets the parameters to default settings (see Chapter 3.13.16).

3 - Options:

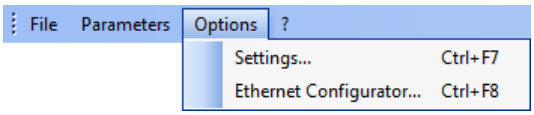


Fig. 3.68: "Options" menu

- **Settings...:** Activates a dialog where you can make basic settings (see Chapter 3.19).
- **Ethernet configurator…:** Activates a dialog where you can modify the network settings of gapCONTROL measurement systems with an Ethernet interface (see Chapter 3.20).

4 - ?:

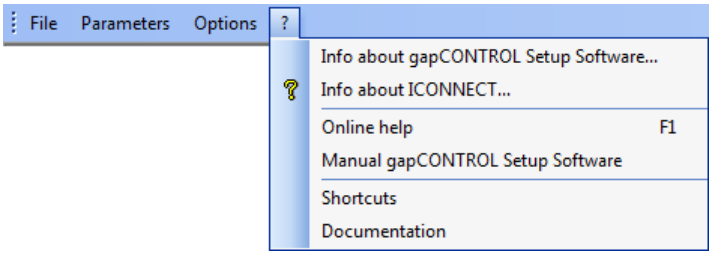


Fig. 3.69: "?" menu

- **Info about gapCONTROL Setup Software...:** Displays an information window about gapCONTROL Setup Software.
- **Info about ICONNECT...:** Displays an information window about ICONNECT, the development environment for gapCONTROL Setup Software.
- **Online help:** Opens the documentation for the current view.
- **Manual gapCONTROL Setup Software:** Opens the instruction manual of gapCONTROL Setup Software.
- **Shortcuts:** Opens an overview of the available key shortcuts (see Chapter 8.3).
- **Documentation:** Opens an overview where you can call up various help and documentation about gapCONTROL.

Note: Using the function key <F1>, you can open the documentation for the current measuring program.

3.15 Functions of the "General" Toolbar

A summary of the functions of the "General" toolbar (see Fig. 3.70) can be seen in the following.

Fig. 3.70: "General" toolbar

Selects the gapCONTROL measurement system connected to the PC as data source (see Chapter 3.5).

Selects a file in which profiles have been saved previously as data source (see Chapter 3.5).

Saves profiles which are transferred by gapCONTROL to a file (see Chapter 3.6).

Activates or deactivates the logging of measured values (see Chapter 5.9).

Loads parameters of the current measuring program from a file (see Chapter 3.13.15).

Saves the parameters of the current measuring program to a file (see Chapter 3.13.14).

Loads parameters which have been saved on the gapCONTROL measurement system (see Chapter 3.13.18).


Saves the parameters of an active measuring program permanently on the gapCONTROL measurement system (see Chapter 3.13.17).


Resets parameters to default settings (see Chapter 3.13.16).

3.16 Functions of the "Display" Toolbar

A summary of the functions of the "Display" toolbar (see Fig. 3.71) can be seen in the following.

Fig. 3.71: "Display" toolbar


Resets the 2D-display to the complete measuring range (see Chapter 3.12.1).


Activates or deactivates the automatic scaling of the 2D-display (see Chapter 3.12.2).


Activates or deactivates the "Keep aspect ratio" mode (see Chapter 3.12.3).


Activates or deactivates the "Zoom" mode (see Chapter 3.12.4).


Activates or deactivates the "Move profile" mode (see Chapter 3.12.5).


Activates or deactivates the "Display extended information of a profile point" mode (see Chapter 3.12.6).

3.17 Functions of the "Measurement" Toolbar

A summary of the functions of the "Measurement" toolbar can be seen in the following.

Note: The elements of the "Measurement" toolbar vary depending on the measuring program.


Activates or deactivates the numeric display of measured values (see Chapter 3.13.11).


Activates or deactivates the "Cutting out" mode (Select inside points, see Chapter 3.13.1).


Activates or deactivates the "Cutting out" mode (Select outside points, see Chapter 3.13.1).


Resets the range for "Cutting out" (see Chapter 3.13.2).


Activates or deactivates the "Set reference line" mode (see Chapter 3.13.6).


Activates or deactivates the "Set threshold" mode (see Chapter 3.13.7).


Activates or deactivates the dynamic tracking of the ranges (see Chapter 3.13.10).

3.18 Navigation in Setup Software

In gapCONTROL Setup software, you can use the navigation menu to switch to the active program, the utilities and the main view. To show the navigation menu (see Fig. 3.73), click on the "Navigation" button (see Fig. 3.72).

Fig. 3.72: "Navigation" button

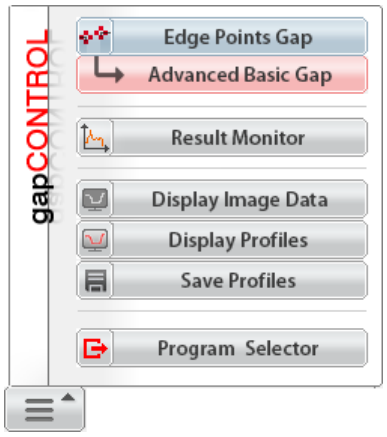


Fig. 3.73: "Navigation" menu

Note: The available options in the "Navigation" menu depend on the current measuring program.

In some programs, you have the option of using the Navigation menu to switch to the respective program with advanced setting options and measured values (Advanced). When doing so, the system applies the parameters of the current program (see Fig. 3.74). It is not possible to switch back to the basic program.

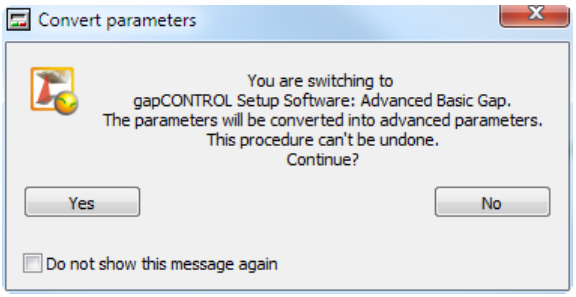


Fig. 3.74: "Convert parameters" dialog box

3.19 Basic Settings

Select the menu item "Options → Settings..." to make basic settings for the software. The "Settings" dialog is displayed (see Fig. 3.75).

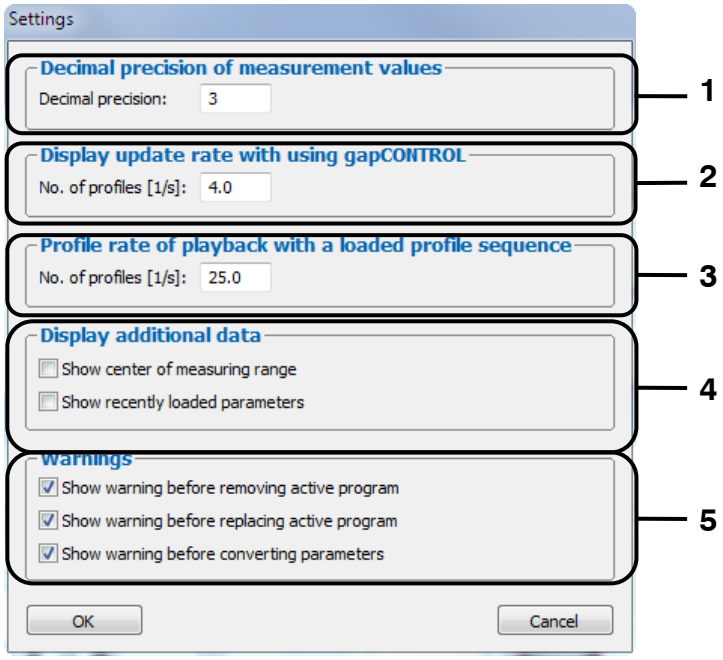


Fig. 3.75: "Settings" dialog box

Parameters in the "Settings" dialog:

1 Decimal precision of measurement values: Specify the number of decimal places displayed for the measured values.

2 Display update rate with using gapCONTROL: Edit the update rate of the display when using a gapCONTROL measurement system.

3 Profile rate of playback with a loaded profile sequence: Edit the speed at which offline profile sequences are played back.

4 Display additional data: Specify whether additional data are shown:
- **Show center of measuring range:** Shows the center of measuring range in the 2D-display.
- **Show recently loaded parameters:** Shows the recently loaded prameters in the 2D-display.

5 Warnings: Specify whether warnings are shown:
- **Show warning before removing active program:** Shows a warning before removing an active program.
- **Show warning before replacing active program:** Shows a warning before replacing an active program.
- **Show warning before converting parameters:** Shows a warning before converting program parameters.

3.20 Adjusting gapCONTROL Network Settings (Ethernet Configurator)

When using a gapCONTROL measurement system with an Ethernet interface you may adjust the system network settings (IP address, etc.) by selecting the "Options → Ethernet Configurator" menu item. The "Ethernet Configurator" dialog will be opened.

Note: To be able to operate a gapCONTROL measurement system via Ethernet with Setup Software, the measurement system and your PC must be located in the same subnet. Adjust any relevant network settings for the measurement system in the "Ethernet Configurator" dialog.

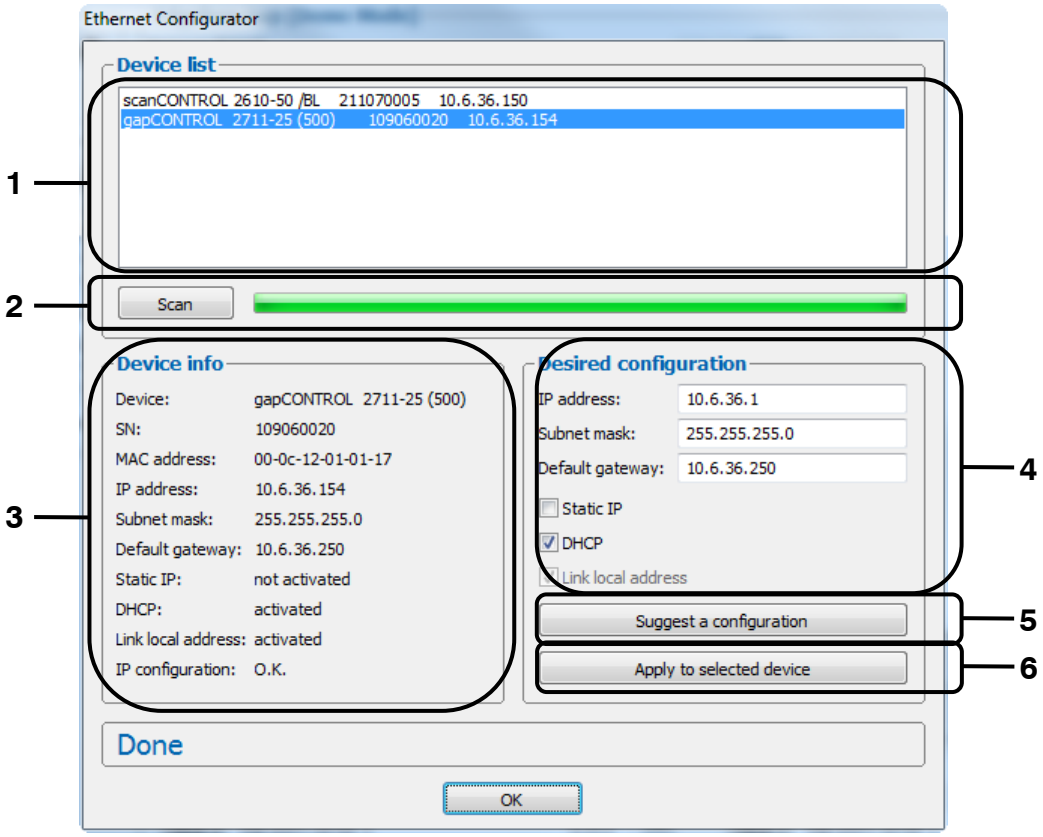


Fig. 3.76: "Ethernet Configurator" dialog

Display elements and parameters in the "Ethernet Configurator" dialog:

1 **Device list:** This section lists all available measurement systems. Click "Scan" to refresh the list. Select the desired measurement system.

2 **Scan:** Click this button to search for gapCONTROL measurement systems in all subnets connected to the PC. The scan progress is displayed. When the scanning is complete, any found measurement systems are displayed in the list.

3 **Device info:** Displays the current settings for the selected gapCONTROL measurement system:
- **Device:** Device name
- **SN:** Serial number
- **MAC address:** Physical address
- **IP address:** IP address
- **Subnet mask:** Subnet mask
- **Default gateway:** Default gateway
- **Static IP:** "Static IP" address option enabled
- **DHCP:** "DHCP" option enabled
- **Link local address:** "Link local address" option enabled
- **IP configuration:** Indicates whether the network configuration is valid. If the network configuration is not valid, the measurement system cannot be used with Setup Software.

4 **Desired configuration:** Use the following input fields to enter the network configuration for the selected gapCONTROL measurement system:
- **IP address:** IP address.
- **Subnet mask:** Subnet mask.
- **Default gateway:** Default gateway.
- **Static IP:** "Static IP" option – if this option is enabled, dynamic address allocation is disabled. The IP address entered is used as IP address. This parameter takes precedence over the "DHCP" and "Link local address" options.
- **DHCP:** "DHCP" option – if this option is enabled, the IP address is allocated dynamically through a DHCP server. This parameter takes precedence over "Link local address".
- **Link local address:** "Link local address" option – if this option is enabled, the IP address is allocated dynamically in the local subnet 169.254.x.x. This option is always enabled.

5 **Suggest a configuration:** Click this button to have a suitable configuration for the selected gapCONTROL measurement system determined automatically. After the process is complete, the system automatically completes the input fields in the "Desired configuration" section.

6 **Apply to selected device:** Click this button to apply the network configuration specified in the "Desired configuration" section to the selected gapCONTROL measurement system.

Proceed as follows to manually enter the network configuration parameters for a gapCONTROL measurement system:

- When the "Ethernet Configurator" dialog is opened, the system automatically searches for available measurement systems. If the measurement system is not connected to your subnet yet, establish a connection, and click the "Scan" button. When scanning is complete, the measurement system is displayed in the device list.
- Select the required measurement system from the device list.
- Specify the required network settings in the input fields in the "Desired configuration" section.
- Click "Apply to selected device" to apply the settings to the selected measurement system.
- Click OK to confirm the selections in the "Ethernet Configurator" dialog.

Proceed as follows to automatically specify network configuration parameters for a gapCONTROL measurement system:

- When the "Ethernet Configurator" dialog is opened, the system automatically searches for available measurement systems. If the measurement system is not connected to your subnet yet, establish a connection, and click the "Scan" button. When scanning is complete, the measurement system is displayed in the device list.
- Select the required measurement system from the device list.
- Click the "Suggest a configuration" button to have a suitable network configuration for the selected gapCONTROL measurement system determined automatically. After the process is complete, the system automatically completes the input fields in the "Desired configuration" section.
- Click "Apply to selected device" to apply the settings to the selected measurement system.
- Click OK to confirm the selections in the "Ethernet Configurator" dialog.

3.21 Exiting gapCONTROL Setup Software

Select the menu item "File → Exit" or press the standard Windows button  in the title bar of the program window in order to exit gapCONTROL Setup Software.

4 Description of the Measuring Programs

The functions of the individual measuring programs are described in detail in the following. The measuring programs are divided into three groups. Additionally a "Tools" group is available which provides useful utilities. The individual group views are activated from the Main View (see Chapter 3.2)

4.1 "Basic Gaps" Group

Programs for measuring the characteristics of simple gaps can be found in "Basic Gaps" group.

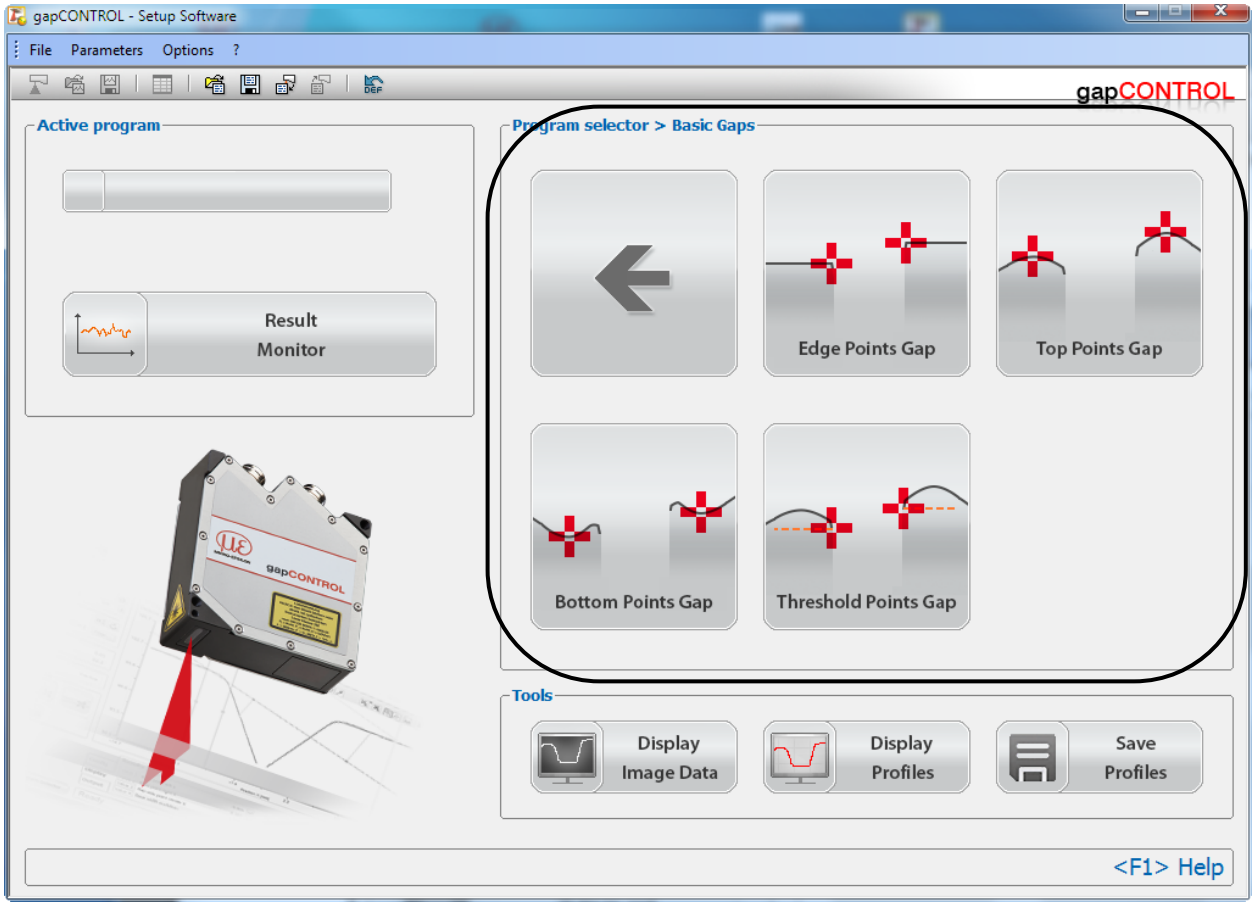


Fig. 4.1: "Basic Gaps" group

Measuring programs:

- **Edge Points Gap**: Measurement of a gap based on the inner edge points.
- **Top Points Gap**: Measurement of a gap based on the highest points.
- **Bottom Points Gap**: Measurement of a gap based on the lowest points.
- **Threshold Points Gap**: Measurement of a gap based on the intersection points of the threshold with the profile.

Refer to the following chapters for more detailed descriptions of the different measuring programs.

4.1.1 "Edge Points Gap" Measuring Program

Use the "Edge Points Gap" measuring program to determine the characteristics of a simple gap based on the inner edge points.

The program first determines the largest gap in the profile (the so-called "base gap"). Starting from the base gap, the start and end points of the gap in the left and right sections of the profile are determinated as follows:

- Start point: The last point of the left profile section.
- End point: The first point of the right profile section.

Afterwards, the flushness is measured using the selected algorithm (see Chapter 3.13.8).

Proceed as follows:

- Configure the gapCONTROL measuring system ("Scanner settings" input field, see Chapter 3.7).
- If necessary, limit the measuring range in order to eliminate any interference points (see Chapter 3.13.1).
- Set the minimum width and alignment of the gap (see Chapter 3.13.4).
- Set the algorithm for determining the flushness (see Chapter 3.13.8).
- If necessary, activate dynamic tracking of the ranges for cutting out and line fitting (see Chapter 3.13.10).

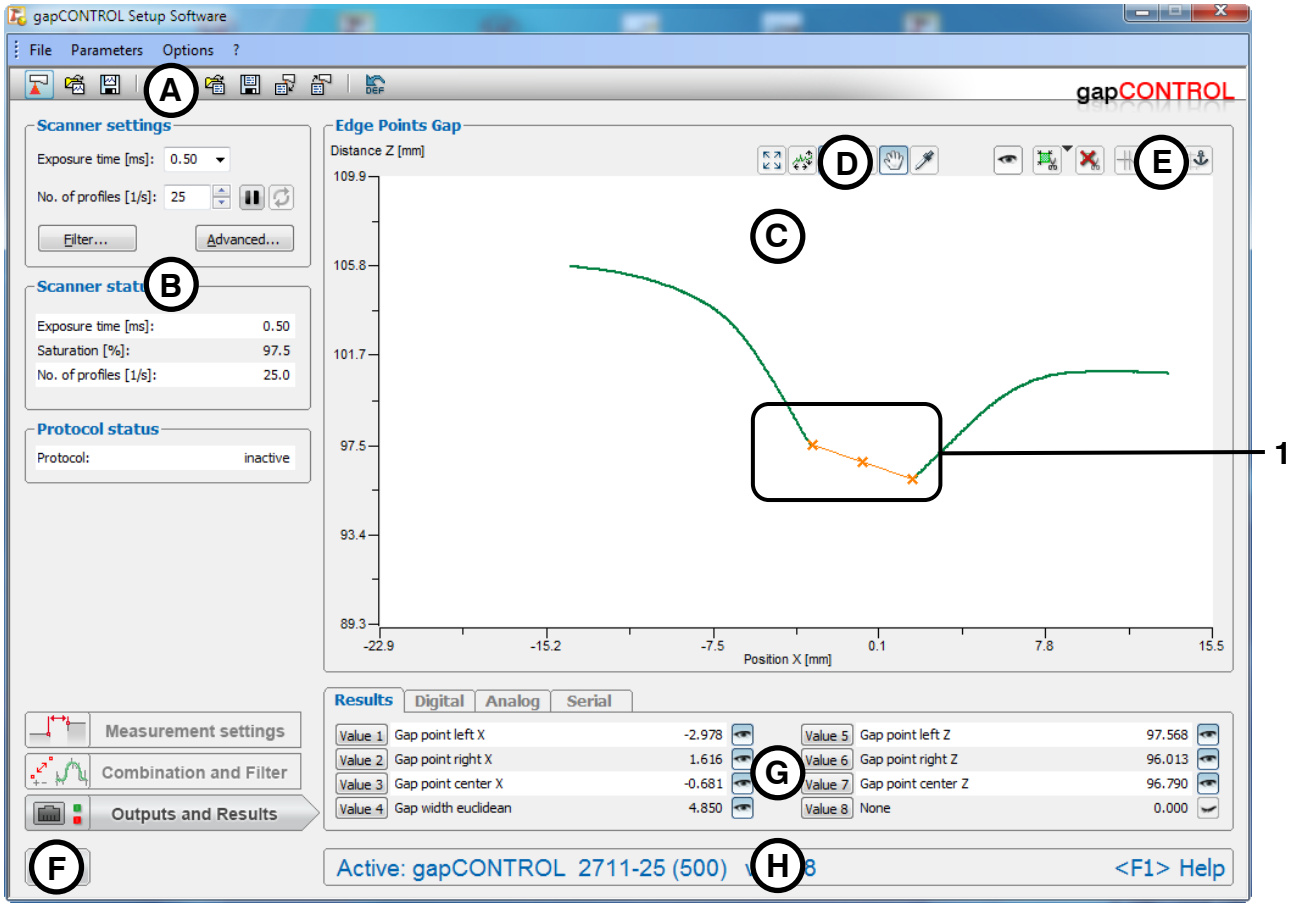


Fig. 4.2: "Edge Points Gap" measuring program

Display elements and parameters in the "Edge Points Gap" measuring program:

A "General" toolbar: Using this toolbar, you can select the data source (see Chapter 3.5), save profile sequences (see Chapter 3.6), save and load parameters (see Chapter 3.13.13) and reset the selected parameters to the default settings (see Chapter 3.13.16).

B Scanner settings: Change the settings of gapCONTROL with these values (see Chapter 3.7). In offline mode (see Chapter 3.5), this input field is replaced by the "File settings" input field, which enables you to control the playback process of a profile sequence loaded from a file (see Chapter 3.10).

C **2D-display:** This display shows the last measured profile, the measuring ranges and measurement results.

D **"Display" toolbar:** Using this toolbar, you can scale the 2D-display and activate various options for mouse interaction (see Chapter 3.16).

E **Measurement toolbar:** You can set the various search areas and limits for measurement using this toolbar (see Chapter 3.17).

F **"Navigation" button:** Click on this button in order to show the "Navigation" menu (see Chapter 3.18).

G **Configuration of the measured values:** In this field, you can specify the measurement algorithms, make settings to combine and filter the measured values and select the results that appear in the 2D-display. Select the measured values to be output at the available interfaces (see Chapter 1.2) of gapCONTROL (see Chapter 5).

H **Status line:** Status and error messages are displayed on the status line (see Chapter 8.1).

1 **Display of the detected gap:** In the 2D-display, the gap determined by the measuring program is displayed.

The measuring program outputs the following measured values:

- **Gap point left X [mm]** : The X coordinate of the start point of the detected gap
- **Gap point left Z [mm]** : The Z coordinate of the start point of the detected gap
- **Gap point center X [mm]** : The X coordinate of the center point of the detected gap
- **Gap point center Z [mm]** : The Z coordinate of the center point of the detected gap
- **Gap point right X [mm]** : The X coordinate of the end point of the detected gap
- **Gap point right Z [mm]** : The Z coordinate of the end point of the detected gap
- **Gap width X [mm]** : The width of the detected gap in the X direction.
- **Gap width Z [mm]** : The width of the detected gap in the Z direction.
- **Gap width euclidian [mm]** : The euclidean width of the detected gap.
- **Flush [mm]** : Flushness (see Chapter 3.13.8).

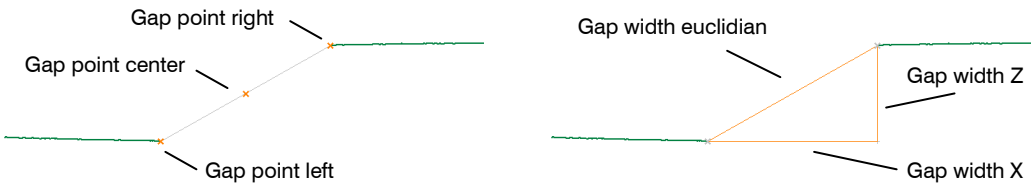


Fig. 4.3: "Edge Points Gap" measured values

Additionally, combined and filtered measured values are available (see Chapters 5.1 and 5.2).

Note: You can switch from the current program to the "Advanced Basic Gap" program (see Chapter 4.4.1) in order to use advanced setting options and measured values. To do this, use the navigation menu (see Chapter 3.18).

4.1.2 "Top Points Gap" Measuring Program

Use the "Top Points Gap" measuring program to determine the characteristics of a simple gap based on the highest points.

The program first determines the largest gap in the profile (the so-called "base gap"). Starting from the base gap, the start and end points of the gap in the left and right sections of the profile are determinated as follows.

- Start point: The highest point of the left profile section.
- End point: The highest point of the right profile section.

Afterwards, the flushness is measured using the selected algorithm (see Chapter 3.13.8).

Proceed as follows:

- Configure the gapCONTROL measuring system ("Scanner settings" input field, see Chapter 3.7).
- If necessary, limit the measuring range in order to eliminate any interference points (see Chapter 3.13.1).
- Set the minimum width and alignment of the gap (see Chapter 3.13.4).
- Set the algorithm for determining the flushness (see Chapter 3.13.8).
- If necessary, activate dynamic tracking of the ranges for cutting out and line fitting (see Chapter 3.13.10).

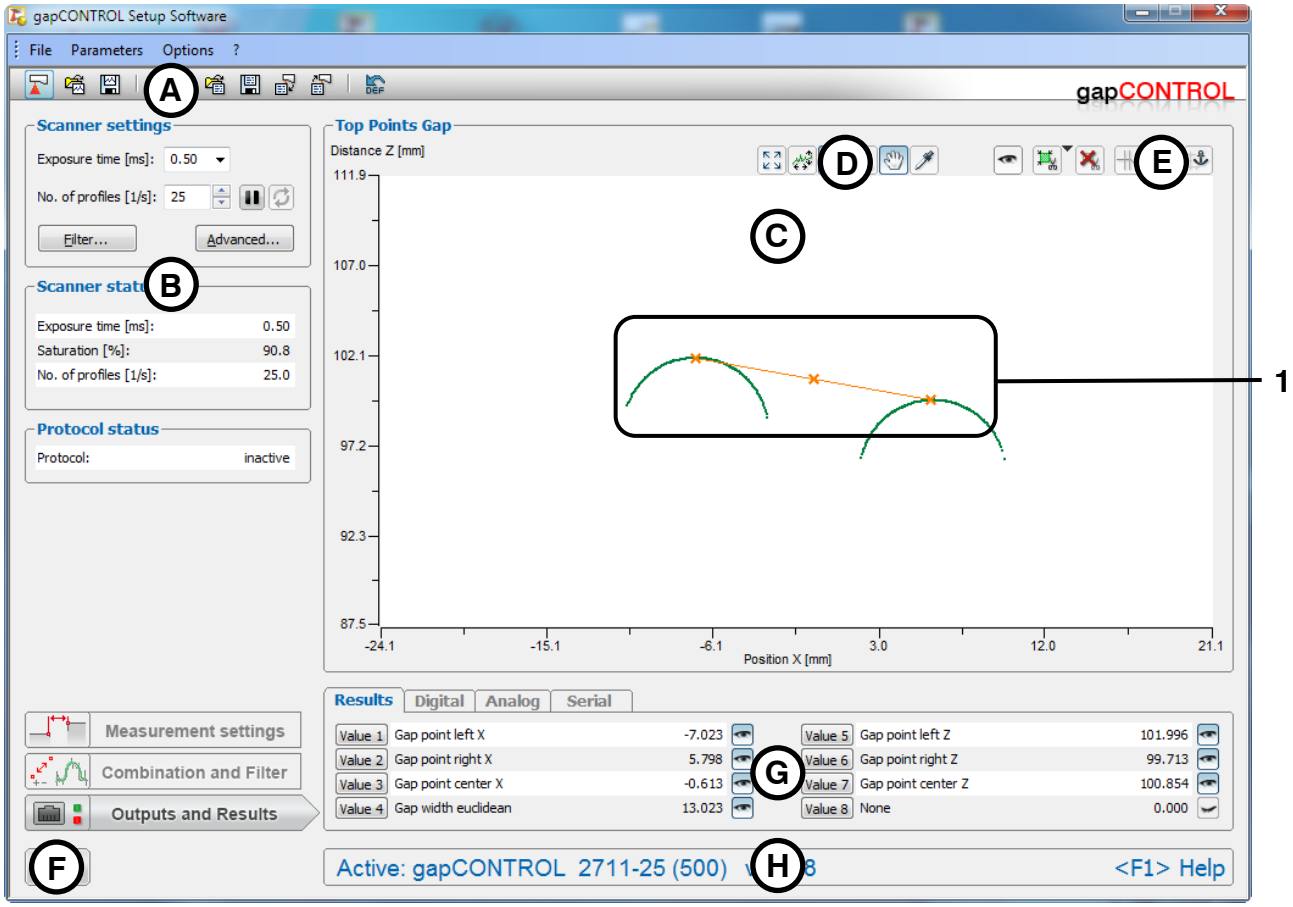


Fig. 4.4: "Top Points Gap" measuring program

Display elements and parameters in the "Top Points Gap" measuring program:

A **"General" toolbar:** Using this toolbar, you can select the data source (see Chapter 3.5), save profile sequences (see Chapter 3.6), save and load parameters (see Chapter 3.13.13) and reset the selected parameters to the default settings (see Chapter 3.13.16).

B **Scanner settings:** Change the settings of gapCONTROL with these values (see Chapter 3.7). In offline mode (see Chapter 3.5), this input field is replaced by the "File settings" input field, which enables you to control the playback process of a profile sequence loaded from a file (see Chapter 3.10).

C **2D-display:** This display shows the last measured profile, the measuring ranges and measurement results.

D **"Display" toolbar:** Using this toolbar, you can scale the 2D-display and activate various options for mouse interaction (see Chapter 3.16).

E **Measurement toolbar:** You can set the various search areas and limits for measurement using this toolbar (see Chapter 3.17).

F **"Navigation" button:** Click on this button in order to show the "Navigation" menu (see Chapter 3.18).

G **Configuration of the measured values:** In this field, you can specify the measurement algorithms, make settings to combine and filter the measured values and select the results that appear in the 2D-display. Select the measured values to be output at the available interfaces (see Chapter 1.2) of gapCONTROL (see Chapter 5).

H **Status line:** Status and error messages are displayed on the status line (see Chapter 8.1).

1 **Display of the detected gap:** In the 2D-display, the gap determined by the measuring program is displayed.

The measuring program outputs the following measured values:

- **Gap point left X [mm]** : The X coordinate of the start point of the detected gap
- **Gap point left Z [mm]** : The Z coordinate of the start point of the detected gap
- **Gap point center X [mm]** : The X coordinate of the center point of the detected gap
- **Gap point center Z [mm]** : The Z coordinate of the center point of the detected gap
- **Gap point right X [mm]** : The X coordinate of the end point of the detected gap
- **Gap point right Z [mm]** : The Z coordinate of the end point of the detected gap
- **Gap width X [mm]** : The width of the detected gap in the X direction.
- **Gap width Z [mm]** : The width of the detected gap in the Z direction.
- **Gap width euclidian [mm]** : The euclidean width of the detected gap.
- **Flush [mm]** : Flushness (see Chapter 3.13.8).

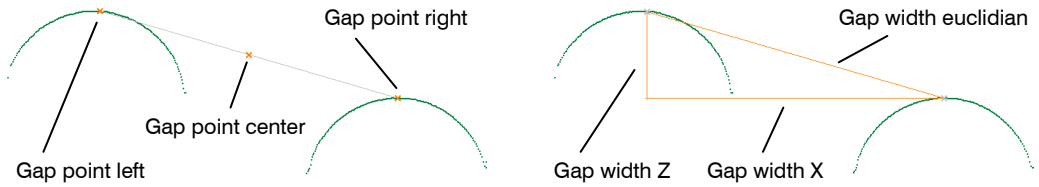


Fig. 4.5: "Top Points Gap" measured values

Additionally, combined and filtered measured values are available (see Chapters 5.1 and 5.2).

Note: You can switch from the current program to the "Advanced Basic Gap" program (see Chapter 4.4.1) in order to use advanced setting options and measured values. To do this, use the navigation menu (see Chapter 3.18).

4.1.3 "Bottom Points Gap" Measuring Program

Use the "Bottom Points Gap" measuring program to determine the characteristics of a simple gap based on the lowest points.

The program first determines the largest gap in the profile (the so-called "base gap"). Starting from the base gap, the start and end points of the gap in the left and right sections of the profile are determinated as follows.

- Start point: The lowest point of the left profile section.
- End point: The lowest point of the right profile section.

Afterwards, the flushness is measured using the selected algorithm (see Chapter 3.13.8).

Proceed as follows:

- Configure the gapCONTROL measuring system ("Scanner settings" input field, see Chapter 3.7).
- If necessary, limit the measuring range in order to eliminate any interference points (see Chapter 3.13.1).
- Set the minimum width and alignment of the gap (see Chapter 3.13.4).
- Set the algorithm for determining the flushness (see Chapter 3.13.8).
- If necessary, activate dynamic tracking of the ranges for cutting out and line fitting (see Chapter 3.13.10).

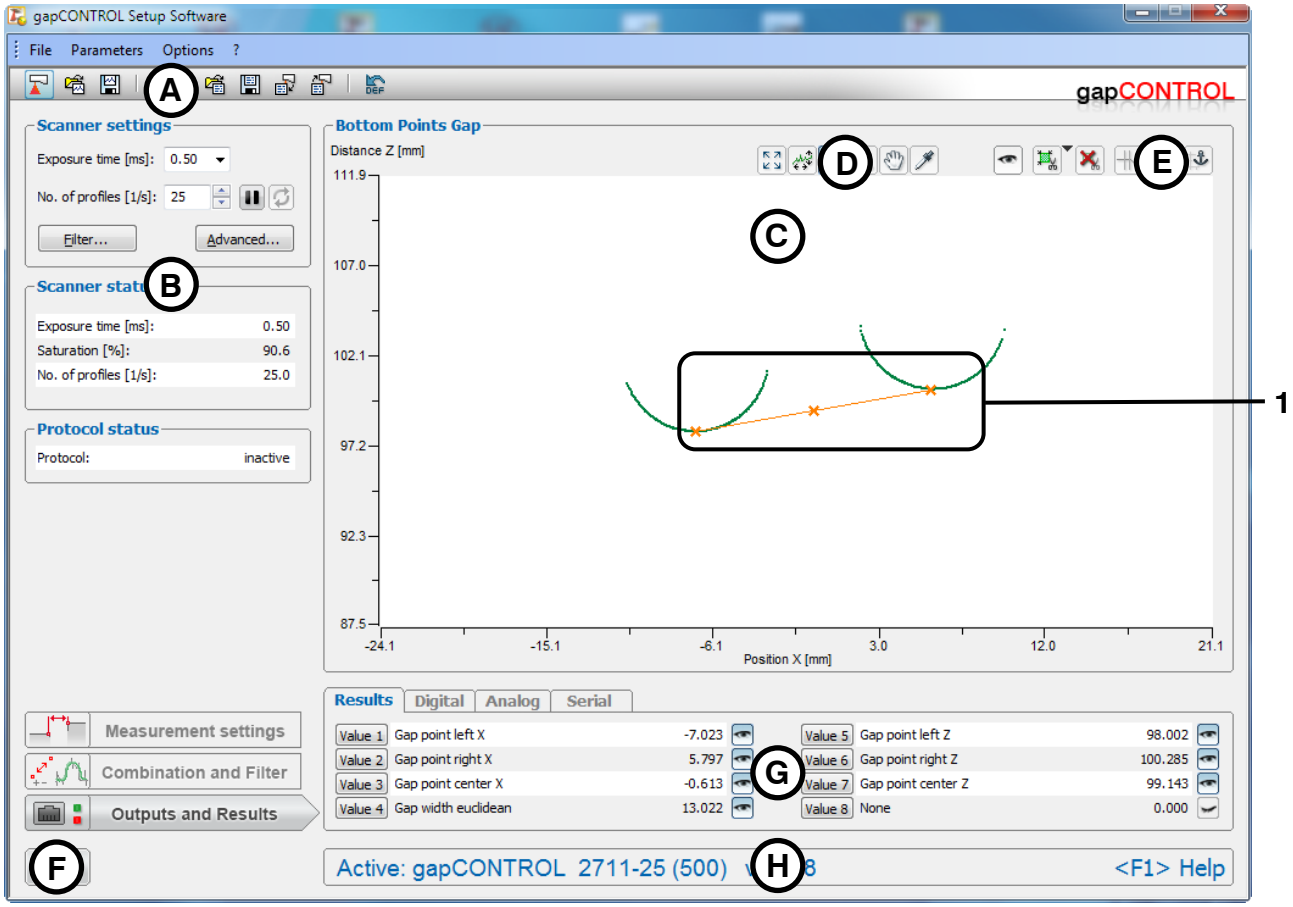


Fig. 4.6: "Bottom Points Gap" measuring program

Display elements and parameters in the "Bottom Points Gap" measuring program:

A **"General" toolbar:** Using this toolbar, you can select the data source (see Chapter 3.5), save profile sequences (see Chapter 3.6), save and load parameters (see Chapter 3.13.13) and reset the selected parameters to the default settings (see Chapter 3.13.16).

B **Scanner settings:** Change the settings of gapCONTROL with these values (see Chapter 3.7). In offline mode (see Chapter 3.5), this input field is replaced by the "File settings" input field, which enables you to control the playback process of a profile sequence loaded from a file (see Chapter 3.10).

C **2D-display:** This display shows the last measured profile, the measuring ranges and measurement results.

D **"Display" toolbar:** Using this toolbar, you can scale the 2D-display and activate various options for mouse interaction (see Chapter 3.16).

E **Measurement toolbar:** You can set the various search areas and limits for measurement using this toolbar (see Chapter 3.17).

F **"Navigation" button:** Click on this button in order to show the "Navigation" menu (see Chapter 3.18).

G **Configuration of the measured values:** In this field, you can specify the measurement algorithms, make settings to combine and filter the measured values and select the results that appear in the 2D-display. Select the measured values to be output at the available interfaces (see Chapter 1.2) of gapCONTROL (see Chapter 5).

H **Status line:** Status and error messages are displayed on the status line (see Chapter 8.1).

1 **Display of the detected gap:** In the 2D-display, the gap determined by the measuring program is displayed.

The measuring program outputs the following measured values:

- **Gap point left X [mm]** : The X coordinate of the start point of the detected gap
- **Gap point left Z [mm]** : The Z coordinate of the start point of the detected gap
- **Gap point center X [mm]** : The X coordinate of the center point of the detected gap
- **Gap point center Z [mm]** : The Z coordinate of the center point of the detected gap
- **Gap point right X [mm]** : The X coordinate of the end point of the detected gap
- **Gap point right Z [mm]** : The Z coordinate of the end point of the detected gap
- **Gap width X [mm]** : The width of the detected gap in the X direction.
- **Gap width Z [mm]** : The width of the detected gap in the Z direction.
- **Gap width euclidian [mm]** : The euclidean width of the detected gap.
- **Flush [mm]** : Flushness (see Chapter 3.13.8).

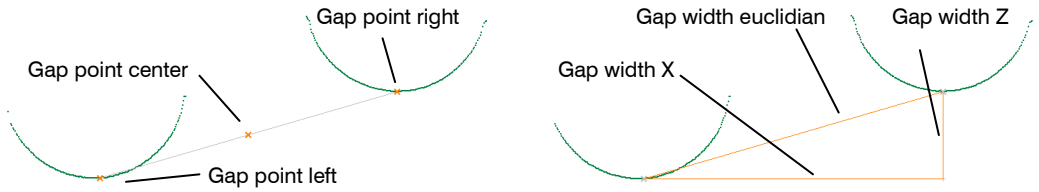


Fig. 4.7: "Bottom Points Gap" measured values

Additionally, combined and filtered measured values are available (see Chapters 5.1 and 5.2).

Note: You can switch from the current program to the "Advanced Basic Gap" program (see Chapter 4.4.1) in order to use advanced setting options and measured values. To do this, use the navigation menu (see Chapter 3.18).

4.1.4 "Threshold Points Gap" Measuring Program

Use the "Threshold Points Gap" measuring program to determine the characteristics of a simple gap based on the intersection points of the threshold with the profile.

The program first determines the largest gap in the profile (the so-called "base gap"). Starting from the base gap, the start and end points of the gap in the left and right sections of the profile are determinated as follows.

- Start point: The intersection point of the threshold with the profile in the left profile half.
- End point: The intersection point of the threshold with the profile in the right profile half.

Afterwards, the flushness is measured using the selected algorithm (see Chapter 3.13.8).

Proceed as follows:

- Configure the gapCONTROL measuring system ("Scanner settings" input field, see Chapter 3.7).
- If necessary, limit the measuring range in order to eliminate any interference points (see Chapter 3.13.1).
- Set the minimum width and alignment of the gap (see Chapter 3.13.4).
- To do this, set the range for fitting a reference line (see Chapter 3.13.6) and define the corresponding threshold line (see Chapter 3.13.7).
- Set the algorithm for determining the flushness (see Chapter 3.13.8).
- If necessary, activate dynamic tracking of the ranges for cutting out and line fitting (see Chapter 3.13.10).

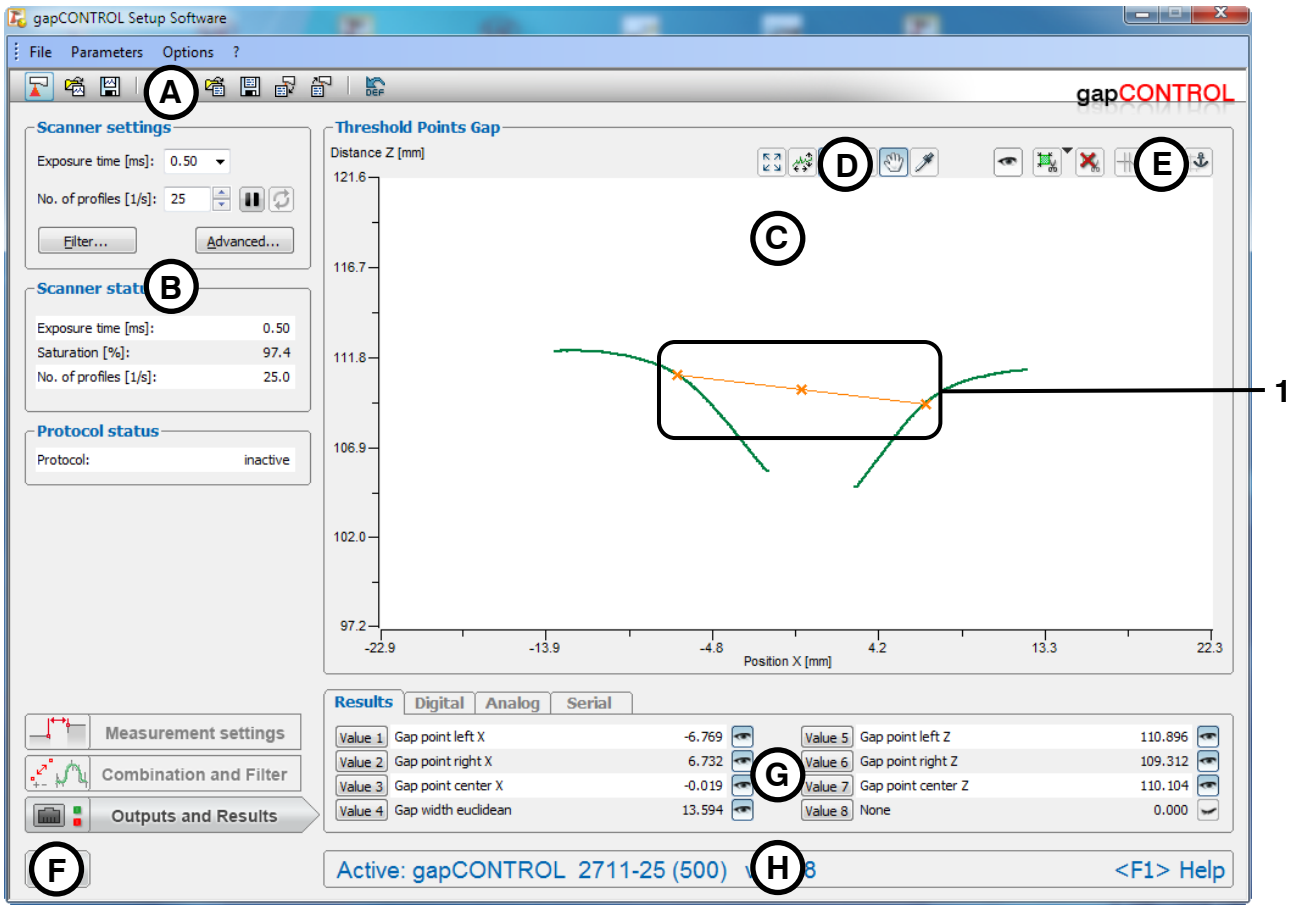


Fig. 4.8: "Threshold Points Gap" measuring program

Display elements and parameters in the "Threshold Points Gap" measuring program:

A **"General" toolbar:** Using this toolbar, you can select the data source (see Chapter 3.5), save profile sequences (see Chapter 3.6), save and load parameters (see Chapter 3.13.13) and reset the selected parameters to the default settings (see Chapter 3.13.16).

B **Scanner settings:** Change the settings of gapCONTROL with these values (see Chapter 3.7). In offline mode (see Chapter 3.5), this input field is replaced by the "File settings" input field, which enables you to control the playback process of a profile sequence loaded from a file (see Chap-

ter 3.10).

C **2D-display:** This display shows the last measured profile, the measuring ranges and measurement results.

D **"Display" toolbar:** Using this toolbar, you can scale the 2D-display and activate various options for mouse interaction (see Chapter 3.16).

E **Measurement toolbar:** You can set the various search areas and limits for measurement using this toolbar (see Chapter 3.17).

F "**Navigation**" **button:** Click on this button in order to show the "Navigation" menu (see Chapter 3.18).

G **Configuration of the measured values:** In this field, you can specify the measurement algorithms, make settings to combine and filter the measured values and select the results that appear in the 2D-display. Select the measured values to be output at the available interfaces (see Chapter 1.2) of gapCONTROL (see Chapter 5).

H **Status line:** Status and error messages are displayed on the status line (see Chapter 8.1).

1 **Display of the detected gap:** In the 2D-display, the gap determined by the measuring program is displayed.

The measuring program outputs the following measured values:

- **Gap point left X [mm]** : The X coordinate of the start point of the detected gap
- **Gap point left Z [mm]** : The Z coordinate of the start point of the detected gap
- **Gap point center X [mm]** : The X coordinate of the center point of the detected gap
- **Gap point center Z [mm]** : The Z coordinate of the center point of the detected gap
- **Gap point right X [mm]** : The X coordinate of the end point of the detected gap
- **Gap point right Z [mm]** : The Z coordinate of the end point of the detected gap
- **Gap width X [mm]** : The width of the detected gap in the X direction.
- **Gap width Z [mm]** : The width of the detected gap in the Z direction.
- **Gap width euclidian [mm]** : The euclidean width of the detected gap.
- **Flush [mm]** : Flushness (see Chapter 3.13.8).

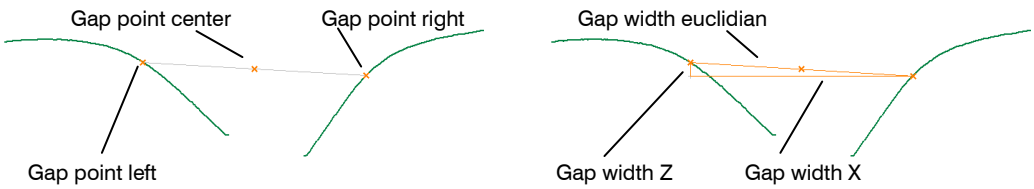


Fig. 4.9: "Threshold Points Gap" measured values

Additionally, combined and filtered measured values are available (see Chapters 5.1 and 5.2).

Note: You can switch from the current program to the "Advanced Basic Gap" program (see Chapter 4.4.1) in order to use advanced setting options and measured values. To do this, use the navigation menu (see Chapter 3.18).

4.2 "Projected Gap" Group

This group contains the programs for measuring the characteristics of gap that is defined by different projection types.

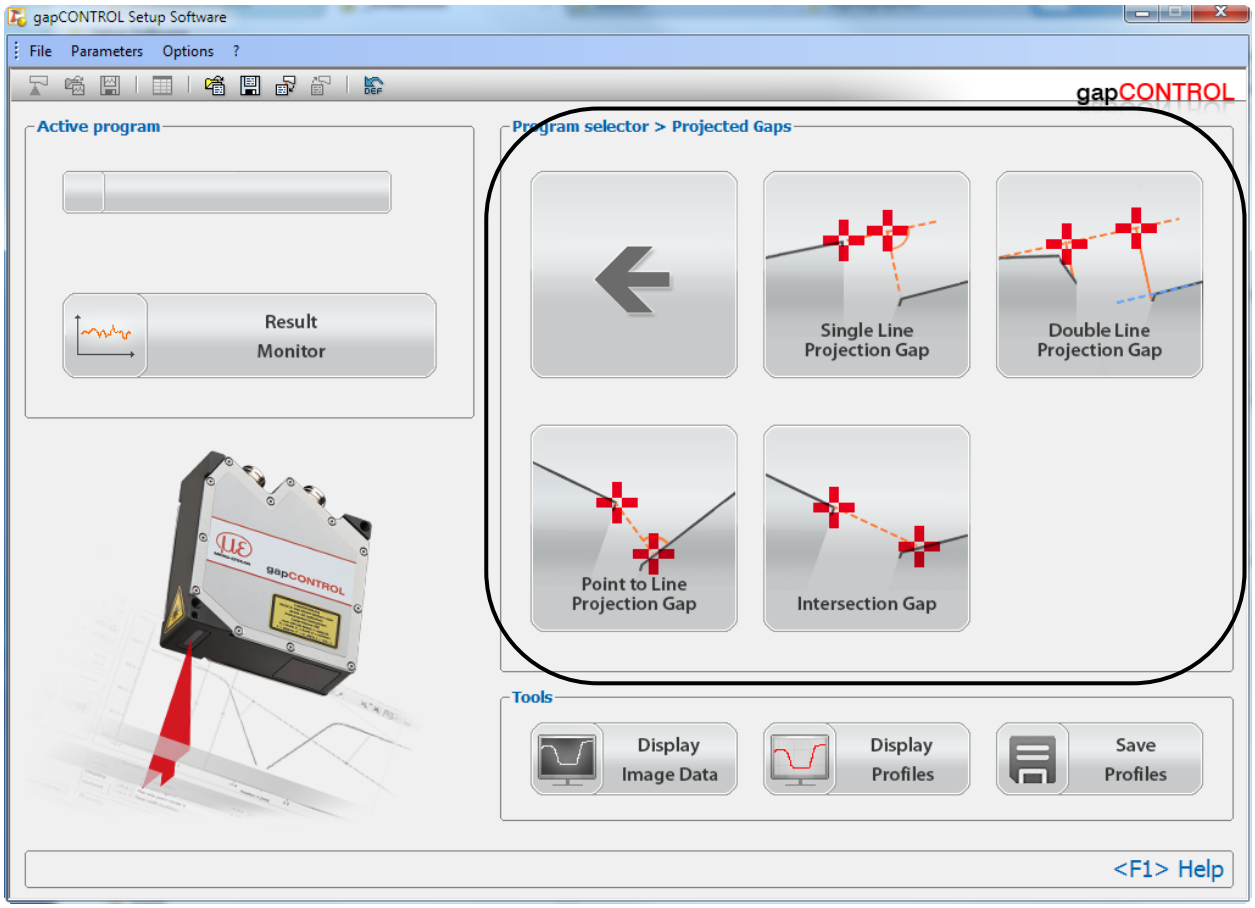


Fig. 4.10: "Projected Gaps" group

Measuring programs:

- **Single Line Projection Gap:** The gap is defined by the projection of the inner edge points onto a straight line.
- **Double Line Projection Gap:** The gap is defined by the projection of the inner edge points onto one of two parallel straight lines.
- **Point to Line Projection Gap:** The gap is defined by an inner edge point and its projection onto a straight line.
- **Intersection Gap:** The gap is defined by the intersection of two straight lines and the projection of an inner edge point.

Refer to the following chapters for more detailed descriptions of the different measuring programs.

4.2.1 "Single Line Projection Gap" Measuring Program

Use the "Single Line Projection" measuring program to determine the characteristics of a simple gap. The gap is defined by the projection of the inner edge points onto a straight line.

The program first determines the largest gap in the profile (the so-called "base gap"). Starting from the base gap, the start and end points of the gap in the left and right sections of the profile are determinated as follows:

- Start point: Projection of the last point of the left profile section onto a straight line.
- End point: Projection of the first point of the right profile section onto a straight line.

Proceed as follows:

- Configure the gapCONTROL measuring system ("Scanner settings" input field, see Chapter 3.7).
- If necessary, limit the measuring range in order to eliminate any interference points (see Chapter 3.13.1).
- Set the minimum width and alignment of the gap (see Chapter 3.13.4).
- Set the algorithm for determining the projection (see Chapter 3.13.9).
- If necessary, activate dynamic tracking of the ranges for cutting out and line fitting (see Chapter 3.13.10).

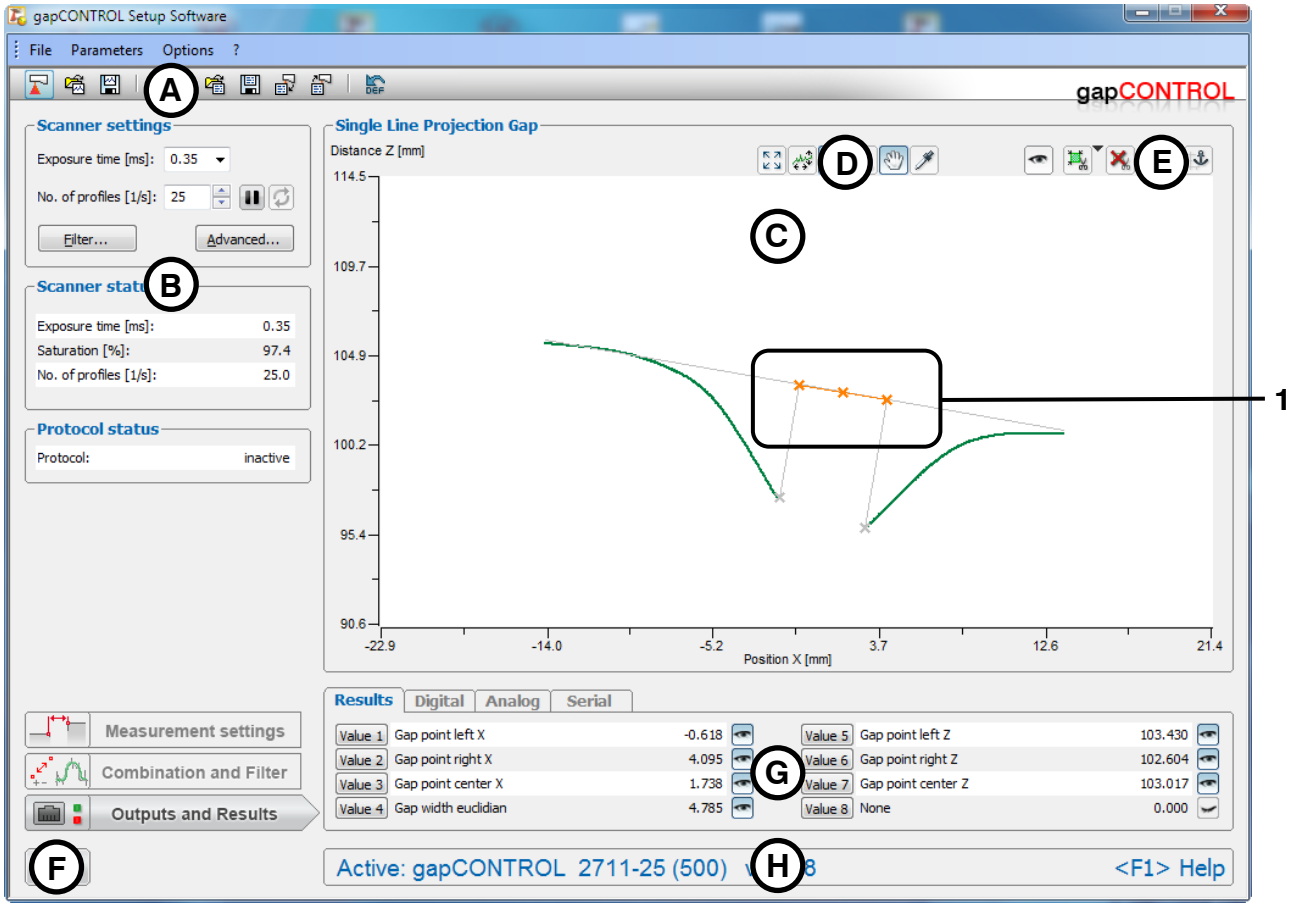


Fig. 4.11: "Single Line Projection Gap" measuring program

Display elements and parameters in the "Single Line Projection Gap" measuring program:

A **"General" toolbar:** Using this toolbar, you can select the data source (see Chapter 3.5), save profile sequences (see Chapter 3.6), save and load parameters (see Chapter 3.13.13) and reset the selected parameters to the default settings (see Chapter 3.13.16).

B **Scanner settings:** Change the settings of gapCONTROL with these values (see Chapter 3.7). In offline mode (see Chapter 3.5), this input field is replaced by the "File settings" input field, which enables you to control the playback process of a profile sequence loaded from a file (see Chapter 3.10).

C **2D-display:** This display shows the last measured profile, the measuring ranges and measurement results.

D **"Display" toolbar:** Using this toolbar, you can scale the 2D-display and activate various options for mouse interaction (see Chapter 3.16).

E **Measurement toolbar:** You can set the various search areas and limits for measurement using this toolbar (see Chapter 3.17).

F **"Navigation" button:** Click on this button in order to show the "Navigation" menu (see Chapter 3.18).

G **Configuration of the measured values:** In this field, you can specify the measurement algorithms, make settings to combine and filter the measured values and select the results that appear in the 2D-display. Select the measured values to be output at the available interfaces (see Chapter 1.2) of gapCONTROL (see Chapter 5).

H **Status line:** Status and error messages are displayed on the status line (see Chapter 8.1).

1 **Display of the detected gap:** In the 2D-display, the gap determined by the measuring program is displayed.

The measuring program outputs the following measured values:

- **Gap point left X [mm]** : The X coordinate of the start point of the detected gap
- **Gap point left Z [mm]** : The Z coordinate of the start point of the detected gap
- **Gap point center X [mm]** : The X coordinate of the center point of the detected gap
- **Gap point center Z [mm]** : The Z coordinate of the center point of the detected gap
- **Gap point right X [mm]** : The X coordinate of the end point of the detected gap
- **Gap point right Z [mm]** : The Z coordinate of the end point of the detected gap
- **Gap width X [mm]** : The width of the detected gap in the X direction.
- **Gap width Z [mm]** : The width of the detected gap in the Z direction.
- **Gap width euclidian [mm]** : The euclidean width of the detected gap.

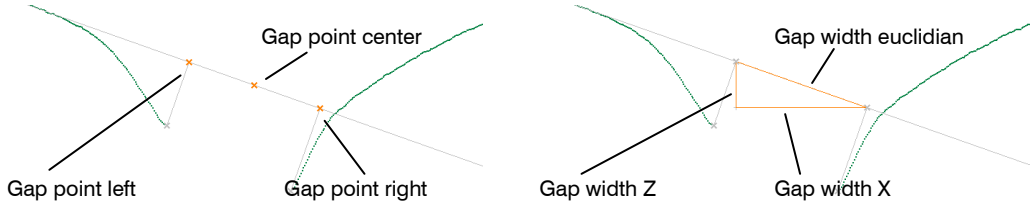


Fig. 4.12: "Single Line Projection Gap" measured values

Additionally, combined and filtered measured values are available (see Chapters 5.1 and 5.2).

Note: You can switch from the current program to the "Advanced Projected Gap" program (see Chapter 4.4.2) in order to use advanced setting options and measured values. To do this, use the navigation menu (see Chapter 3.18).

4.2.2 "Double Line Projection Gap" Measuring Program

Use the "Double Line Projection" measuring program to determine the characteristics of a simple gap. The gap is defined by the projection of the inner edge points onto one of two parallel straight lines.

The program first determines the largest gap in the profile (the so-called "base gap"). Starting from the base gap, the start and end points of the gap in the left and right sections of the profile are determinated as follows:

- Start point: Projection of the last point of the left profile section onto one of two parallel straight lines.
- End point: Projection of the first point of the right profile section onto one of two parallel straight lines.

Proceed as follows:

- Configure the gapCONTROL measuring system ("Scanner settings" input field, see Chapter 3.7).
- If necessary, limit the measuring range in order to eliminate any interference points (see Chapter 3.13.1).
- Set the minimum width and alignment of the gap (see Chapter 3.13.4).
- Set the algorithm for determining the projection (see Chapter 3.13.9).
- If necessary, activate dynamic tracking of the ranges for cutting out and line fitting (see Chapter 3.13.10).

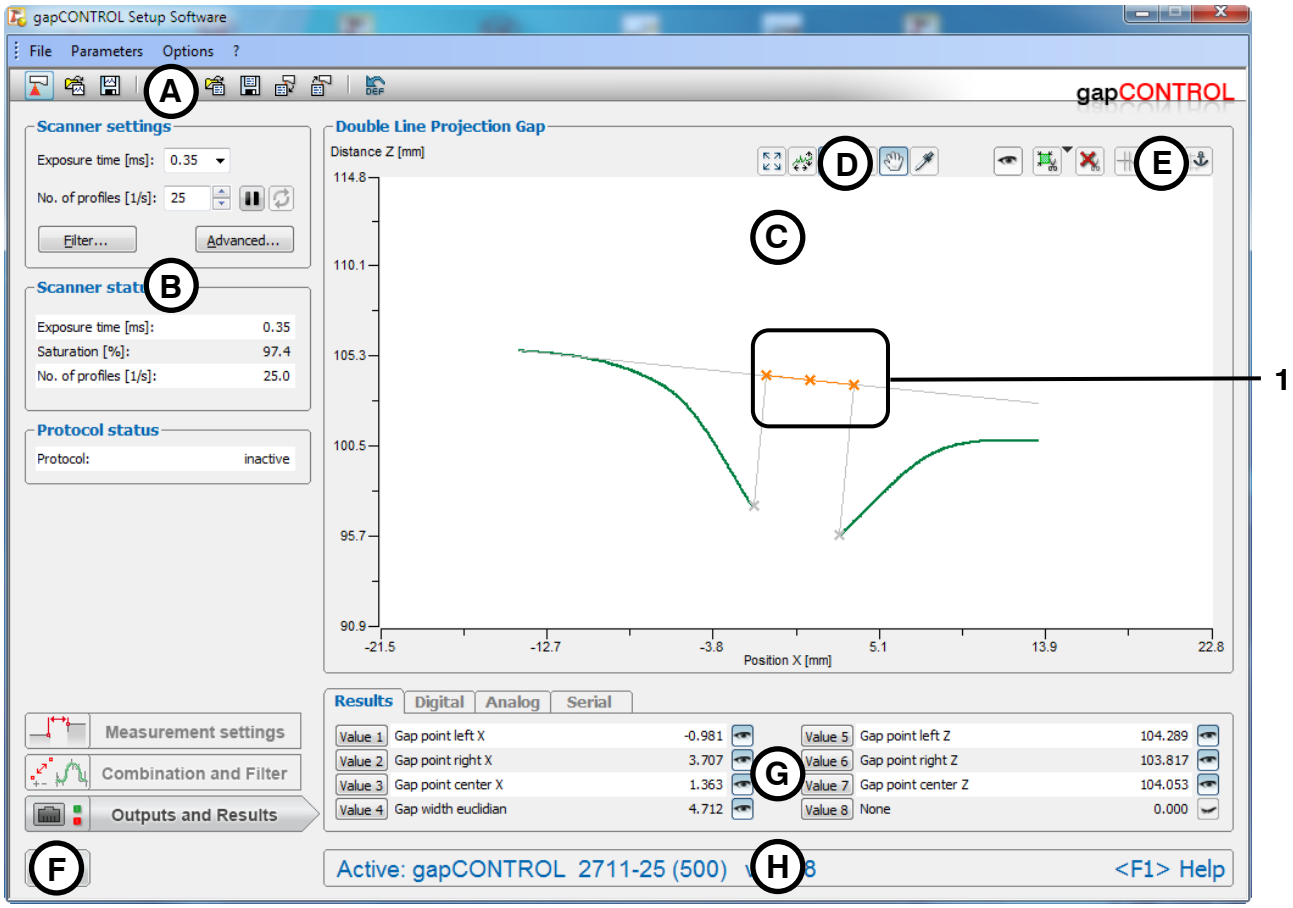


Fig. 4.13: "Double Line Projection Gap" measuring program

Display elements and parameters in the "Double Line Projection Gap" measuring program:

A **"General" toolbar:** Using this toolbar, you can select the data source (see Chapter 3.5), save profile sequences (see Chapter 3.6), save and load parameters (see Chapter 3.13.13) and reset the selected parameters to the default settings (see Chapter 3.13.16).

B **Scanner settings:** Change the settings of gapCONTROL with these values (see Chapter 3.7). In offline mode (see Chapter 3.5), this input field is replaced by the "File settings" input field, which enables you to control the playback process of a profile sequence loaded from a file (see Chapter 3.10).

C **2D-display:** This display shows the last measured profile, the measuring ranges and measurement results.

D **"Display" toolbar:** Using this toolbar, you can scale the 2D-display and activate various options for mouse interaction (see Chapter 3.16).

E **Measurement toolbar:** You can set the various search areas and limits for measurement using this toolbar (see Chapter 3.17).

F "**Navigation**" **button:** Click on this button in order to show the "Navigation" menu (see Chapter 3.18).

G **Configuration of the measured values:** In this field, you can specify the measurement algorithms, make settings to combine and filter the measured values and select the results that appear in the 2D-display. Select the measured values to be output at the available interfaces (see Chapter 1.2) of gapCONTROL (see Chapter 5).

H **Status line:** Status and error messages are displayed on the status line (see Chapter 8.1).

1 **Display of the detected gap:** In the 2D-display, the gap determined by the measuring program is displayed.

The measuring program outputs the following measured values:

- **Gap point left X [mm]** : The X coordinate of the start point of the detected gap
- **Gap point left Z [mm]** : The Z coordinate of the start point of the detected gap
- **Gap point center X [mm]** : The X coordinate of the center point of the detected gap
- **Gap point center Z [mm]** : The Z coordinate of the center point of the detected gap
- **Gap point right X [mm]** : The X coordinate of the end point of the detected gap
- **Gap point right Z [mm]** : The Z coordinate of the end point of the detected gap
- **Gap width X [mm]** : The width of the detected gap in the X direction.
- **Gap width Z [mm]** : The width of the detected gap in the Z direction.
- **Gap width euclidian [mm]** : The euclidean width of the detected gap.

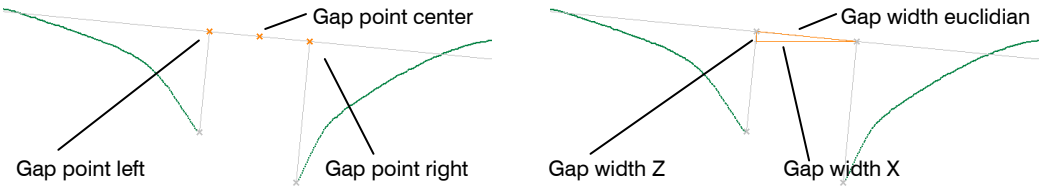


Fig. 4.14: "Double Line Projection Gap" measured values

Additionally, combined and filtered measured values are available (see Chapters 5.1 and 5.2).

Note: You can switch from the current program to the "Advanced Projected Gap" program (see Chapter 4.4.2) in order to use advanced setting options and measured values. To do this, use the navigation menu (see Chapter 3.18).

4.2.3 "Point to Line Projection Gap" Measuring Program

Use the "Point to Line Projection Gap" measuring program to determine the characteristics of a simple gap. The gap is defined by an inner edge point and its projection onto a straight line.

The program first determines the largest gap in the profile (the so-called "base gap"). Starting from the base gap, the start and end points of the gap in the left and right sections of the profile are determinated as follows:

- "Point to line left" algorithm:
  - Start point: The last point of the left profile section.
  - End point: Projection of the last point of the left profile section onto a straight line.
- "Point to line right" algorithm:
  - Start point: The first point of the right profile section
  - End point: Projection of the first point of the right profile section onto a straight line.

Proceed as follows:

- Configure the gapCONTROL measuring system ("Scanner settings" input field, see Chapter 3.7).
- If necessary, limit the measuring range in order to eliminate any interference points (see Chapter 3.13.1).
- Set the minimum width and alignment of the gap (see Chapter 3.13.4).
- Set the algorithm for determining the projection (see Chapter 3.13.9).
- If necessary, activate dynamic tracking of the ranges for cutting out and line fitting (see Chapter 3.13.10).

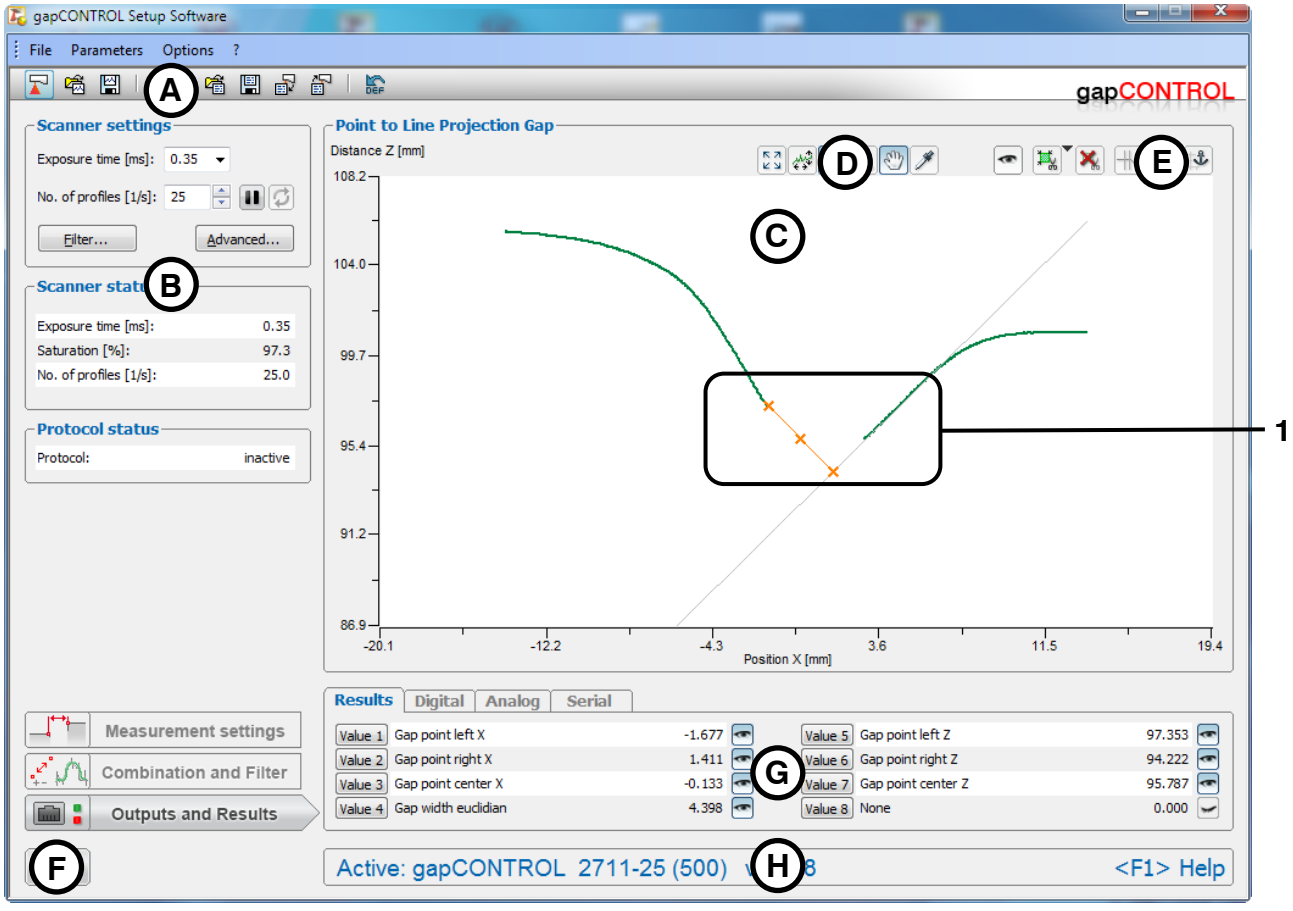


Fig. 4.15: "Point to Line Projection Gap" measuring program ("Point to Line left" algorithm)

Display elements and parameters in the "Point to Line Projection Gap" measuring program:

A **"General" toolbar:** Using this toolbar, you can select the data source (see Chapter 3.5), save profile sequences (see Chapter 3.6), save and load parameters (see Chapter 3.13.13) and reset the selected parameters to the default settings (see Chapter 3.13.16).

B **Scanner settings:** Change the settings of gapCONTROL with these values (see Chapter 3.7). In offline mode (see Chapter 3.5), this input field is replaced by the "File settings" input field, which enables you to control the playback process of a profile sequence loaded from a file (see Chapter 3.10).

C **2D-display:** This display shows the last measured profile, the measuring ranges and measurement results.

D **"Display" toolbar:** Using this toolbar, you can scale the 2D-display and activate various options for mouse interaction (see Chapter 3.16).

E **Measurement toolbar:** You can set the various search areas and limits for measurement using this toolbar (see Chapter 3.17).

F **"Navigation" button:** Click on this button in order to show the "Navigation" menu (see Chapter 3.18).

G **Configuration of the measured values:** In this field, you can specify the measurement algorithms, make settings to combine and filter the measured values and select the results that appear in the 2D-display. Select the measured values to be output at the available interfaces (see Chapter 1.2) of gapCONTROL (see Chapter 5).

H **Status line:** Status and error messages are displayed on the status line (see Chapter 8.1).

1 **Display of the detected gap:** In the 2D-display, the gap determined by the measuring program is displayed.

The measuring program outputs the following measured values:

- **Gap point left X [mm]** : The X coordinate of the start point of the detected gap
- **Gap point left Z [mm]** : The Z coordinate of the start point of the detected gap
- **Gap point center X [mm]** : The X coordinate of the center point of the detected gap
- **Gap point center Z [mm]** : The Z coordinate of the center point of the detected gap
- **Gap point right X [mm]** : The X coordinate of the end point of the detected gap
- **Gap point right Z [mm]** : The Z coordinate of the end point of the detected gap
- **Gap width X [mm]** : The width of the detected gap in the X direction.
- **Gap width Z [mm]** : The width of the detected gap in the Z direction.
- **Gap width euclidian [mm]** : The euclidean width of the detected gap.

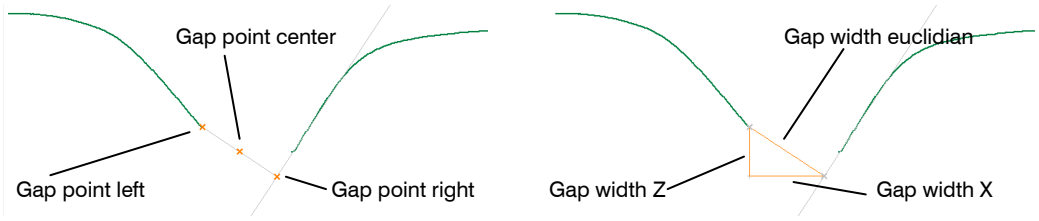


Fig. 4.16: "Point to Line Projection Gap" measured values

Additionally, combined and filtered measured values are available (see Chapters 5.1 and 5.2).

Note: You can switch from the current program to the "Advanced Projected Gap" program (see Chapter 4.4.2) in order to use advanced setting options and measured values. To do this, use the navigation menu (see Chapter 3.18).

4.2.4 "Intersection Gap" Measuring Program

Use the "Intersection Gap" measuring program to determine the characteristics of a simple gap. The gap is defined by the intersection of two straight lines and the projection of an inner edge point.

The program first determines the largest gap in the profile (the so-called "base gap"). Starting from the base gap, the start and end points of the gap in the left and right sections of the profile are determinated as follows:

- "Intersection left" algorithm:
  - Start point: Projection of the last point of the left profile section onto a straight line.
  - End point: The intersection point of two straight lines.
- "Intersection right" algorithm:
  - Start point: The intersection point of two straight lines.
  - End point: Projection of the first point of the right profile section onto a straight line.

Proceed as follows:

- Configure the gapCONTROL measuring system ("Scanner settings" input field, see Chapter 3.7).
- If necessary, limit the measuring range in order to eliminate any interference points (see Chapter 3.13.1).
- Set the minimum width and alignment of the gap (see Chapter 3.13.4).
- Set the algorithm for determining the projection (see Chapter 3.13.9).
- If necessary, activate dynamic tracking of the ranges for cutting out and line fitting (see Chapter 3.13.10).

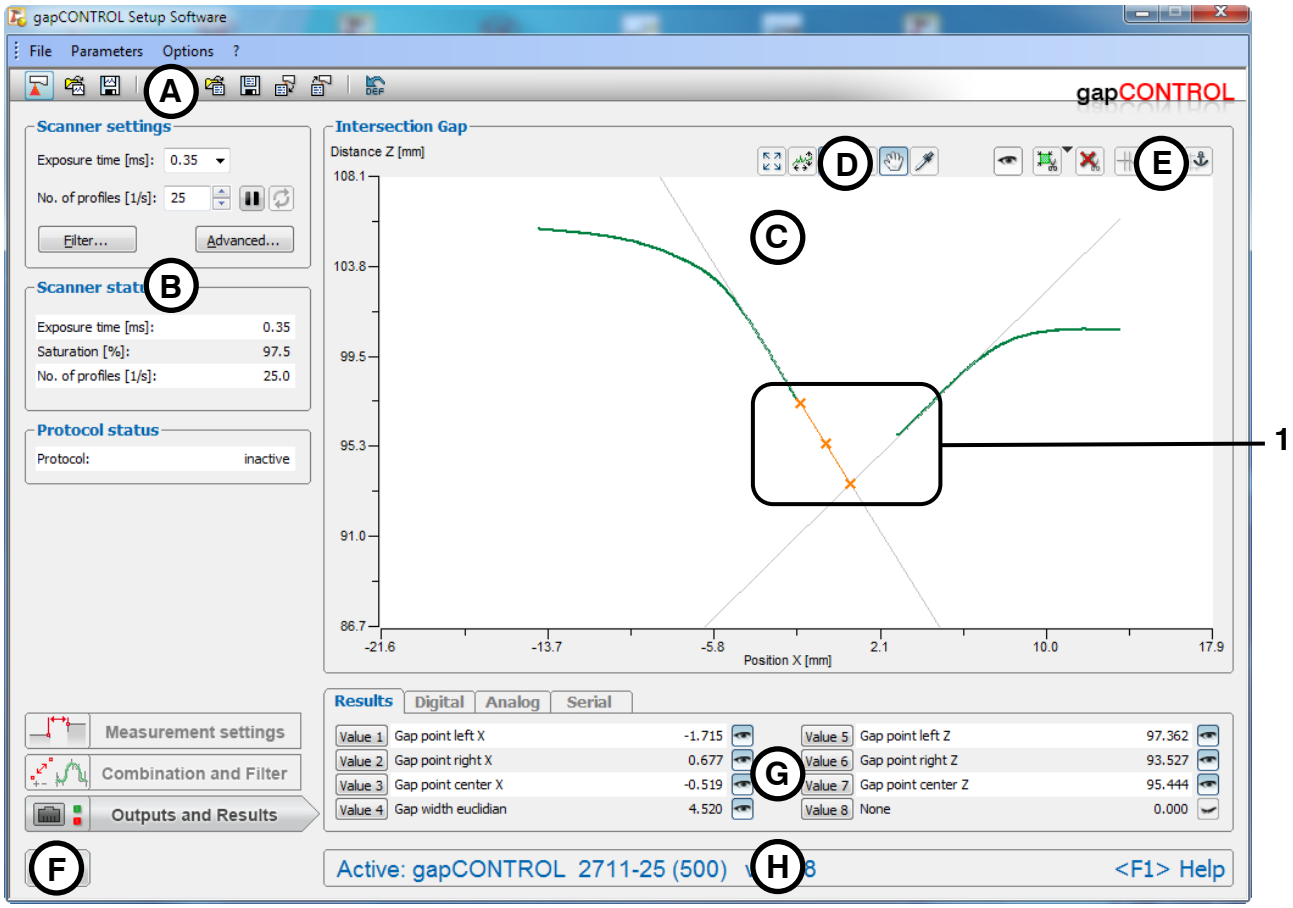


Fig. 4.17: "Intersection Gap" measuring program ("Intersection left" algorithm)

Display elements and parameters in the "Intersection Gap" measuring program:

A **"General" toolbar:** Using this toolbar, you can select the data source (see Chapter 3.5), save profile sequences (see Chapter 3.6), save and load parameters (see Chapter 3.13.13) and reset the selected parameters to the default settings (see Chapter 3.13.16).

B **Scanner settings:** Change the settings of gapCONTROL with these values (see Chapter 3.7). In offline mode (see Chapter 3.5), this input field is replaced by the "File settings" input field, which en-

ables you to control the playback process of a profile sequence loaded from a file (see Chapter 3.10).

C **2D-display:** This display shows the last measured profile, the measuring ranges and measurement results.

D **"Display" toolbar:** Using this toolbar, you can scale the 2D-display and activate various options for mouse interaction (see Chapter 3.16).

E **Measurement toolbar:** You can set the various search areas and limits for measurement using this toolbar (see Chapter 3.17).

F **"Navigation" button:** Click on this button in order to show the "Navigation" menu (see Chapter 3.18).

G **Configuration of the measured values:** In this field, you can specify the measurement algorithms, make settings to combine and filter the measured values and select the results that appear in the 2D-display. Select the measured values to be output at the available interfaces (see Chapter 1.2) of gapCONTROL (see Chapter 5).

H **Status line:** Status and error messages are displayed on the status line (see Chapter 8.1).

1 **Display of the detected gap:** In the 2D-display, the gap determined by the measuring program is displayed.

The measuring program outputs the following measured values:

- **Gap point left X [mm]** : The X coordinate of the start point of the detected gap
- **Gap point left Z [mm]** : The Z coordinate of the start point of the detected gap
- **Gap point center X [mm]** : The X coordinate of the center point of the detected gap
- **Gap point center Z [mm]** : The Z coordinate of the center point of the detected gap
- **Gap point right X [mm]** : The X coordinate of the end point of the detected gap
- **Gap point right Z [mm]** : The Z coordinate of the end point of the detected gap
- **Gap width X [mm]** : The width of the detected gap in the X direction
- **Gap width Z [mm]** : The width of the detected gap in the Z direction
- **Gap width euclidian [mm]** : The euclidean width of the detected gap

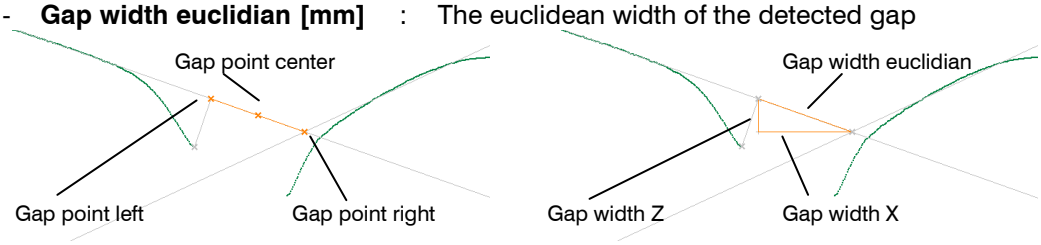


Fig. 4.18: "Intersection Gap" measured values

Additionally, combined and filtered measured values are available (see Chapters 5.1 and 5.2).

Note: You can switch from the current program to the "Advanced Projected Gap" program (see Chapter 4.4.2) in order to use advanced setting options and measured values. To do this, use the navigation menu (see Chapter 3.18).

4.3 "Groove Gaps" Group

This group contains the programs for measuring the characteristics of a V-shaped gap.

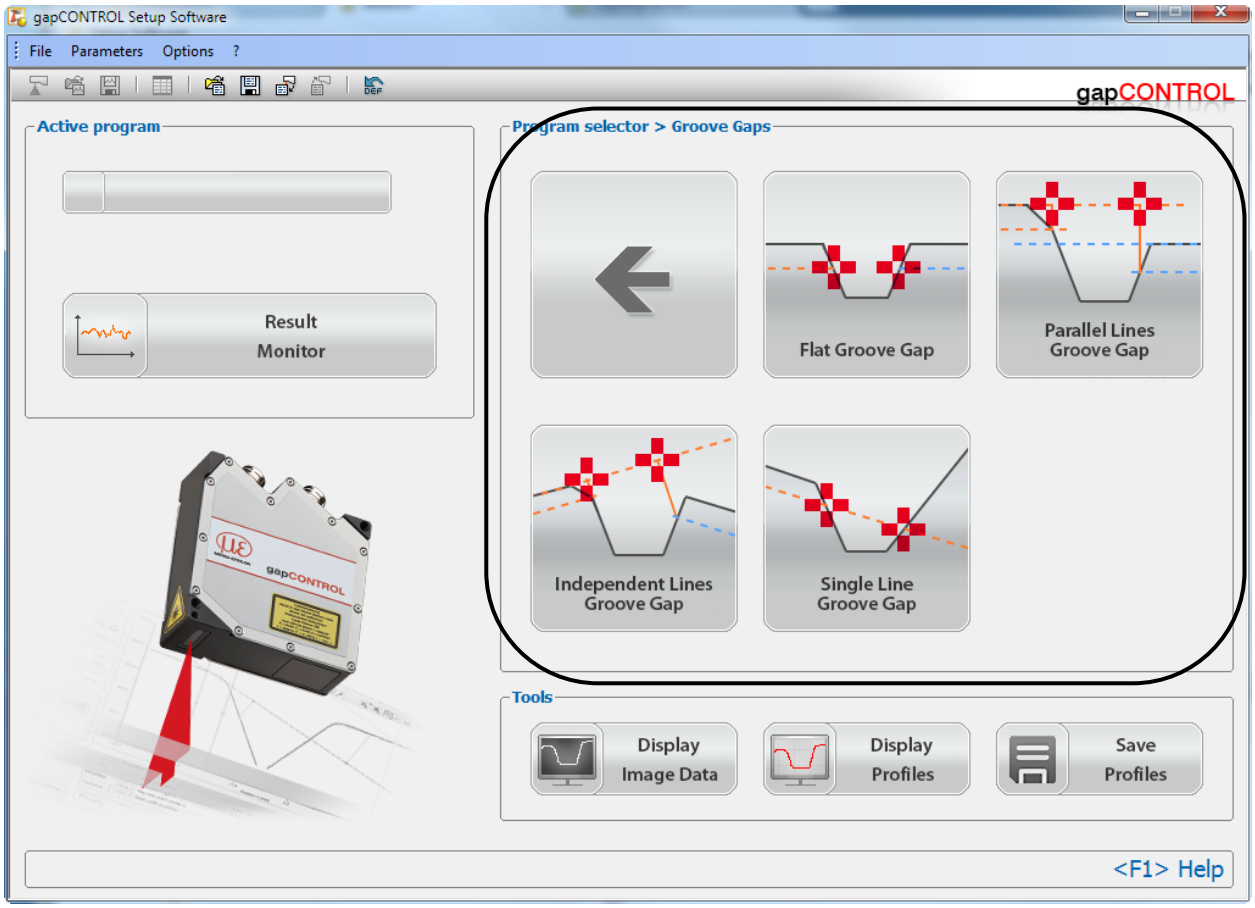


Fig. 4.19: "Groove Gaps" Group

Measuring programs:

- **Flat Groove Gap:** Measurement of a gap with flat edges.
- **Parallel Lines Groove Gap:** Measurement of a gap with parallel edges.
- **Independent Lines Groove Gap:** Measurement of a gap with independent edges.
- **Single Line Groove Gap:** Measurement of a gap with one edge.

Refer to the following chapters for more detailed descriptions of the different measuring programs.

4.3.1 "Flat Groove Gap" Measuring Program

Use the "Flat Groove Gap" measuring program to determine the characteristics of a V-shaped gap with flat edges. The program first determines one reference line, which is determined by a line fitting. The reference line is fitted to the profile points from the left and right reference range. A minimum depth (the so-called "threshold") is specified relative to the reference line. The gap points are calculated as the intersection points between the threshold line and the profile.

Proceed as follows:

- Configure the gapCONTROL measuring system („Scanner settings“ input field, see Chapter 3.7).
- If necessary, limit the measuring range in order to eliminate any interference points (see Chapter 3.13.1).
- Set the ranges for reference line fitting (see Chapter 3.13.6).
- Set the thresholds in order to calculate the gap points (see Chapter 3.13.7).
- If necessary, activate dynamic tracking of the ranges for cutting out and line fitting (see Chapter 3.13.10).

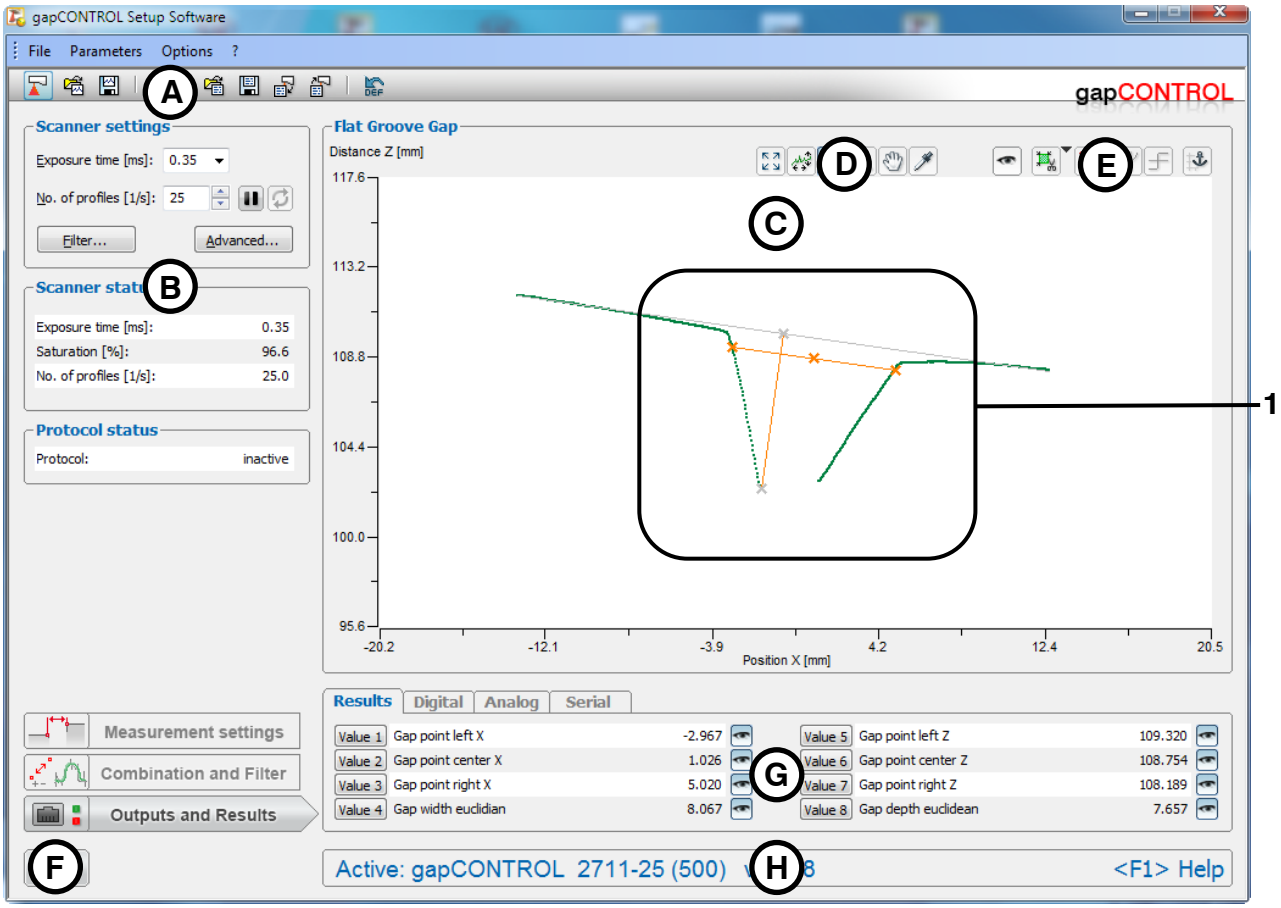


Fig. 4.20: "Flat Groove Gap" measuring program

Display elements and parameters in the "Flat Groove Gap Gap" measuring program:

A **"General" toolbar:** Using this toolbar, you can select the data source (see Chapter 3.5), save profile sequences (see Chapter 3.6), save and load parameters (see Chapter 3.13.13) and reset the selected parameters to the default settings (see Chapter 3.13.16).

B **Scanner settings:** Change the settings of gapCONTROL with these values (see Chapter 3.7). In offline mode (see Chapter 3.5), this input field is replaced by the "File settings" input field, which enables you to control the playback process of a profile sequence loaded from a file (see Chapter 3.10).

C **2D-display:** This display shows the last measured profile, the measuring ranges and measurement results.

D **"Display" toolbar:** Using this toolbar, you can scale the 2D-display and activate various options for mouse interaction (see Chapter 3.16).

E **Measurement toolbar:** You can set the various search areas and limits for measurement using this toolbar (see Chapter 3.17).

F **"Navigation" button:** Click on this button in order to show the "Navigation" menu (see Chapter 3.18).

G **Configuration of the measured values:** In this field, you can specify the measurement algorithms, make settings to combine and filter the measured values and select the results that appear in the 2D-display. Select the measured values to be output at the available interfaces (see Chapter 1.2) of gapCONTROL (see Chapter 5).

H **Status line:** Status and error messages are displayed on the status line (see Chapter 8.1).

1 **Display of the detected gap:** In the 2D-display, the gap determined by the measuring program is displayed.

The measuring program outputs the following measured values:

- **Gap point left X [mm]** : The X coordinate of the start point of the determined gap
- **Gap point left Z [mm]** : The Z coordinate of the start point of the determined gap
- **Gap point center X [mm]** : The X coordinate of the center point of the detected gap
- **Gap point center Z [mm]** : The Z coordinate of the center point of the detected gap
- **Gap point right X [mm]** : The X coordinate of the end point of the detected gap
- **Gap point right Z [mm]** : The Z coordinate of the end point of the detected gap
- **Gap width X [mm]** : The width of the detected gap in the X direction
- **Gap width Z [mm]** : The width of the detected gap in the Z direction
- **Gap width euclidian [mm]** : The euclidean width of the detected gap
- **Gap depth euclidian [mm]** : The euclidean depth of the detected gap

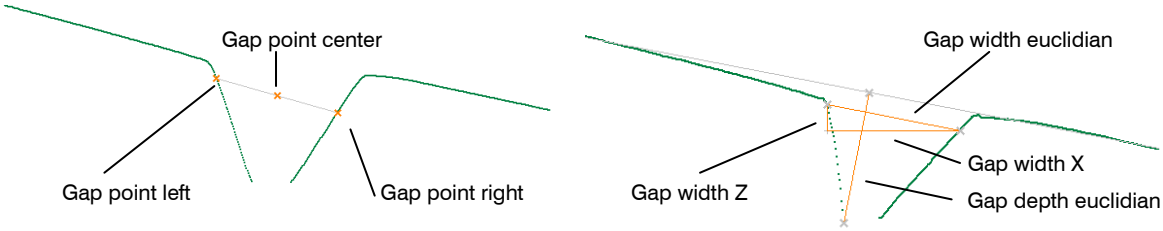


Fig. 4.21: "Flat Groove Gap" meaured values, "Gap" group

Additionally, combined and filtered measured values are available (see Chapters 5.1 and 5.2).

Note: You can switch from the current program to the "Advanced Groove Gap" program (see Chapter 4.4.3) in order to use advanced setting options and measured values. To do this, use the navigation menu (see Chapter 3.18).

4.3.2 "Parallel Lines Groove Gap" Measuring Program

Use the "Parallel Lines Groove Gap" measuring program to determine the characteristics of a V-shaped gap with paralle edges. The program first determines two parallel reference lines, which are determined by a line fitting. The reference lines are fitted to the profile points from the left and right reference ranges. The direction vector for both reference lines is calculated from the points of the two ranges. The offsets of the reference lines are calculated from the points of the two respective ranges. A minimum depth (the so-called "threshold") is specified relative to each reference line. The gap points are calculated as the intersection points between the threshold lines and the profile.

Proceed as follows:

- Configure the gapCONTROL measuring system („Scanner settings“ input field, see Chapter 3.7).
- If necessary, limit the measuring range in order to eliminate any interference points (see Chapter 3.13.1).
- Set the ranges for reference line fitting (see Chapter 3.13.6).
- Set the thresholds in order to calculate the gap points (see Chapter 3.13.7).
- Set the algorithm of projection (see Chapter 3.13.9).
- If necessary, activate dynamic tracking of the ranges for cutting out and line fitting (see Chapter 3.13.10).

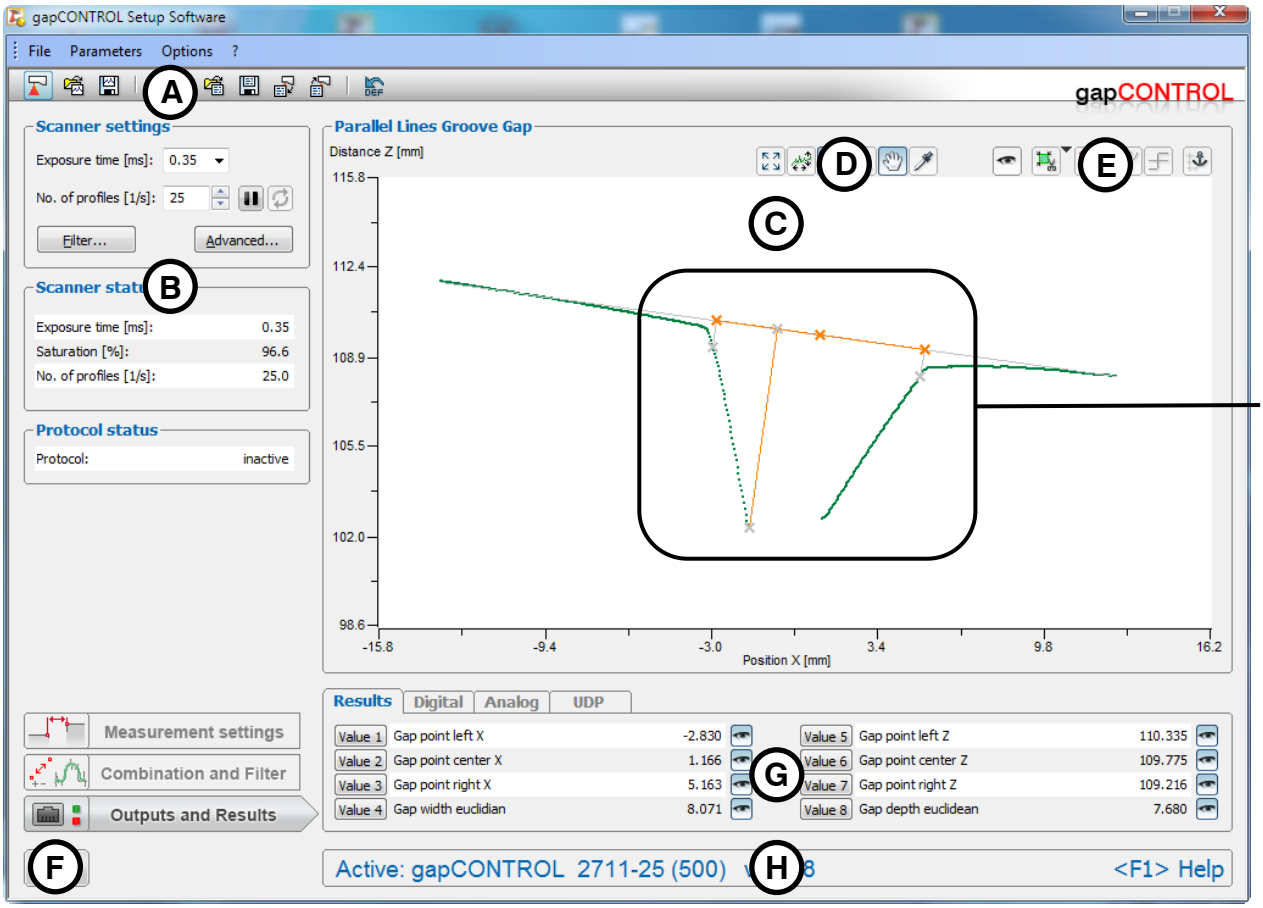


Fig. 4.22: "Parallel Lines Groove Gap" measuring program

Display elements and parameters in the "Parallel Lines Groove Gap" measuring program:

A **"General" toolbar:** Using this toolbar, you can select the data source (see Chapter 3.5), save profile sequences (see Chapter 3.6), save and load parameters (see Chapter 3.13.13) and reset the selected parameters to the default settings (see Chapter 3.13.16).

B **Scanner settings:** Change the settings of gapCONTROL with these values (see Chapter 3.7). In offline mode (see Chapter 3.5), this input field is replaced by the "File settings" input field, which enables you to control the playback process of a profile sequence loaded from a file (see Chapter 3.10).

C **2D-display:** This display shows the last measured profile, the measuring ranges and measurement results.

D **"Display" toolbar:** Using this toolbar, you can scale the 2D-display and activate various options for mouse interaction (see Chapter 3.16).

E **Measurement toolbar:** You can set the various search areas and limits for measurement using this toolbar (see Chapter 3.17).

F **"Navigation" button:** Click on this button in order to show the "Navigation" menu (see Chapter 3.18).

G **Configuration of the measured values:** In this field, you can specify the measurement algorithms, make settings to combine and filter the measured values and select the results that appear in the 2D-display. Select the measured values to be output at the available interfaces (see Chapter 1.2) of gapCONTROL (see Chapter 5).

H **Status line:** Status and error messages are displayed on the status line (see Chapter 8.1).

1 **Display of the detected gap:** In the 2D-display, the gap determined by the measuring program is displayed.

The measuring program outputs the following measured values:

- **Gap point left X [mm]** : The X coordinate of the start point of the determined gap
- **Gap point left Z [mm]** : The Z coordinate of the start point of the determined gap
- **Gap point center X [mm]** : The X coordinate of the center point of the detected gap
- **Gap point center Z [mm]** : The Z coordinate of the center point of the detected gap
- **Gap point right X [mm]** : The X coordinate of the end point of the detected gap
- **Gap point right Z [mm]** : The Z coordinate of the end point of the detected gap
- **Gap width X [mm]** : The width of the detected gap in the X direction
- **Gap width Z [mm]** : The width of the detected gap in the Z direction
- **Gap width euclidian [mm]** : The euclidean width of the detected gap
- **Gap depth euclidian [mm]** : The euclidean depth of the detected gap

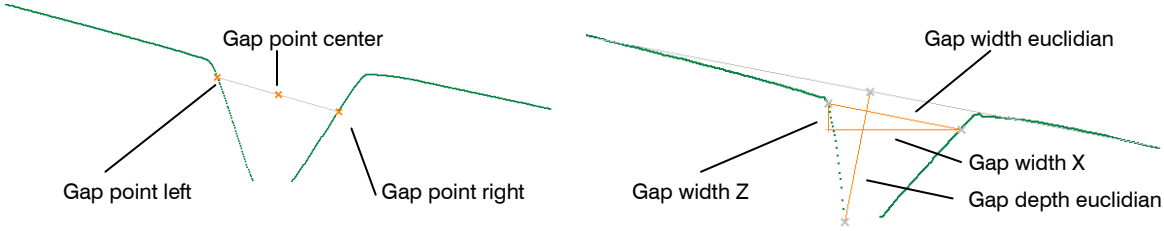


Fig. 4.23: "Parallel Lines Groove Gap" measured values, "Gap" group

- **Projection distance lines / flush [mm]** : The distance between the right projection line and the left one.

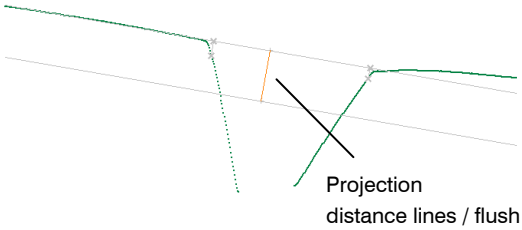


Fig. 4.24: Parallel Lines Groove Gap" measured values, "Projection" group

Additionally, combined and filtered measured values are available (see Chapters 5.1 and 5.2).

Note: You can switch from the current program to the "Advanced Groove Gap" program (see Chapter 4.4.3) in order to use advanced setting options and measured values. To do this, use the navigation menu (see Chapter 3.18).

4.3.3 "Independent Lines Groove Gap" Measuring Program

Use the "Independent Lines Groove Gap" measuring program to determine the characteristics of a V-shaped gap with independent edges. The program first determines two independent lines, which are determined by a line fitting. The reference lines are fitted to the profile points from the left and right reference ranges. A minimum depth (the so-called "threshold") is specified relative to each reference line. The gap points are calculated as the intersection points between the threshold lines and the profile.

Proceed as follows:

- Configure the gapCONTROL measuring system („Scanner settings“ input field, see Chapter 3.7).
- If necessary, limit the measuring range in order to eliminate any interference points (see Chapter 3.13.1).
- Set the ranges for reference line fitting (see Chapter 3.13.6).
- Set the thresholds in order to calculate the gap points (see Chapter 3.13.7).
- If necessary, activate dynamic tracking of the ranges for cutting out and line fitting (see Chapter 3.13.10).

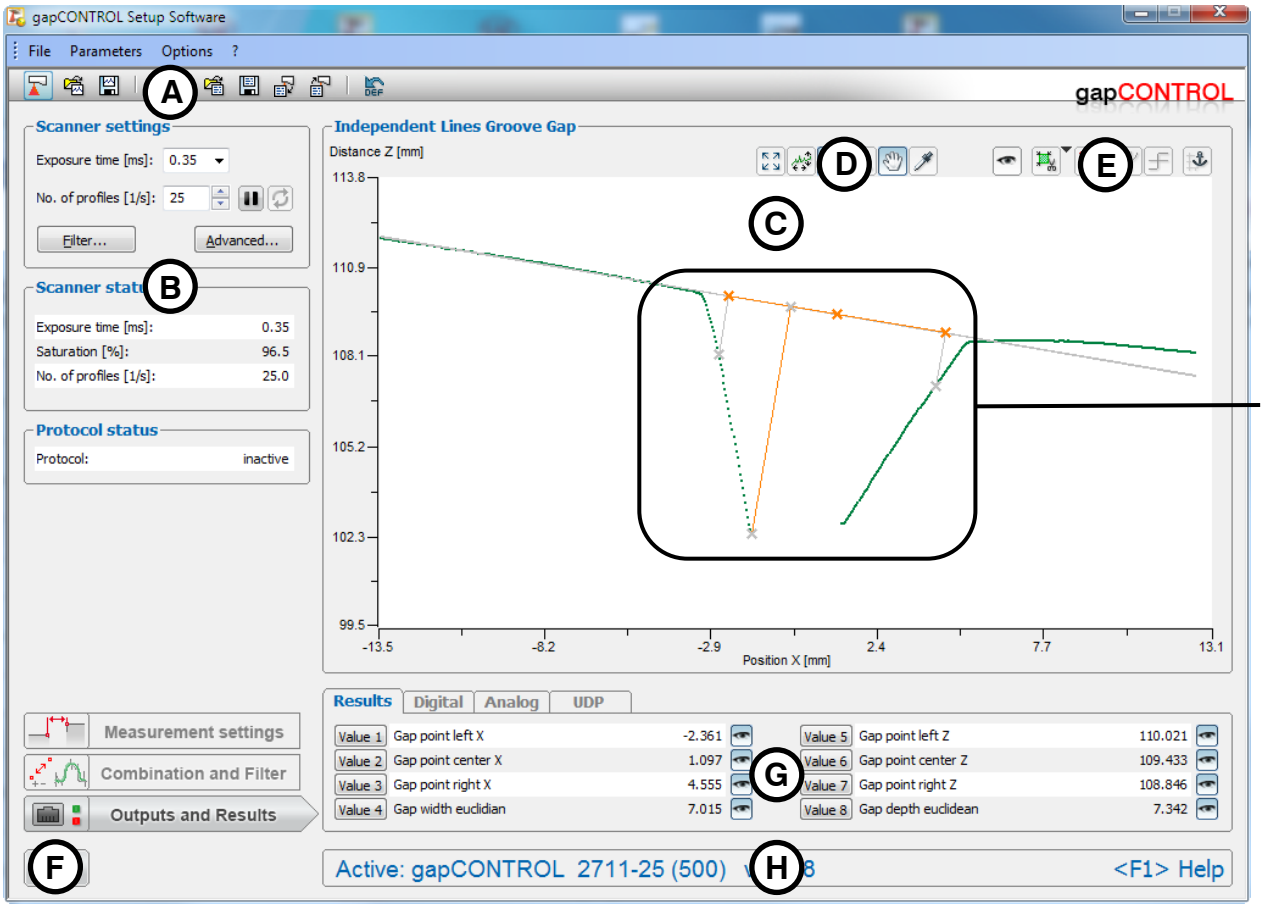


Fig. 4.25: "Independent Lines Groove Gap" measuring program

Display elements and parameters in the "Independent Lines Groove Gap" measuring program:

A **"General" toolbar:** Using this toolbar, you can select the data source (see Chapter 3.5), save profile sequences (see Chapter 3.6), save and load parameters (see Chapter 3.13.13) and reset the selected parameters to the default settings (see Chapter 3.13.16).

B **Scanner settings:** Change the settings of gapCONTROL with these values (see Chapter 3.7). In offline mode (see Chapter 3.5), this input field is replaced by the "File settings" input field, which enables you to control the playback process of a profile sequence loaded from a file (see Chapter 3.10).

C **2D-display:** This display shows the last measured profile, the measuring ranges and measurement results.

D **"Display" toolbar:** Using this toolbar, you can scale the 2D-display and activate various options for mouse interaction (see Chapter 3.16).

E **Measurement toolbar:** You can set the various search areas and limits for measurement using this toolbar (see Chapter 3.17).

F **"Navigation" button:** Click on this button in order to show the "Navigation" menu (see Chapter 3.18).

G **Configuration of the measured values:** In this field, you can specify the measurement algorithms, make settings to combine and filter the measured values and select the results that appear in the 2D-display. Select the measured values to be output at the available interfaces (see Chapter 1.2) of gapCONTROL (see Chapter 5).

H **Status line:** Status and error messages are displayed on the status line (see Chapter 8.1).

1 **Display of the detected gap:** In the 2D-display, the gap determined by the measuring program is displayed.

The measuring program outputs the following measured values:

- **Gap point left X [mm]** : The X coordinate of the start point of the determined gap
- **Gap point left Z [mm]** : The Z coordinate of the start point of the determined gap
- **Gap point center X [mm]** : The X coordinate of the center point of the detected gap
- **Gap point center Z [mm]** : The Z coordinate of the center point of the detected gap
- **Gap point right X [mm]** : The X coordinate of the end point of the detected gap
- **Gap point right Z [mm]** : The Z coordinate of the end point of the detected gap
- **Gap width X [mm]** : The width of the detected gap in the X direction
- **Gap width Z [mm]** : The width of the detected gap in the Z direction
- **Gap width euclidian [mm]** : The euclidean width of the detected gap
- **Gap depth euclidian [mm]** : The euclidean depth of the detected gap

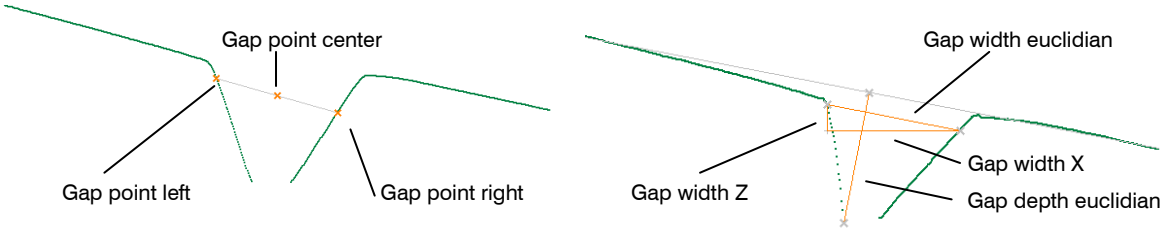


Fig. 4.26: "Independent Lines Groove Gap" measured values, "Gap" group

Additionally, combined and filtered measured values are available (see Chapters 5.1 and 5.2).

Note: You can switch from the current program to the "Advanced Groove Gap" program (see Chapter 4.4.3) in order to use advanced setting options and measured values. To do this, use the navigation menu (see Chapter 3.18).

4.3.4 "Single Line Groove Gap" Measuring Program

Use the "Single Line Groove Gap" measuring program to determine the characteristics of a V-shaped gap with a one edge. The program first determines one line, which is determined by a line fitting. The reference line is fitted to the profile points from the left or right reference range. A minimum depth (the so-called "threshold") is specified relative to the reference line. The gap points are calculated as the intersection points between the threshold line and the profile.

Proceed as follows:

- Configure the gapCONTROL measuring system („Scanner settings“ input field, see Chapter 3.7).
- If necessary, limit the measuring range in order to eliminate any interference points (see Chapter 3.13.1).
- Set the algorithm for determining the start and end points of the gap (see Chapter 3.13.5).
- Set the ranges for reference line fitting (see Chapter 3.13.6).
- Set the thresholds in order to calculate the gap points (see Chapter 3.13.7).
- If necessary, activate dynamic tracking of the ranges for cutting out and line fitting (see Chapter 3.13.10).

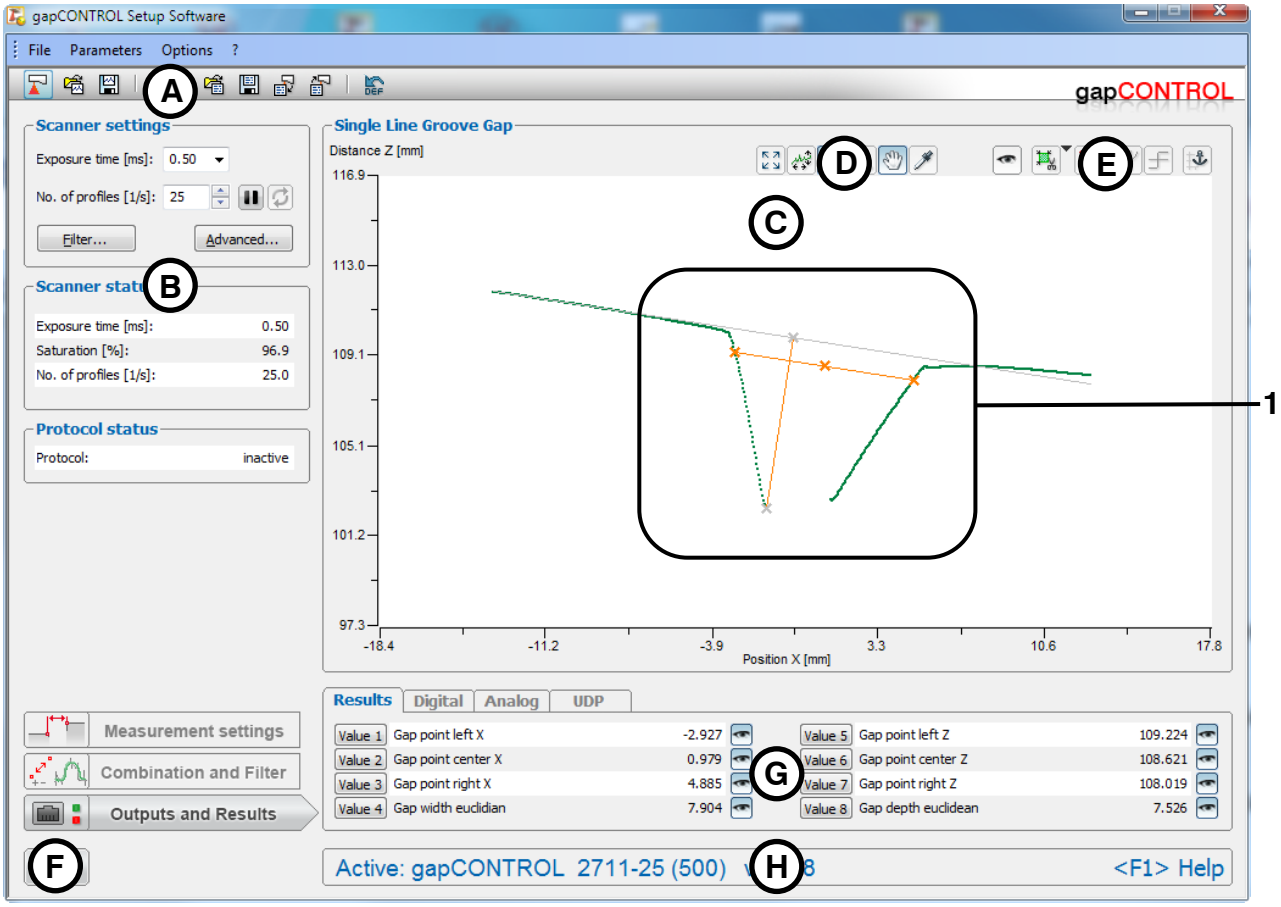


Fig. 4.27: "Single Line Groove Gap" measuring program

Display elements and parameters in the "Single Line Groove Gap" measuring program:

A **"General" toolbar:** Using this toolbar, you can select the data source (see Chapter 3.5), save profile sequences (see Chapter 3.6), save and load parameters (see Chapter 3.13.13) and reset the selected parameters to the default settings (see Chapter 3.13.16).

B **Scanner settings:** Change the settings of gapCONTROL with these values (see Chapter 3.7). In offline mode (see Chapter 3.5), this input field is replaced by the "File settings" input field, which enables you to control the playback process of a profile sequence loaded from a file (see Chapter 3.10).

C **2D-display:** This display shows the last measured profile, the measuring ranges and measurement results.

D **"Display" toolbar:** Using this toolbar, you can scale the 2D-display and activate various options for

mouse interaction (see Chapter 3.16).

E **Measurement toolbar:** You can set the various search areas and limits for measurement using this toolbar (see Chapter 3.17).

F **"Navigation" button:** Click on this button in order to show the "Navigation" menu (see Chapter 3.18).

G **Configuration of the measured values:** In this field, you can specify the measurement algorithms, make settings to combine and filter the measured values and select the results that appear in the 2D-display. Select the measured values to be output at the available interfaces (see Chapter 1.2) of gapCONTROL (see Chapter 5).

H **Status line:** Status and error messages are displayed on the status line (see Chapter 8.1).

1 **Display of the detected gap:** In the 2D-display, the gap determined by the measuring program is displayed.

The measuring program outputs the following measured values:

- **Gap point left X [mm]** : The X coordinate of the start point of the determined gap
- **Gap point left Z [mm]** : The Z coordinate of the start point of the determined gap
- **Gap point center X [mm]** : The X coordinate of the center point of the detected gap
- **Gap point center Z [mm]** : The Z coordinate of the center point of the detected gap
- **Gap point right X [mm]** : The X coordinate of the end point of the detected gap
- **Gap point right Z [mm]** : The Z coordinate of the end point of the detected gap
- **Gap width X [mm]** : The width of the detected gap in the X direction
- **Gap width Z [mm]** : The width of the detected gap in the Z direction
- **Gap width euclidian [mm]** : The euclidean width of the detected gap
- **Gap depth euclidian [mm]** : The euclidean depth of the detected gap

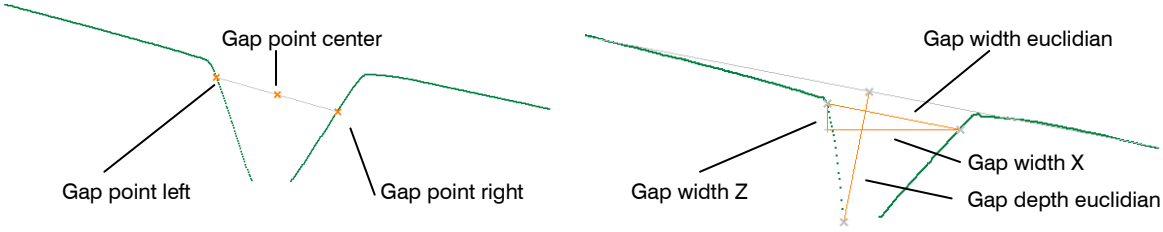


Fig. 4.28: "Single Lines Groove Gap" measured values, "Gap" group

Additionally, combined and filtered measured values are available (see Chapters 5.1 and 5.2).

Note: You can switch from the current program to the "Advanced Groove Gap" program (see Chapter 4.4.3) in order to use advanced setting options and measured values. To do this, use the navigation menu (see Chapter 3.18).

4.4 "Advanced Gaps" Group

This group contains the programs for measuring the characteristics of a gap with extended setting options and measured values.

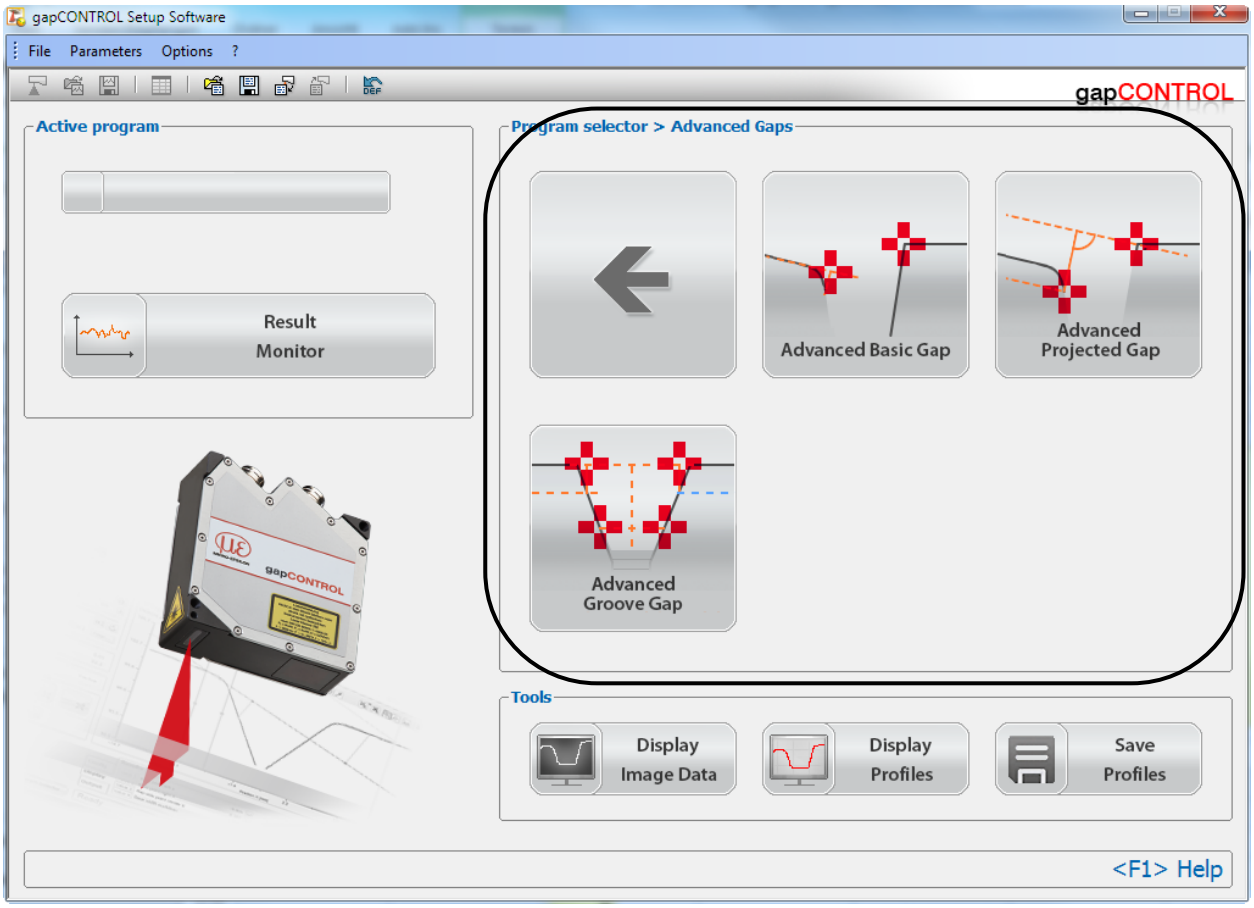


Fig. 4.29: "Advanced Gaps" group

Measuring programs:

- **Advanced Basic Gap:** All the setting options from the measuring programs in the "Basic Gaps" group are available to measure the gap.
- **Advanced Projected Gap:** All the setting options from the measuring programs in the "Projected Gaps" group are available to measure the gap.
- **Advanced Groove Gap:** All the setting options from the measuring programs in the "Groove Gaps" group are available to measure the gap.

Refer to the following chapters for more detailed descriptions of the different measuring programs.

4.4.1 "Advanced Basic Gap" Measuring Program

Use the "Advanced Basic Gap" measuring program to determine the characteristics of a gap.

The program first determines the largest gap in the profile (the so-called "base gap"). Starting from the base gap, the start and end points of the gap are determined in the left and right part of the profile using the selected algorithm (see Chapter 3.13.5). Afterwards, the flushness is measured using the selected algorithm (see Chapter 3.13.8).

Proceed as follows:

- Configure the gapCONTROL measuring system ("Scanner settings" input field, see Chapter 3.7).
- If necessary, limit the measuring range in order to eliminate any interference points (see Chapter 3.13.1).
- Set the minimum width and alignment of the gap (see Chapter 3.13.4).
- Set the algorithm for determining the start and end points of the gap (see Chapter 3.13.5).
- Set the algorithm for determining the flushness (see Chapter 3.13.8).
- If necessary, activate dynamic tracking of the ranges for cutting out and line fitting (see Chapter 3.13.10).

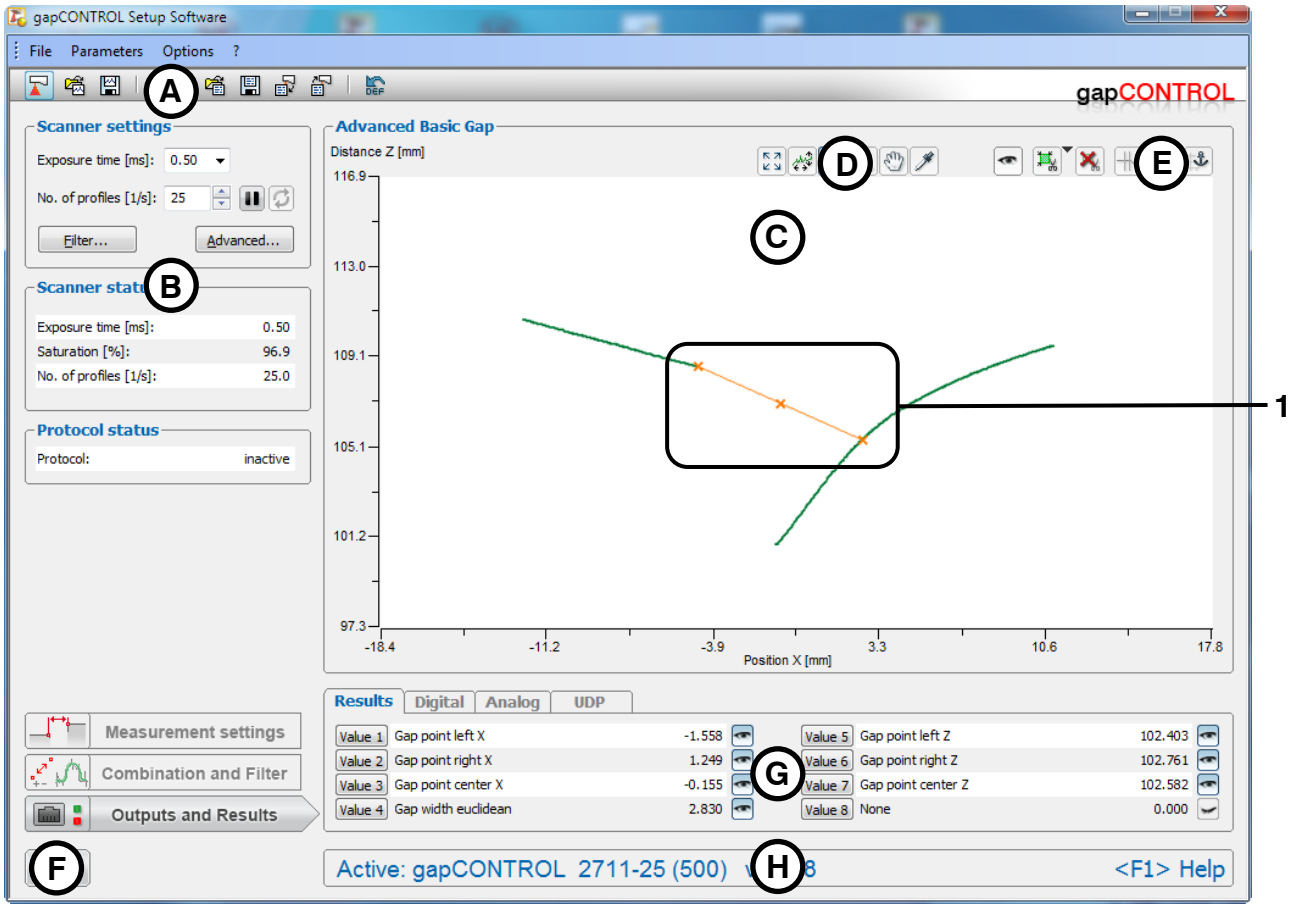


Fig. 4.30: "Advanced Basic Gap" measuring program

Display elements and parameters in the "Advanced Basic Gap" measuring program:

A **"General" toolbar:** Using this toolbar, you can select the data source (see Chapter 3.5), save profile sequences (see Chapter 3.6), save and load parameters (see Chapter 3.13.13) and reset the selected parameters to the default settings (see Chapter 3.13.16).

B **Scanner settings:** Change the settings of gapCONTROL with these values (see Chapter 3.7). In offline mode (see Chapter 3.5), this input field is replaced by the "File settings" input field, which enables you to control the playback process of a profile sequence loaded from a file (see Chapter 3.10).

C **2D-display:** This display shows the last measured profile, the measuring ranges and measurement results.

D **"Display" toolbar:** Using this toolbar, you can scale the 2D-display and activate various options for

mouse interaction (see Chapter 3.16).

E **Measurement toolbar:** You can set the various search areas and limits for measurement using this toolbar (see Chapter 3.17).

F "**Navigation**" **button:** Click on this button in order to show the "Navigation" menu (see Chapter 3.18).

G **Configuration of the measured values:** In this field, you can specify the measurement algorithms, make settings to combine and filter the measured values and select the results that appear in the 2D-display. Select the measured values to be output at the available interfaces (see Chapter 1.2) of gapCONTROL (see Chapter 5).

H **Status line:** Status and error messages are displayed on the status line (see Chapter 8.1).

1 **Display of the detected gap:** In the 2D-display, the gap determined by the measuring program is displayed.

The measuring program outputs the following measured values:

- **Gap point left X [mm]** : The X coordinate of the start point of the detected gap
- **Gap point left Z [mm]** : The Z coordinate of the start point of the detected gap
- **Gap point center X [mm]** : The X coordinate of the center point of the detected gap
- **Gap point center Z [mm]** : The Z coordinate of the center point of the detected gap
- **Gap point right X [mm]** : The X coordinate of the end point of the detected gap
- **Gap point right Z [mm]** : The Z coordinate of the end point of the detected gap
- **Gap width X [mm]** : The width of the detected gap in the X direction.
- **Gap width Z [mm]** : The width of the detected gap in the Z direction.
- **Gap width euclidian [mm]** : The euclidean width of the detected gap.

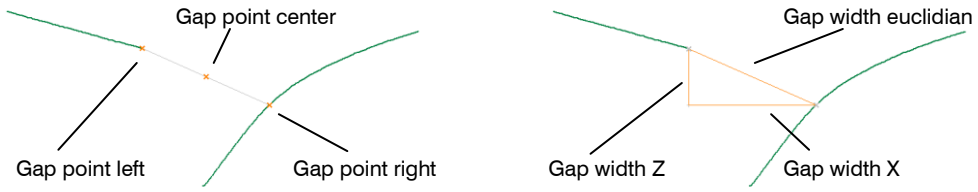


Fig. 4.31: "Advanced Basic Gap" measured values, "Gap" group

- **Reference no. of points left** : The number of profile points in the fitting range of the left reference line.
- **Reference no. of points right** : The number of profile points in the fitting range of the right reference line.
- **Reference angle left [°]** : The angle of the left reference line.
- **Reference angle right [°]** : The angle of the right reference line.
- **Reference offset left [mm]** : The Z coordinate of the intersection point of the left reference line with the Z-axis.
- **Reference offset right [mm]** : The Z coordinate of the intersection point of the right reference line with the Z-axis.
- **Reference sigma left [mm]** : The standard deviation of the distances of the points in the fitting range to the left reference line.
- **Reference sigma right [mm]** : The standard deviation of the distances of the points in the fitting range to the right reference line.
- **Reference angle difference [°]** : The angle between the two reference lines.
- **Reference intersection point X [mm]** : The X coordinate of the intersection point of both reference lines.
- **Reference intersection point Z [mm]** : The Z coordinate of the intersection point of both reference lines.
- **Reference anchor point X [mm]** : The X coordinate of the anchor point for line fitting.
- **Reference anchor point Z [mm]** : The Z coordinate of the anchor point for line fitting.

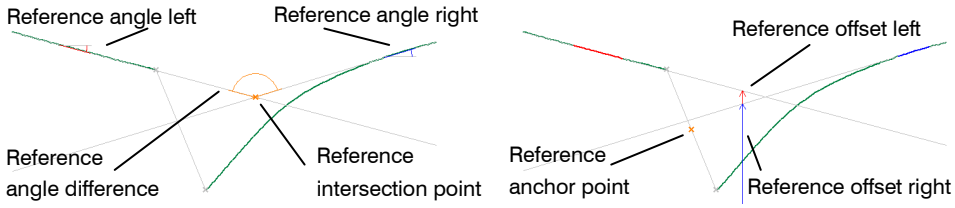


Fig. 4.32: "Advanced Basic Gap" measured values, "Reference" group

- **Flush point left X [mm]** : The X coordinate of the center of gravity of the left flush range.
- **Flush point left Z [mm]** : The Z coordinate of the center of gravity of the left flush range.
- **Flush point right X [mm]** : The X coordinate of the center of gravity of the right flush range.
- **Flush point right Z [mm]** : The Z coordinate of the center of gravity of the right flush range.
- **Flush no. of points left** : The number of profile points in the left flush range.
- **Flush no. of points right** : The number of profile points in the right flush range.
- **Flush angle left [°]** : The angle of the left flush line.
- **Flush angle right [°]** : The angle of the right flush line.
- **Flush offset left [mm]** : The Z coordinate of the intersection point of the left flush line with the Z-axis.
- **Flush offset right [mm]** : The Z coordinate of the intersection point of the right flush line with the Z-axis.
- **Flush sigma left [mm]** : The standard deviation of the distances of the points in the fitting range to the left flush straight line.
- **Flush sigma right [mm]** : The standard deviation of the distances of the points in the fitting range to the right flush straight line.
- **Flush [mm]** : Flushness (see Chapter 3.13.8).

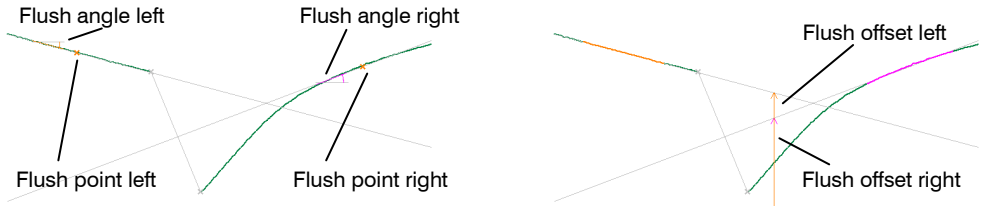


Fig. 4.33: "Advanced Basic Gap" measured values, "Flush" group

- **Min. Gap point left X [mm]** : The X coordinate of the left point of the base gap.
- **Min. Gap point left Z [mm]** : The Z coordinate of the left point of the base gap.
- **Min. Gap point center X [mm]** : The X coordinate of the center point of the base gap.
- **Min. Gap point center Z [mm]** : The Z coordinate of the center point of the base gap.
- **Min. Gap point right X [mm]** : The X coordinate of the right point of the base gap.
- **Min. Gap point right Z [mm]** : The Z coordinate of the right point of the base gap.
- **Min. Gap width X [mm]** : The width of the base gap in the X direction.
- **Min. Gap width Z [mm]** : The width of the base gap in the Z direction.
- **Min. Gap width euclidian [mm]** : The euclidean width of the base gap.

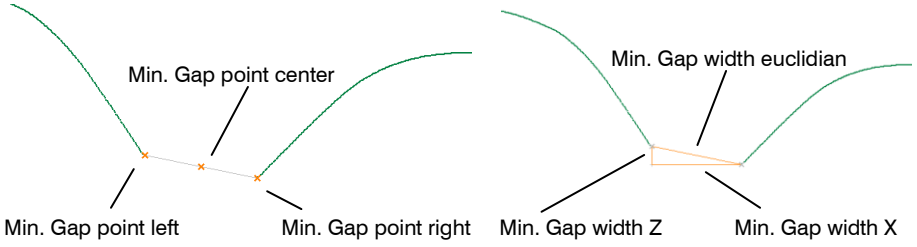


Fig. 4.34: "Advanced Basic Gap" measured values, "Min. Gap"

- **ROI anchor point X [mm]** : The X coordinate of the anchor point for the cutting out.
- **ROI anchor point Z [mm]** : The Z coordinate of the anchor point for the cutting out.
- **ROI point first X [mm]** : The X coordinate of the first point inside the range for cutting out.
- **ROI point first Z [mm]** : The Z coordinate of the first point inside the range for cutting out.

- **ROI point last X [mm]** : The X coordinate of the last point inside the range for cutting out.
- **ROI point last Z [mm]** : The Z coordinate of the last point inside the range for cutting out.
- **ROI point minimum X [mm]** : The X coordinate of the lowest point inside the range for cutting out.
- **ROI point minimum Z [mm]** : The Z coordinate of the lowest point inside the range for cutting out.
- **ROI point maximum X [mm]** : The X coordinate of the highest point inside the range for cutting out.
- **ROI point maximum Z [mm]** : The Z coordinate of the highest point inside the range for cutting out.

- **Global point first X [mm]** : The X coordinate of the first point of the profile.
- **Global point first Z [mm]** : The Z coordinate of the first point of the profile.
- **Global point last X [mm]** : The X coordinate of the last point of the profile.
- **Global point last Z [mm]** : The Z coordinate of the last point of the profile.
- **Global point minimum X [mm]** : The X coordinate of the lowest point of the profile.
- **Global point minimum Z [mm]** : The Z coordinate of the lowest point of the profile.
- **Global point maximum X [mm]** : The X coordinate of the highest point of the profile.
- **Global point maximum Z [mm]** : The Z coordinate of the highest point of the profile.

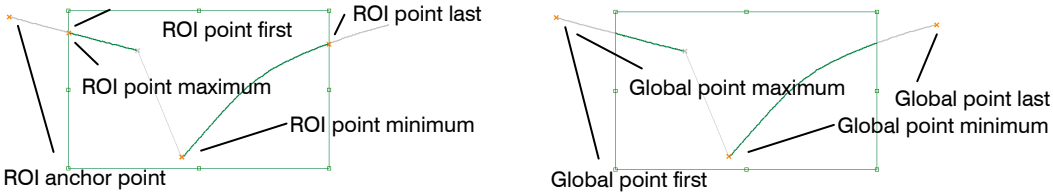


Fig. 4.35: "Advanced Basic Gap" measured values, "ROI" and "Global" groups

Additionally, combined and filtered measured values are available (see Chapters 5.1 and 5.2).

4.4.2 "Advanced Projected Gap" Measuring Program

Use the "Advanced Projected Gap" measuring program to determine the characteristics of a gap.

The program first determines the largest gap in the profile (the so-called "base gap"). Starting from the base gap, the start and end points of the gap are determined in the left and right part of the profile using the selected algorithms (see Chapter 3.13.5). Afterwards, the determined points are projected using the selected algorithm (see Chapter 3.13.9).

Proceed as follows:

- Configure the gapCONTROL measuring system ("Scanner settings" input field, see Chapter 3.7).
- If necessary, limit the measuring range in order to eliminate any interference points (see Chapter 3.13.1).
- Set the minimum width and alignment of the gap (see Chapter 3.13.4).
- Set the algorithm for determining the start and end points of the gap (see Chapter 3.13.5).
- Set the algorithm of projection (see Chapter 3.13.9).
- If necessary, activate dynamic tracking of the ranges for cutting out and line fitting (see Chapter 3.13.10).

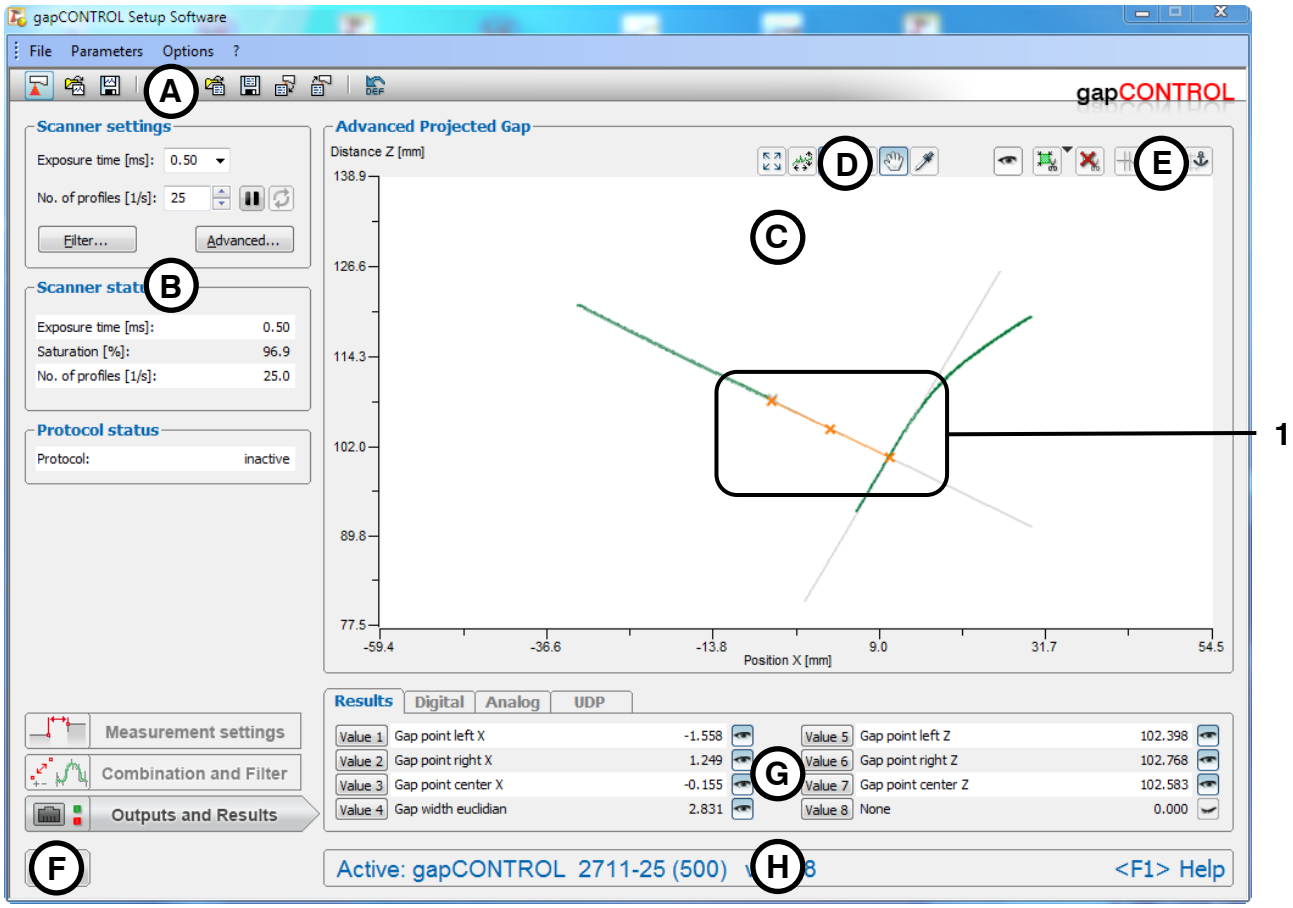


Fig. 4.36: "Advanced Projected Gap" measuring program

Display elements and parameters in the "Advanced Projected Gap" measuring program:

A **"General" toolbar:** Using this toolbar, you can select the data source (see Chapter 3.5), save profile sequences (see Chapter 3.6), save and load parameters (see Chapter 3.13.13) and reset the selected parameters to the default settings (see Chapter 3.13.16).

B **Scanner settings:** Change the settings of gapCONTROL with these values (see Chapter 3.7). In offline mode (see Chapter 3.5), this input field is replaced by the "File settings" input field, which enables you to control the playback process of a profile sequence loaded from a file (see Chapter 3.10).

C **2D-display:** This display shows the last measured profile, the measuring ranges and measurement results.

D **"Display" toolbar:** Using this toolbar, you can scale the 2D-display and activate various options for mouse interaction (see Chapter 3.16).

E **Measurement toolbar:** You can set the various search areas and limits for measurement using this toolbar (see Chapter 3.17).

F "**Navigation**" **button:** Click on this button in order to show the "Navigation" menu (see Chapter 3.18).

G **Configuration of the measured values:** In this field, you can specify the measurement algorithms, make settings to combine and filter the measured values and select the results that appear in the 2D-display. Select the measured values to be output at the available interfaces (see Chapter 1.2) of gapCONTROL (see Chapter 5).

H **Status line:** Status and error messages are displayed on the status line (see Chapter 8.1).

1 **Display of the detected gap:** In the 2D-display, the gap determined by the measuring program is displayed.

The measuring program outputs the following measured values:

- **Gap point left X [mm]** : The X coordinate of the start point of the detected gap
- **Gap point left Z [mm]** : The Z coordinate of the start point of the detected gap
- **Gap point center X [mm]** : The X coordinate of the center point of the detected gap
- **Gap point center Z [mm]** : The Z coordinate of the center point of the detected gap
- **Gap point right X [mm]** : The X coordinate of the end point of the detected gap
- **Gap point right Z [mm]** : The Z coordinate of the end point of the detected gap
- **Gap width X [mm]** : The width of the detected gap in the X direction.
- **Gap width Z [mm]** : The width of the detected gap in the Z direction.
- **Gap width euclidian [mm]** : The euclidean width of the detected gap.

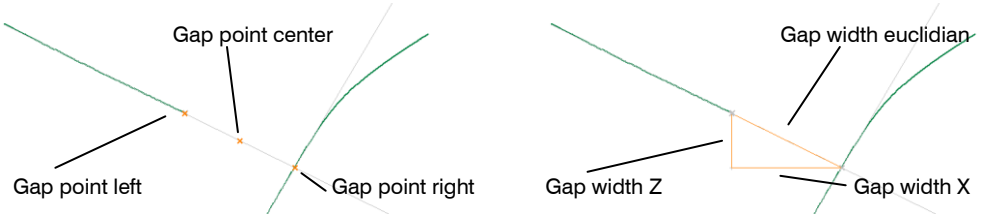


Fig. 4.37: "Advanced Projected Gap" measured values, "Gap" group

- **Reference no. of points left** : The number of profile points in the fitting range of the left reference line.
- **Reference no. of points right** : The number of profile points in the fitting range of the right reference line.
- **Reference angle left [°]** : The angle of the left reference line.
- **Reference angle right [°]** : The angle of the right reference line.
- **Reference offset left [mm]** : The Z coordinate of the intersection point of the left reference line with the Z-axis.
- **Reference offset right [mm]** : The Z coordinate of the intersection point of the right reference line with the Z-axis.
- **Reference sigma left [mm]** : The standard deviation of the distances of the points in the fitting range to the left reference line.
- **Reference sigma right [mm]** : The standard deviation of the distances of the points in the fitting range to the right reference line.
- **Reference angle difference [°]** : The angle between the two reference lines.
- **Reference intersection point X [mm]** : The X coordinate of the intersection point of both reference lines.
- **Reference intersection point Z [mm]** : The Z coordinate of the intersection point of both reference lines.
- **Reference anchor point X [mm]** : The X coordinate of the anchor point for line fitting.
- **Reference anchor point Z [mm]** : The Z coordinate of the anchor point for line fitting.

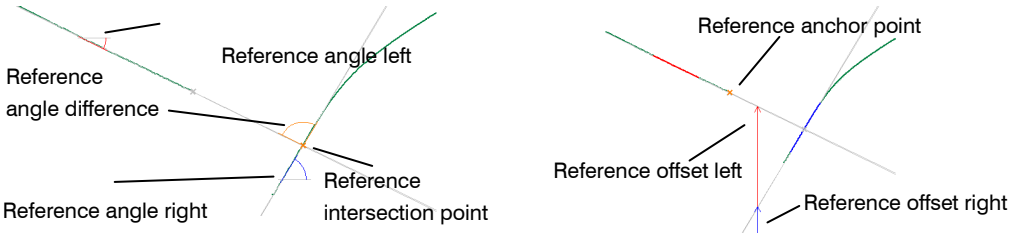


Fig. 4.38: "Advanced Projected Gap" measured values, "Reference" group

- **Projection side point left X [mm]** : The X coordinate of the point to be projected (left side of the gap).
- **Projection side point left Z [mm]** : The Z coordinate of the point to be projected (left side of the gap).
- **Projection side point right X [mm]** : The X coordinate of the point to be projected (right side of the gap).
- **Projection side point right Z [mm]** : The Z coordinate of the point to be projected (right side of the gap).
- **Projection distance left [mm]** : The distance between the projected point and the point to be projected (left side of the gap).
- **Projection distance right [mm]** : The distance between the projected point and the point to be projected (right side of the gap).
- **Projection distance diff. [mm]** : The distance between the point on the right and on the left that are to be projected vertical to the projection line.
- **Projection no. of points left** : The number of profile points in the fitting range of the left projection line.
- **Projection no. of points right** : The number of profile points in the fitting range of the right projection line.
- **Projection angle left [°]** : The angle of the left projection line.
- **Projection angle right [°]** : The angle of the right projection line.
- **Projection offset left [mm]** : The Z coordinate of the intersection point of the left projection line with the Z-axis.
- **Projection offset right [mm]** : The Z coordinate of the intersection point of the right projection line with the Z-axis.
- **Projection sigma left [mm]** : The standard deviation of the distances of the points in the left fitting range from the projection line.
- **Projection sigma right [mm]** : The standard deviation of the distances of the points in the right fitting range from the projection line.
- **Projection distance lines [mm]** : The distance between the right projection line and the left one.

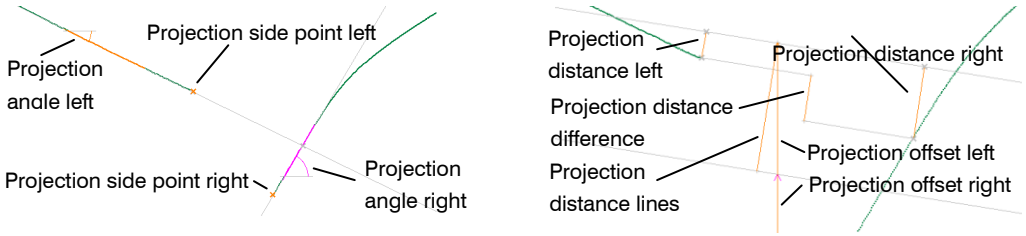


Fig. 4.39: "Advanced Projected Gap" measured values, "Projection" group

- **Min. Gap point left X [mm]** : The X coordinate of the left point of the base gap.
- **Min. Gap point left Z [mm]** : The Z coordinate of the left point of the base gap.
- **Min. Gap point center X [mm]** : The X coordinate of the center point of the base gap.
- **Min. Gap point center Z [mm]** : The Z coordinate of the center point of the base gap.
- **Min. Gap point right X [mm]** : The X coordinate of the right point of the base gap.
- **Min. Gap point right Z [mm]** : The Z coordinate of the right point of the base gap.
- **Min. Gap width X [mm]** : The width of the base gap in the X direction.
- **Min. Gap width Z [mm]** : The width of the base gap in the Z direction.
- **Min. Gap width euclidian [mm]** : The euclidean width of the base gap.

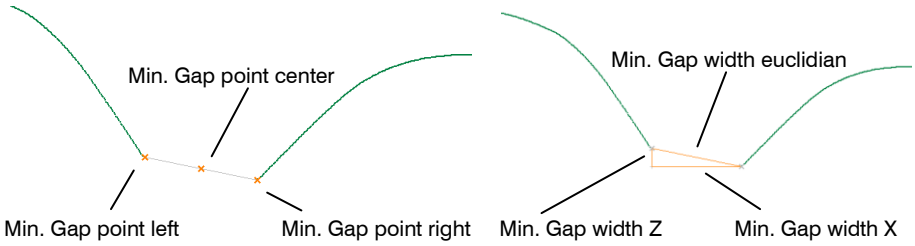


Fig. 4.40: "Advanced Projected Gap" measured values, "Min. Gap"

- **ROI anchor point X [mm]** : The X coordinate of the anchor point for the cutting out.
- **ROI anchor point Z [mm]** : The Z coordinate of the anchor point for the cutting out.
- **ROI point first X [mm]** : The X coordinate of the first point inside the range for cutting out.
- **ROI point first Z [mm]** : The Z coordinate of the first point inside the range for cutting out.
- **ROI point last X [mm]** : The X coordinate of the last point inside the range for cutting out.
- **ROI point last Z [mm]** : The Z coordinate of the last point inside the range for cutting out.
- **ROI point minimum X [mm]** : The X coordinate of the lowest point inside the range for cutting out.
- **ROI point minimum Z [mm]** : The Z coordinate of the lowest point inside the range for cutting out.
- **ROI point maximum X [mm]** : The X coordinate of the highest point inside the range for cutting out.
- **ROI point maximum Z [mm]** : The Z coordinate of the highest point inside the range for cutting out.

- **Global point first X [mm]** : The X coordinate of the first point of the profile.
- **Global point first Z [mm]** : The Z coordinate of the first point of the profile.
- **Global point last X [mm]** : The X coordinate of the last point of the profile.
- **Global point last Z [mm]** : The Z coordinate of the last point of the profile.
- **Global point minimum X [mm]** : The X coordinate of the lowest point of the profile.
- **Global point minimum Z [mm]** : The Z coordinate of the lowest point of the profile.
- **Global point maximum X [mm]** : The X coordinate of the highest point of the profile.
- **Global point maximum Z [mm]** : The Z coordinate of the highest point of the profile.

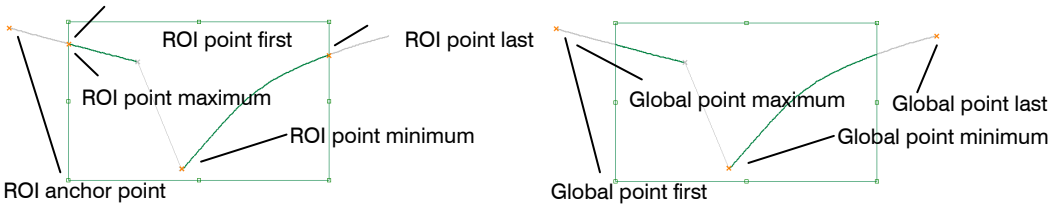


Fig. 4.41: "Advanced Projected Gap" measured values, "ROI" and "Global" groups

Additionally, combined and filtered measured values are available (see Chapters 5.1 and 5.2).

4.4.3 "Advanced Groove Gap" Measuring Program

Use the "Advanced Groove Gap" measuring program to determine the characteristics of a V-shaped gap. The program first determines one or two reference lines, which are determined by a line fitting. A minimum depth (the so-called "threshold") is specified relative to each reference line. The gap points are calculated as the intersection points between the threshold lines and the profile. Then, the determined points are projected onto a straight line. The deepest profile point relative to the main reference line is determined in the next step. A base threshold is again defined relative to this profile point. In this way, the distance from the base threshold to the lowest point of the profile remains constant. Then, the start and end points of the base are detected as the intersection points of the gap threshold together with the profile.

Proceed as follows:

- Configure the gapCONTROL measuring system ("Scanner settings" input field, see Chapter 3.7).
- If necessary, limit the measuring range in order to eliminate any interference points (see Chapter 3.13.1).
- Specify the algorithm of the left and right reference line. Proceed as follows:
  - If not already done so, click on the "Measurement settings" button (see Fig. 4.42).
  - If not already done so, click on the "Algorithm" tab (see Fig. 4.42).

Fig. 4.42: "Measurement settings" input field, "Algorithm" tab sheet

In the "Algorithm" tab sheet, you can set the den algorithm of the right and left reference line:

- **Only left line:** The reference line is fitted to the profile points from the left reference range. The points in the right reference range are ignored.
- **Only right line:** The reference line is fitted to the profile points from the right reference range. The points in the left reference range are ignored.
- **Combined line:** The reference line is fitted to the profile points from the left and right reference range.
- **Parallel lines:** Two parallel reference lines are fitted to the profile points from the left and right reference ranges. The direction vector for both reference lines is calculated from the points of the two ranges. The offsets of the reference lines are calculated from the points of the two respective ranges.
- **Independent lines:** Two independent reference lines are fitted to the profile points from the left and right reference ranges.

- Set the algorithm for determining the start and end points of the gap (see Chapter 3.13.5).
- Set the algorithm for the projection (see Chapter 3.13.9).
- Define the base threshold: The intersection points of the base threshold with the profile are used as start and end points of the base. Proceed as follows:
  - If not already done so, click on the "Measurement settings" button (see Fig. 4.43).
  - If not already done so, click on the "Base threshold" tab (see Fig. 4.43).
  - Set the base threshold (see Chapter 3.13.7).

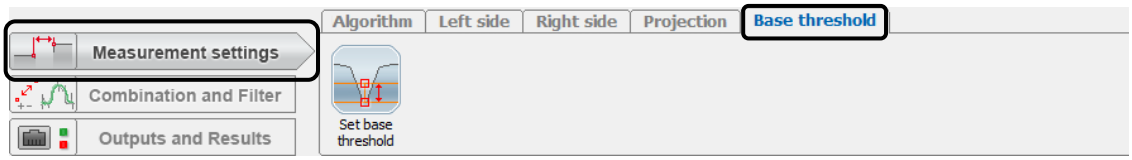


Fig. 4.43: "Measurement settings" input field, "Base threshold" tab sheet

- If necessary, activate dynamic tracking of the ranges for cutting out and line fitting (see Chapter 3.13.10).

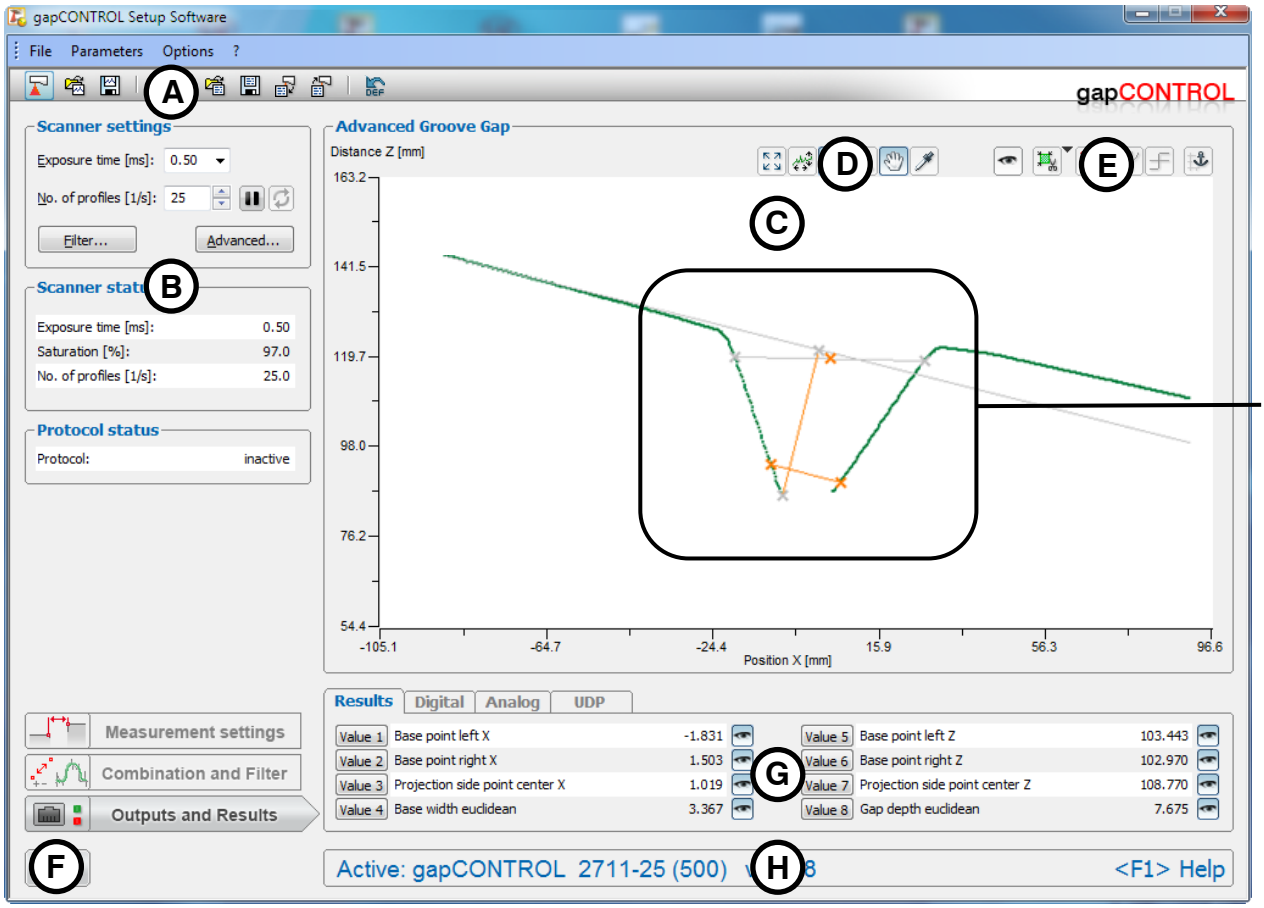


Fig. 4.44: "Advanced Groove Gap" measuring program

Display elements and parameters in the "Advanced Groove Gap" measuring program:

A **"General" toolbar:** Using this toolbar, you can select the data source (see Chapter 3.5), save profile sequences (see Chapter 3.6), save and load parameters (see Chapter 3.13.13) and reset the selected parameters to the default settings (see Chapter 3.13.16).

B **Scanner settings:** Change the settings of gapCONTROL with these values (see Chapter 3.7). In offline mode (see Chapter 3.5), this input field is replaced by the "File settings" input field, which enables you to control the playback process of a profile sequence loaded from a file (see Chapter 3.10).

C **2D-display:** This display shows the last measured profile, the measuring ranges and measurement results.

D **"Display" toolbar:** Using this toolbar, you can scale the 2D-display and activate various options for mouse interaction (see Chapter 3.16).

E **Measurement toolbar:** You can set the various search areas and limits for measurement using this toolbar (see Chapter 3.17).

F **"Navigation" button:** Click on this button in order to show the "Navigation" menu (see Chapter 3.18).

G **Configuration of the measured values:** In this field, you can specify the measurement algorithms, make settings to combine and filter the measured values and select the results that appear in the 2D-display. Select the measured values to be output at the available interfaces (see Chapter 1.2) of gapCONTROL (see Chapter 5).

H **Status line:** Status and error messages are displayed on the status line (see Chapter 8.1).

1 **Display of the detected gap:** In the 2D-display, the gap determined by the measuring program is displayed.

The measuring program outputs the following measured values:

- **Gap point left X [mm]** : The X coordinate of the start point of the determined gap
- **Gap point left Z [mm]** : The Z coordinate of the start point of the determined gap
- **Gap point center X [mm]** : The X coordinate of the center point of the detected gap
- **Gap point center Z [mm]** : The Z coordinate of the center point of the detected gap
- **Gap point right X [mm]** : The X coordinate of the end point of the detected gap
- **Gap point right Z [mm]** : The Z coordinate of the end point of the detected gap
- **Gap width X [mm]** : The width of the detected gap in the X direction.
- **Gap width Z [mm]** : The width of the detected gap in the Z direction.
- **Gap width euclidian [mm]** : The euclidean width of the detected gap.
- **Gap depth euclidian [mm]** : The euclidean depth of the detected gap.

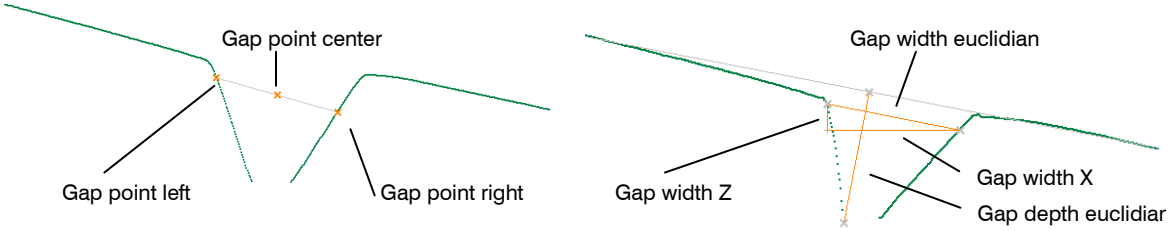


Fig. 4.45: "Advanced Groove Gap" measured values, "Gap" group

- **Reference no. of points left** : The number of profile points in the fitting range of the left reference line.
- **Reference no. of points right** : The number of profile points in the fitting range of the right reference line.
- **Reference angle left [°]** : The angle of the left reference line.
- **Reference angle right [°]** : The angle of the right reference line.
- **Reference offset left [mm]** : The Z coordinate of the intersection point of the left reference line with the Z-axis.
- **Reference offset right [mm]** : The Z coordinate of the intersection point of the right reference line with the Z-axis.
- **Reference sigma left [mm]** : The standard deviation of the distances of the points in the fitting range to the left reference line.
- **Reference sigma right [mm]** : The standard deviation of the distances of the points in the fitting range to the right reference line.
- **Reference angle difference [°]** : The angle between the two reference lines.
- **Reference intersection point X [mm]** : The X coordinate of the intersection point of both reference lines.
- **Reference intersection point Z [mm]** : The Z coordinate of the intersection point of both reference lines.
- **Reference anchor point X [mm]** : The X coordinate of the anchor point for line fitting.
- **Reference anchor point Z [mm]** : The Z coordinate of the anchor point for line fitting.

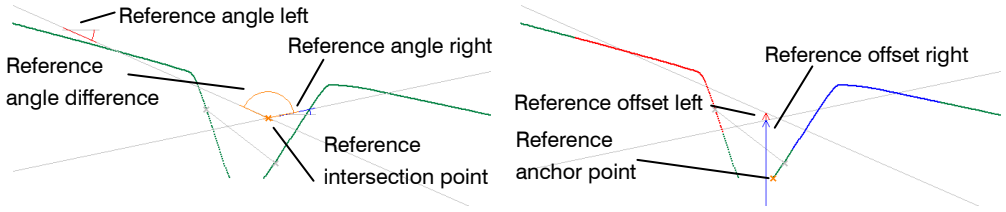


Fig. 4.46: "Advanced Groove Gap" measured values, "Reference" group

- **Projection side point left X [mm]** : The X coordinate of the point to be projected (left side of the gap).
- **Projection side point left Z [mm]** : The Z coordinate of the point to be projected (left side of the gap).
- **Projection side point right X [mm]** : The X coordinate of the point to be projected (right side of the gap).

- **Projection side point right Z [mm]** : The Z coordinate of the point to be projected (right side of the gap).
- **Projection distance left / flush [mm]** : The distance between the projected point and the point to be projected (left side of the gap).
- **Projection distance right / flush [mm]** : The distance between the projected point and the point to be projected (right side of the gap).
- **Projection distance diff. / flush [mm]** : The distance between the point on the right and on the left that are to be projected vertical to the projection line.
- **Projection no. of points left** : The number of profile points in the fitting range of the left projection line.
- **Projection no. of points right** : The number of profile points in the fitting range of the right projection line.
- **Projection angle left [°]** : The angle of the left projection line.
- **Projection angle right [°]** : The angle of the right projection line.
- **Projection offset left [mm]** : The Z coordinate of the intersection point of the left projection line with the Z-axis.
- **Projection offset right [mm]** : The Z coordinate of the intersection point of the right projection line with the Z-axis.
- **Projection sigma left [mm]** : The standard deviation of the distances of the points in the left fitting range from the projection line.
- **Projection sigma right [mm]** : The standard deviation of the distances of the points in the right fitting range from the projection line.
- **Projection distance lines / flush [mm]** : The distance between the right projection line and the left one.

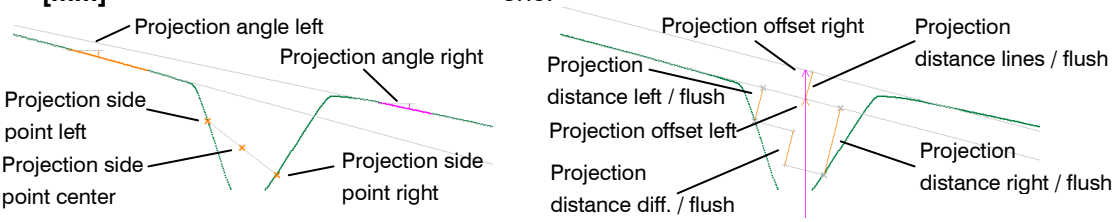


Fig. 4.47: "Advanced Groove Gap" measured values, "Projection" group

- **Base point left X [mm]** : The X coordinate of the start point of the detected gap base.
- **Base point left Z [mm]** : The Z coordinate of the start point of the detected gap base.
- **Base point center X [mm]** : The X coordinate of the center point of the detected gap base.
- **Base point center Z [mm]** : The Z coordinate of the center point of the detected gap base.
- **Base point right X [mm]** : The X coordinate of the end point of the detected gap base.
- **Base point right Z [mm]** : The Z coordinate of the end point of the detected gap base.
- **Base point bottom X [mm]** : The X coordinate of the lowest point of the detected gap base
- **Base point bottom Z [mm]** : The Z coordinate of the lowest point of the detected gap base
- **Base point top X [mm]** : The X coordinate of the perpendicular point of the bottom point to the reference line.
- **Base point top Z [mm]** : The Z coordinate of the perpendicular point of the bottom point to the line.
- **Base width X [mm]** : The width of the detected gap base in the X direction.
- **Base width Z [mm]** : The width of the detected gap base in the Z direction.
- **Base width euclidian [mm]** : The euclidean width of the detected gap base.

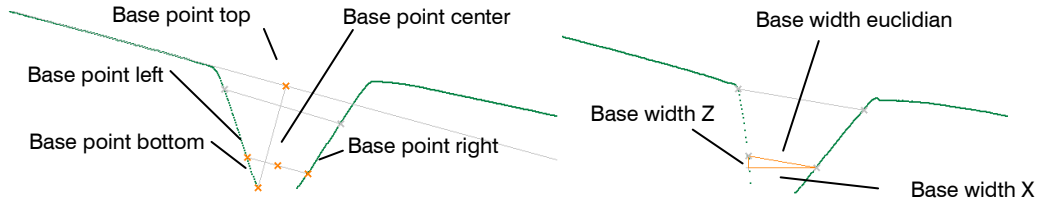


Fig. 4.48: "Advanced Groove Gap" measured values, "Base" group

- **ROI anchor point X [mm]** : The X coordinate of the anchor point for the cutting out.
- **ROI anchor point Z [mm]** : The Z coordinate of the anchor point for the cutting out.

- **ROI point first X [mm]** : The X coordinate of the first point inside the range for cutting out.
- **ROI point first Z [mm]** : The Z coordinate of the first point inside the range for cutting out.
- **ROI point last X [mm]** : The X coordinate of the last point inside the range for cutting out.
- **ROI point last Z [mm]** : The Z coordinate of the last point inside the range for cutting out.
- **ROI point minimum X [mm]** : The X coordinate of the lowest point inside the range for cutting out.
- **ROI point minimum Z [mm]** : The Z coordinate of the lowest point inside the range for cutting out.
- **ROI point maximum X [mm]** : The X coordinate of the highest point inside the range for cutting out.
- **ROI point maximum Z [mm]** : The Z coordinate of the highest point inside the range for cutting out.

- **Global point first X [mm]** : The X coordinate of the first point of the profile.
- **Global point first Z [mm]** : The Z coordinate of the first point of the profile.
- **Global point last X [mm]** : The X coordinate of the last point of the profile.
- **Global point last Z [mm]** : The Z coordinate of the last point of the profile.
- **Global point minimum X [mm]** : The X coordinate of the lowest point of the profile.
- **Global point minimum Z [mm]** : The Z coordinate of the lowest point of the profile.
- **Global point maximum X [mm]** : The X coordinate of the highest point of the profile.
- **Global point maximum Z [mm]** : The Z coordinate of the highest point of the profile.

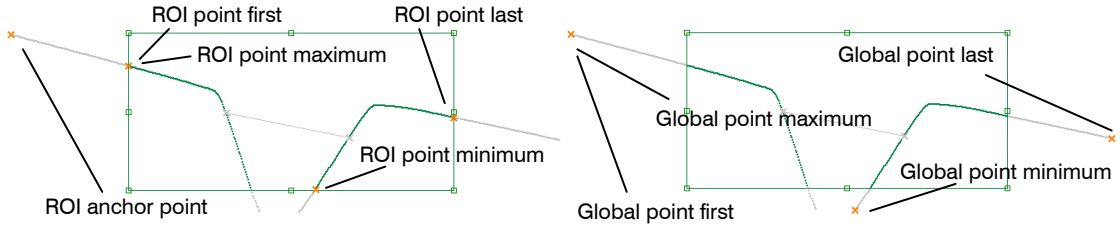


Fig. 4.49: "Advanced Groove Gap" measured values, "ROI" and "Global" groups

Additionally, combined and filtered measured values are available (see Chapters 5.1 and 5.2).

4.5 "Tools" Group

In the bottom area of the man view you will find the "Tools" group which provides useful utilities.

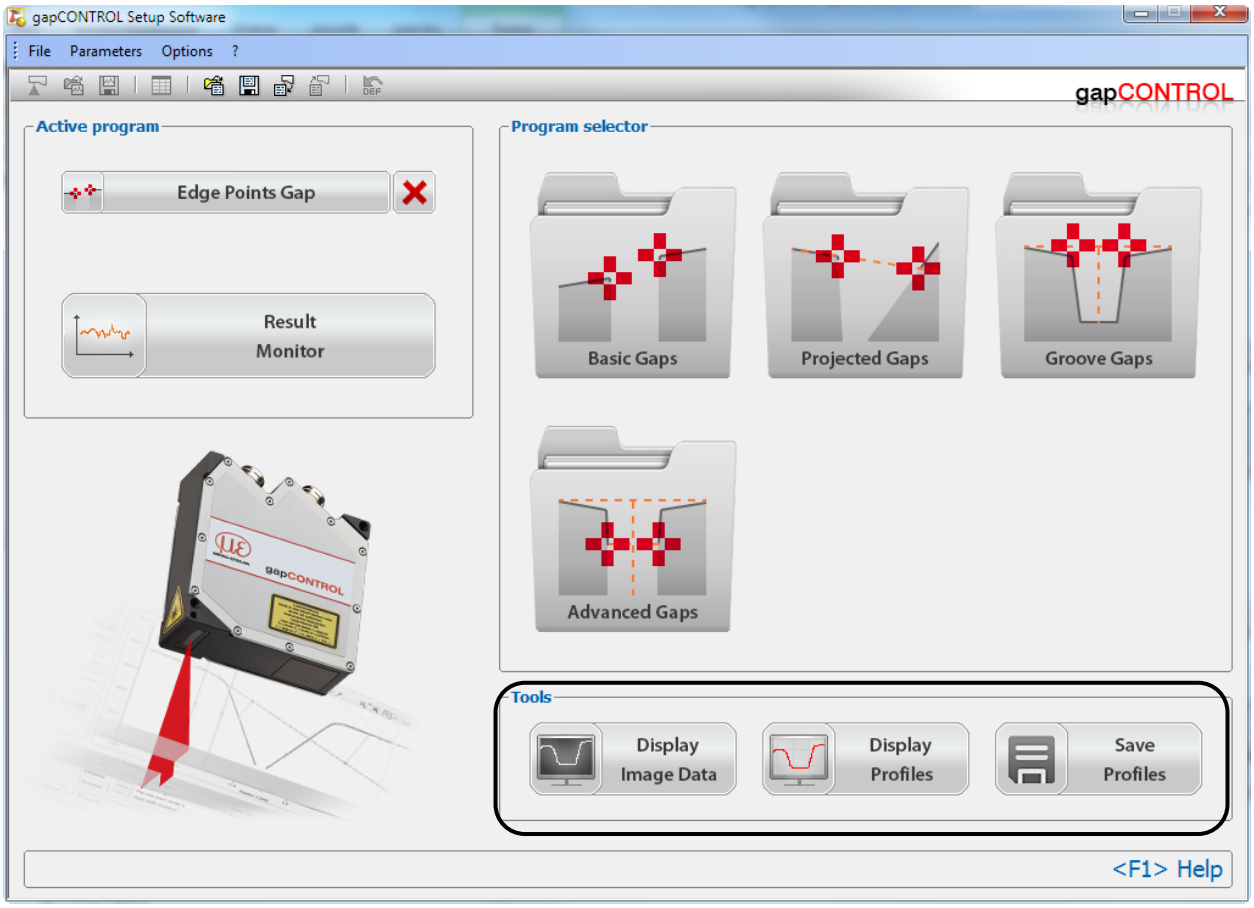


Fig. 4.50: "Tools" group

Programs in the "Tools" group:

- **Display Image Data:** Visualization of the image data recorded by the sensor matrix.
- **Display Profiles:** Display of the profile data.
- **Save Profiles:** Saves profile sequences for later offline analysis.

4.5.1 "Display Image Data" Program

The original signal recorded on the sensor matrix of gapCONTROL is displayed using the "Display Image Data" program. This program is useful for detecting and eliminating sources of errors and interference, such as overexposure or multiple reflections.

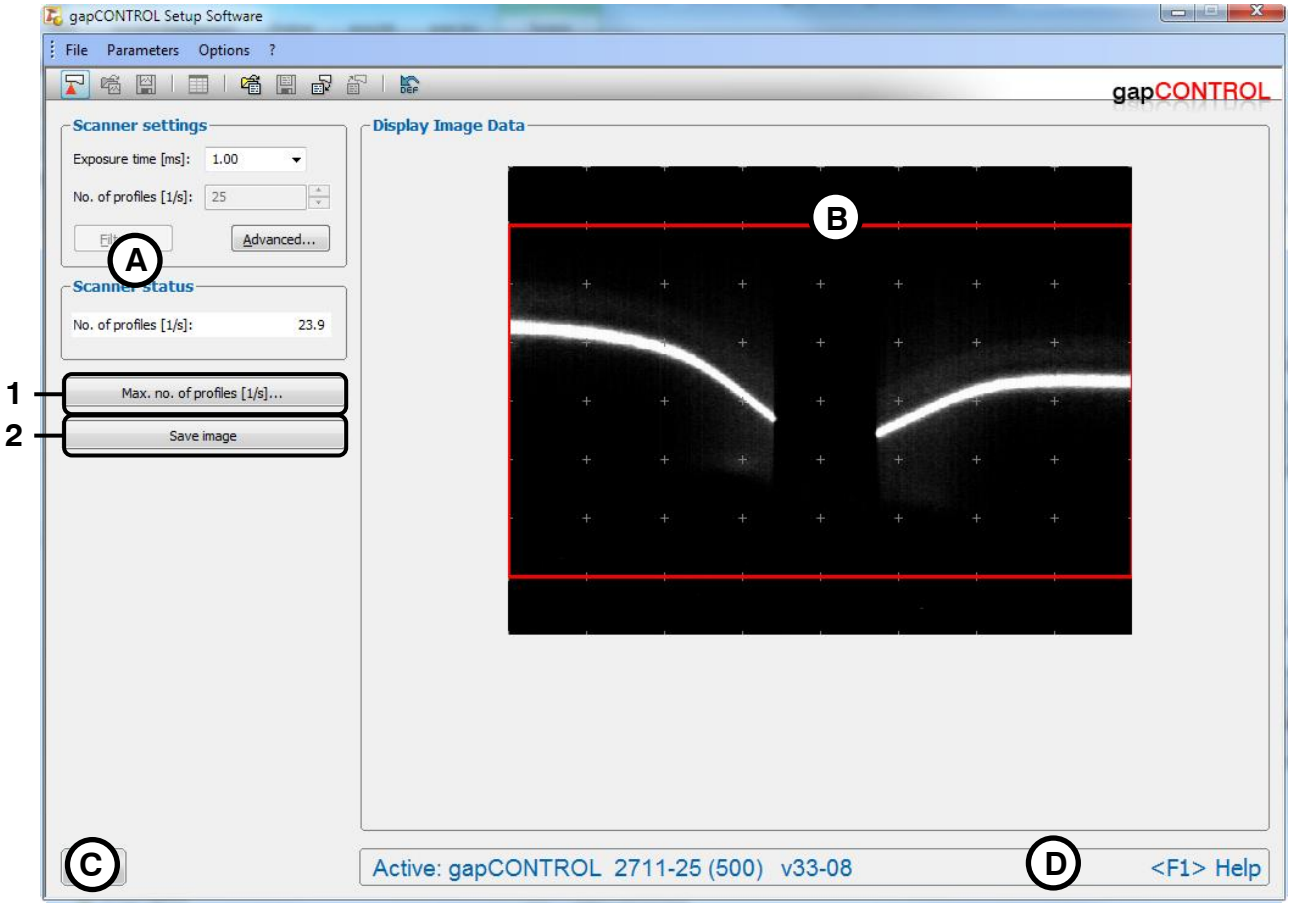


Fig. 4.51: "Display Image Data" program

Display elements and parameters in the "Display Image Data" program:

A **Scanner settings:** Change the settings of gapCONTROL with these values. Detail information about each parameter can be found in the Chapter 3.7 "Scanner settings". Only the values "Measuring field", "Points per profile" and "Exposure time" are available in the "Display image data" measuring program.

B **2D-display:** This display shows the just recorded image of the sensor matrix. The measuring field (see Chapter 3.9) selected with the "Measuring field" parameter is shown on the display as a red rectangle.

C "**Navigation**" **button**: Click on this button in order to show the "Navigation" menu (see Chapter 3.18).

D **Status line:** Status and error messages are displayed on the status line (see Chapter 8.1).

1 **Max. no. of profiles [1/s]...:** With this button you open the dialog "Max. no of profiles [1/s]" where you can determine the maximum possible profile frequency depending on the currently selected scanner settings (see Fig. 4.52).

2 **Save image:** This saves the just recorded image of the sensor matrix to a file. A standard Windows dialog is displayed for selection of the path and file name for saving the image. The image is saved in "png" file format using the "png" file extension.

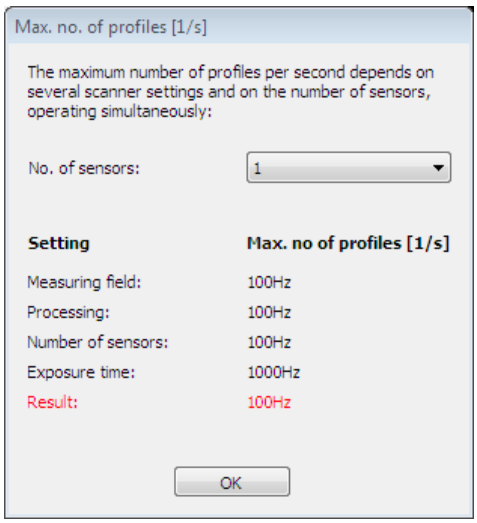


Fig. 4.52: "Max. no. of profiles [1/s]" dialog box

The maximum possible profile frequency which gapCONTROL can be operated with depends on various scanner settings and the number of scanners being operated in parallel. You can determine the maximum possible profile frequency in this dialog:

- **No. of sensors:** With this setting you determine the effect of the number of gapCONTROL sensors to be operated simultaneously on the FireWire controller (see below).
- **Measuring field:** The maximum profile frequency resulting from the setting of the "Measuring field" parameter.
- **Processing:** The maximum profile frequency resulting from the setting in the "Processing" (see Chapter 3.9, Fig. 3.11) input field.
- **Number of sensors:** The maximum profile frequency resulting from the setting of the "No. of sensors" parameter (see above).
- **Exposure time:** The maximum profile frequency resulting from the setting of the "Exposure time" parameter.
- **Result:** The maximum profile frequency resulting from the above restrictions.

Note: Further information about maximum profile frequency can be found in the document "Quick Reference gapCONTROL" (see Chapter 3.14, Section 4 "Documentation").

4.5.2 "Display Profiles" Program

Use the "Display Profiles" program to display profiles.

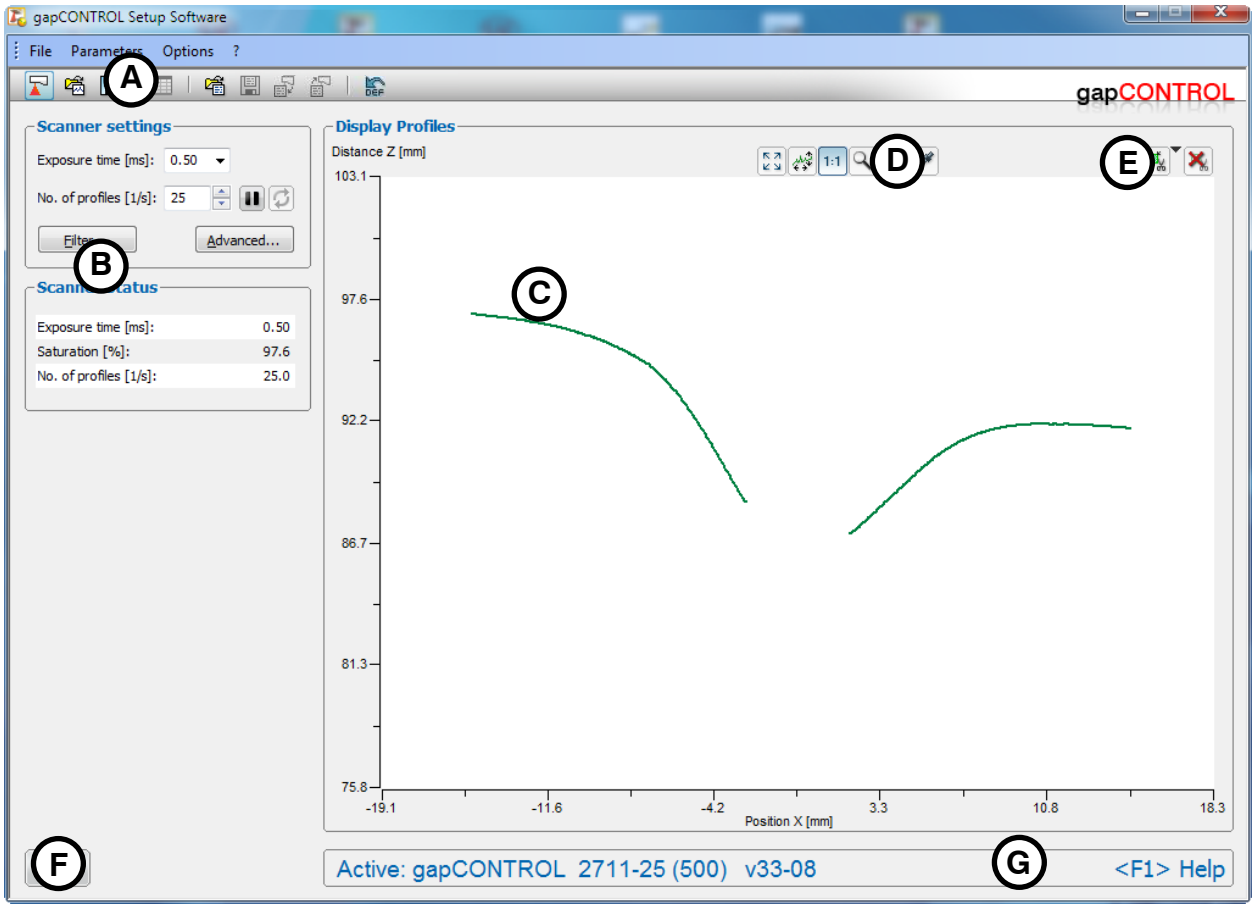


Fig. 4.53: "Display Profiles" program

Display elements and parameters in the "Display Profiles" program:

A "**General**" **toolbar:** Using this toolbar, you can select the data source (see Chapter 3.5), save profile sequences (see Chapter 3.6), and reset selected parameters to default settings (see Chapter 3.13.16).

B **Scanner settings:** Change the settings of gapCONTROL with these values (see Chapter 3.7). In Offline mode (see Chapter 3.5) this input field will be replaced by the "File settings" input field (see Chapter 3.10) for controlling the playback of a loaded profile sequence.

C **2D-display:** This display shows the last measured profile.

D "**Display**" **toolbar:** Using this toolbar, you scale the 2D-display and activate various options for the mouse interaction (see Chapter 3.16).

E "**Measurement**" **toolbar:** Set the various search ranges and limits for the measurement using this toolbar (see Chapter 3.17).

F "**Navigation**" **button**: Click on this button in order to show the "Navigation" menu (see Chapter 3.18).

G **Status line:** Status and error messages are displayed on the status line (see Chapter 8.1).

Note: It is not possible in the "Display profiles" program to save parameters in a file or to save them permanently on gapCONTROL.

4.5.3 "Save Profiles" Program

You create recordings of profile sequences with the "Save Profiles" program. Setup Software creates a file which can later be loaded into any measuring program. Use this function to save profile sequences with a high scan rate. In doing so, the profiles are first buffered in the RAM of the PC and then saved in a file.

Note: It is also possible in the measuring programs described above to save profile sequences ("General" toolbar). However, only low scan rates are possible there as the data are written to the file immediately.

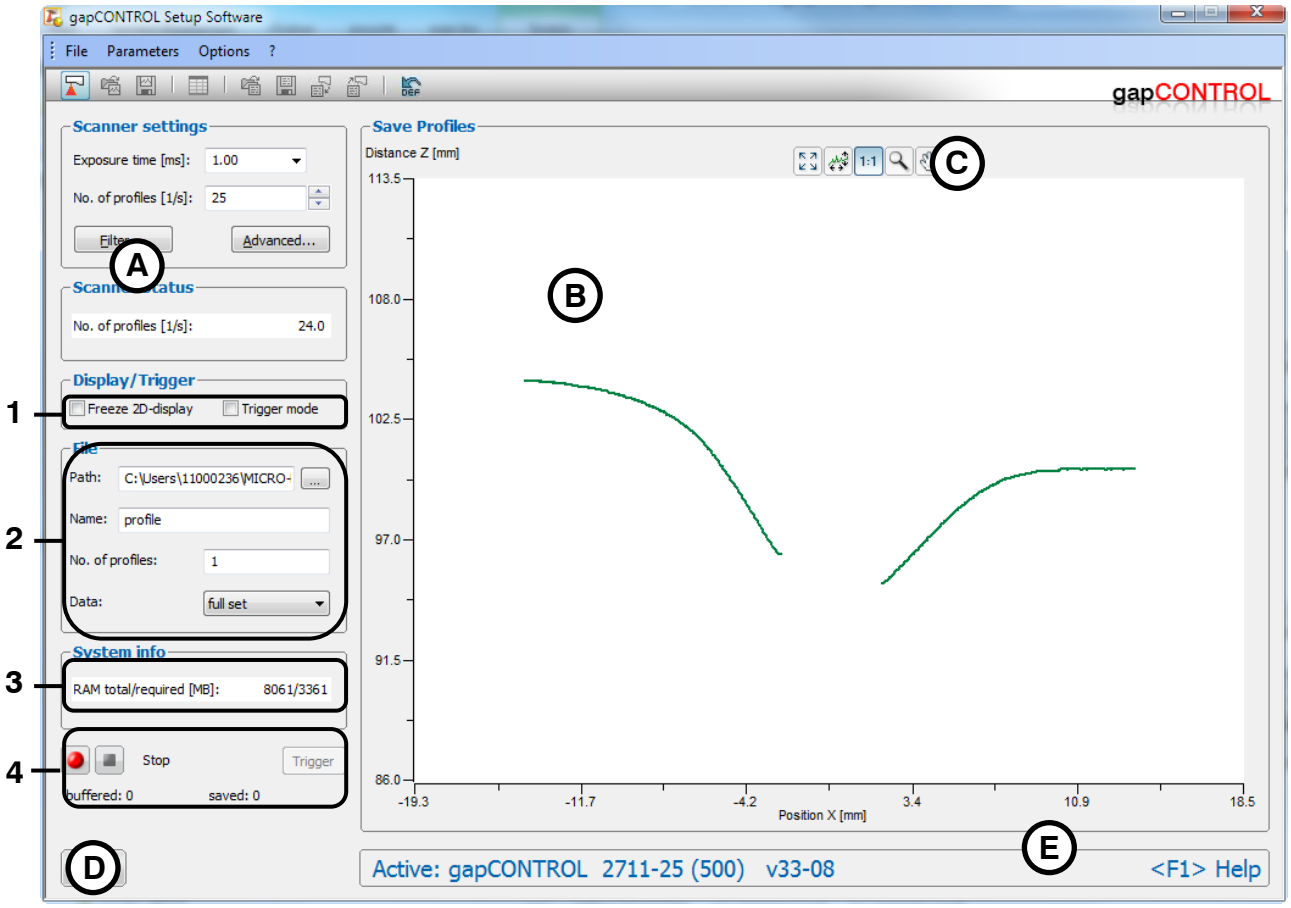


Fig. 4.54: "Save Profiles" program

Display elements and parameters in the "Save Profiles" program:

A **Scanner settings:** Change the settings of gapCONTROL with these values (see Chapter 3.7).

B **2D-display:** This display shows the last measured profile.

C "**Display**" **toolbar:** Using this toolbar, you scale the 2D-display and activate various options for the mouse interaction (see Chapter 3.16).

D "**Navigation**" **button**: Click on this button in order to show the "Navigation" menu (see Chapter 3.18).

E **Status line:** Status and error messages are displayed on the status line (see Chapter 8.1).

1 **Freeze 2D-display/Trigger mode**

- **Freeze 2D-display:** Deactivates the 2D-display. When the display is deactivated, the performance of the system is better and profiles can be saved with a higher scan rate. This option is automatically deactivated when the measuring program is started.
- **Trigger mode:** You activate the trigger mode (see below, "Record" section) with this input field.

2 File/Buffer

- **Path:** The directory in which the file is stored.
- **Name:** Input the name for the profile sequence to be saved here.
- **No. of profiles:** Maximum number of profiles which should be saved in the file. This number should not be selected higher than necessary as the reserved part of the RAM for the profiles is dependent on it. The upper limit for this parameter depends on the number of points per profile (see Chapter 3.9).
- **Data:** Using this input field, select which information is saved in the profile file. This setting is crucial for the resulting file size of the profile file.
  - **x/z only:** The X and Z coordinates of the individual measuring points will be saved. This setting minimizes the file size.
  - **x/z + data:** The information of the selected reflection is saved (X/Z coordinates, width, maximum, threshold, moment 0th and 1st order).
  - **full set:** All four reflections, the timestamp and the gapCONTROL settings (only for active parameter loopback, see Chapter 3.9) are saved. This setting results in an enlarged file, however it is recommended as no information is lost with this setting.

3 System Info

- **RAM total/required:** Two values are displayed. The first value indicates the size of the physical RAM of your system. The second value indicates the size of the memory which is necessary for saving the profile sequences. This value depends, among other things, on the settings of the parameters "No. of profiles" (File/Buffer) and "Points per profile" (Advanced scanner settings, see Chapter 3.9). If the value of used memory exceeds the available memory, the system may accept user inputs only very slowly and error-free behavior is no longer guaranteed.

4 Record

- **Trigger mode, inactive:** Start the recording of the profile sequences with the red "Record" button. The profiles are now buffered in the RAM. The program shows you the status of this process in the field "buffered: [profile number]". If the maximum number of profiles is reached, the profiles are saved in the selected file. The buffering can be ended prematurely and the saving started by pressing the "Stop" button. The time required for the operation varies according to the size of the profile sequence. The program shows you the status of this process in the field "saved: [profile number]".
- **Trigger mode, active:** Press the red "Record" button. The measuring program is now ready to buffer profiles in the RAM. Press the "Trigger" button in order to buffer individual profiles. If the maximum number of profiles is reached, the profiles are saved in the selected file. The buffering can be ended prematurely and the saving started by pressing the "Stop" button. The time required for the operation varies according to the size of the profile sequence. The program shows you the status of this process in the field "saved: [profile number]".

Note: It is not possible in the "Save profile" program to load profile sequences, log measured values, load parameters from a file, save them in a file, save them permanently on gapCONTROL or to reset default settings.

Note: In order to save the gapCONTROL settings in the profile file, select "full set" as file format.

Note: There may be a discrepancy between the set point value and the actual value for the scan rate used for saving if the number of scans is set too high or the processing power of the PC is insufficient.

4.6 "Export Profiles" Program

Use the "Export Profiles" program to save profiles in an Excel-compatible format. The profiles are saved as "slk" files. Use the "File → Export profiles" menu entry in order to start the the "Export Profiles" program.

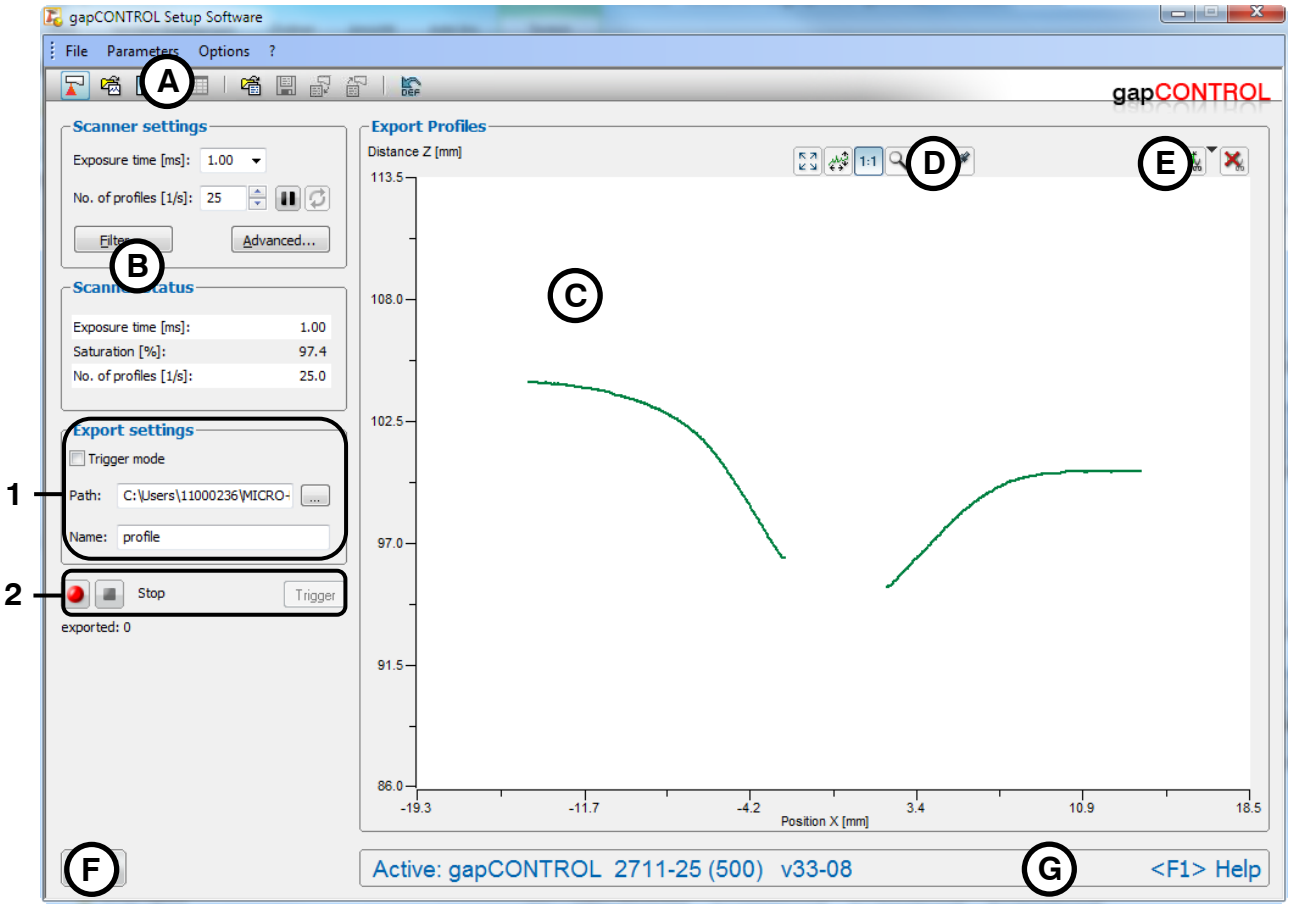


Fig. 4.55: "Export Profiles" program

Display elements and parameters in the "Export Profiles" program:

A "**General**" **toolbar:** Using this toolbar, you can select the data source (see Chapter 3.5), save profile sequences (see Chapter 3.6), and reset selected parameters to default settings (see Chapter 3.13.16).

B **Scanner settings:** Change the settings of gapCONTROL with these values (see Chapter 3.7). In Offline mode (see Chapter 3.5) this input field will be replaced by the "File settings" input field (see Chapter 3.10) for controlling the playback of a loaded profile sequence.

C **2D-display:** This display shows the last measured profile.

D "**Display**" **toolbar:** Using this toolbar, you scale the 2D-display and activate various options for the mouse interaction (see Chapter 3.16).

E "**Measurement**" **toolbar:** Set the various search ranges and limits for the measurement using this toolbar (see Chapter 3.17).

F "**Navigation**" **button**: Click on this button in order to show the "Navigation" menu (see Chapter 3.18).

G **Status line:** Status and error messages are displayed on the status line (see Chapter 8.1).

1 Export settings

- **Trigger mode:** You activate the trigger mode (see below, "Record" section) with this input field.
- **Path:** The directory in which the files are stored.
- **Name:** The name of the profile files which the profile data are exported to.

2 Record

- **Trigger mode, inactive:** Start the recording of the profile sequences with the red "Record" button. The transferred profiles are exported now. The process can be finished by pressing the "Stop" button.
- **Trigger mode, active:** Press the red "Record" button. The measuring program is now ready to export profiles. Press the "Trigger" button in order to export individual profiles. The process can be finished by pressing the "Stop" button.

Note: The program stores the profiles as "slk" files. This format can be imported into other programs, for example Microsoft Excel. One profile is stored in each file whereby the file names are automatically incremented. For example, if the profile name is specified as "profile", the files "profile_00001.slk", "profile_00002.slk" etc. are created. The profile counter is reset after 99999 profiles.

Note: Only profile points being inside the region of interest (Cutting out, see Chapter 3.13.1) are stored.

Note: It is not possible in the "Export profiles" program to save parameters in a file or to save them permanently on gapCONTROL.

5 Combining, Filtering and Evaluating Measured Values and Configuring Outputs

Once the configuration of the measurement is complete, you may configure the measured values output ports of the gapCONTROL measurement system. In addition, you may combine, filter and visualize the measured values.

To do so, use the "Configuration of the measured values" input field (see Fig. 5.1).

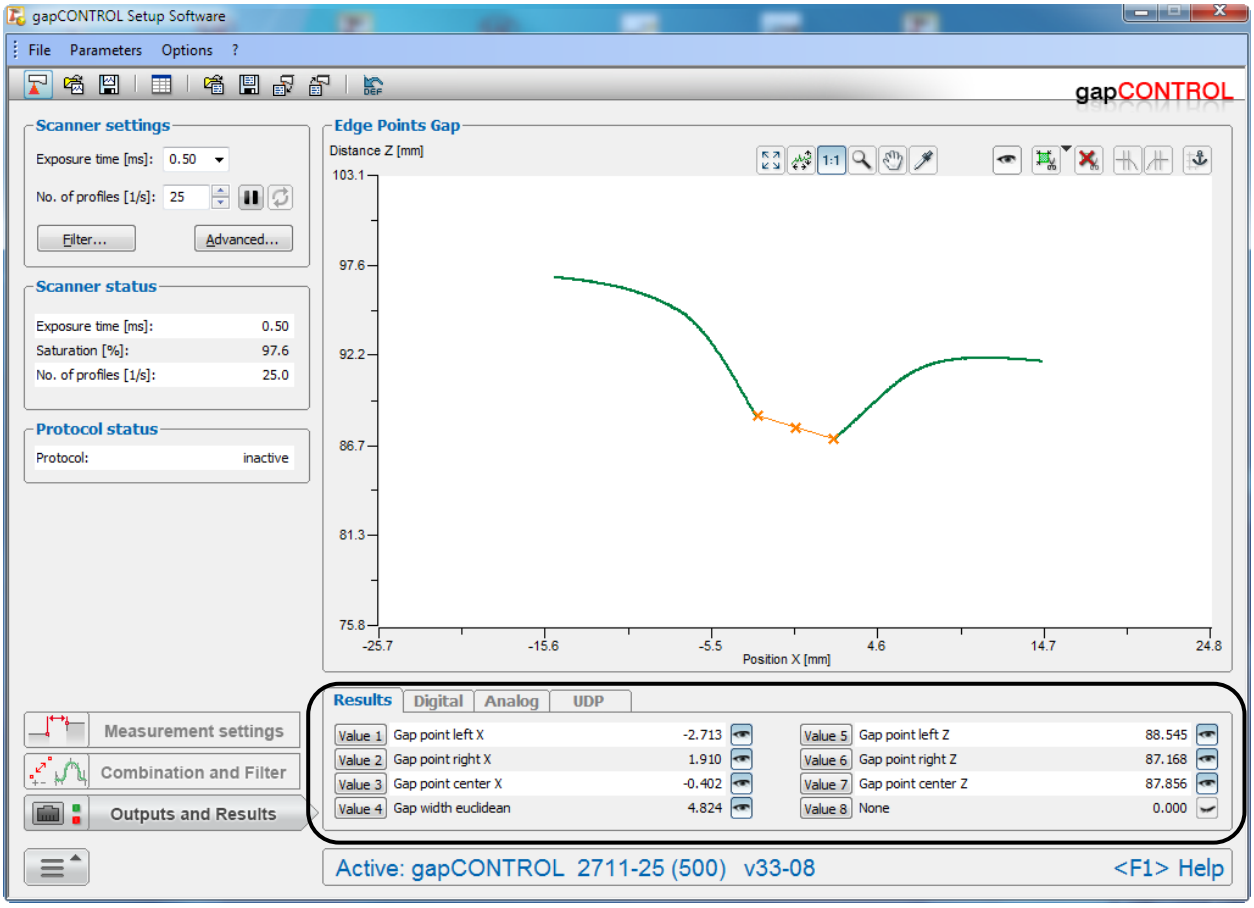


Fig. 5.1: "Configuration of the measured values" input field

5.1 Configuration of the Result Combination

Setup Software provides the possibility to calculate up to eight measured values.

➡ To do so, press the "Combination and Filter" button and select the "Combination" tab.

All the measured values from the active measuring program will be available.

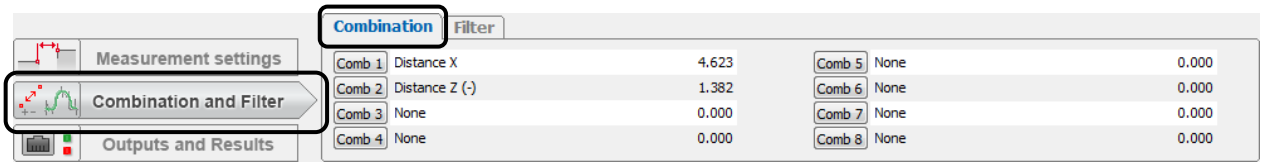


Fig. 5.2: "Combination" tab sheet

The currently combined values are listed in the "Combination" tab sheet (see Fig. 5.2).

➡ Press the "Comb x" button to configure the respective combination.

The following dialog box will be displayed:

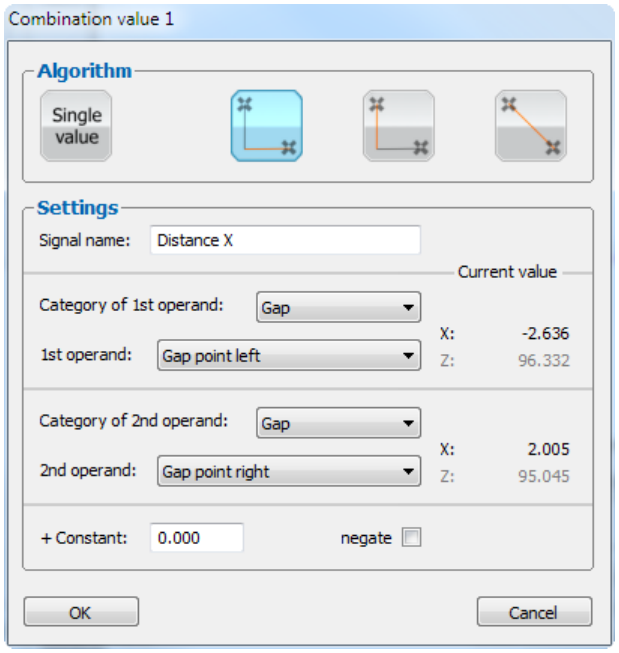


Fig. 5.3: "Combination value" dialog box

Make the following settings:

Algorithm: The following algorithms are available for combining measured values:

Single value: You can select a measured value from the active measuring program.

Distance X: Calculates the difference of the X coordinates of two points.

Distance Z: Calculates the difference of the Z coordinates of two points.

Distance euclidean: Calculates the euclidean distance between two points.

Settings: Define operands and constants for a combined signal:

- **Signal name:** Enter a name for the combined signal.
- **Category of 1st/2nd operand:** Select the category of measured value which needs to be combined:
  - **None:** No measured value is selected.
  - **Gap:** Characteristics of the gap measurement.
  - **Flush:** Characteristics of the flush measurement (optional).
  - **Reference:** Characteristics of the reference lines and selected anchor point (optional).

    - **Projection:** Characteristics of the projection lines (optional).
    - **Min. Gap:** Characteristics of the base gap (optional).
    - **Base:** Characteristics of the extended gap measurement (Groove Gap, optional).
    - **ROI:** Coordinates of the selected anchor point and bounding points of the range for cutting out (optional).
    - **Global:** Coordinates of the bounding points of the profile (optional).
- **1st/2nd operand:** Select the operand for the calculation.
- **+ Constant:** Define a constant to be added to the result of the calculation.
- **negate:** Activate the check box to negate the result of the calculation.

➡ Confirm your settings with the "OK" button.

5.2 Configuration of the Result Filters

Setup Software provides the possibility to filter up to eight measured values chronologically.

➪ To do so, press the "Combination and Filter" button and select the "Filter" tab.

All the measured values from the active measuring program and all combined measurement values are available.

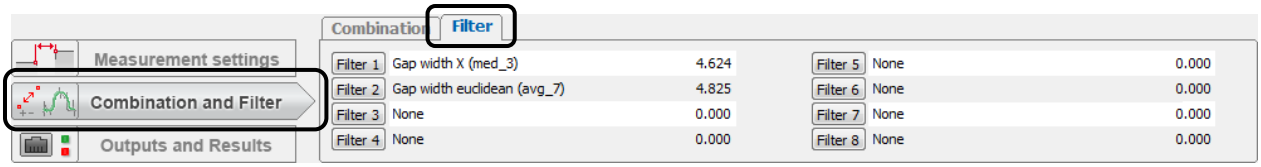


Fig. 5.4: "Filter" tab sheet

The currently filtered values are listed in the "Filter" tab sheet (see Fig. 5.4).

➪ Press the "Filter x" button to configure the respective filter.

The following dialog box will be displayed:

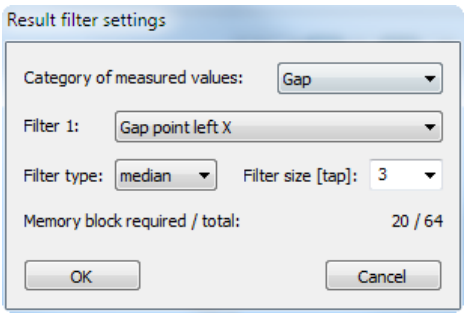


Fig. 5.5: "Result filter settings" dialog box

Make the following settings:

- **Category of measured values:** Select the category of measured value which needs to be filtered:
  - **None:** No measured value is selected.
  - **Gap:** Characteristics of the gap measurement.
  - **Flush:** Characteristics of the flush measurement (optional).
  - **Reference:** Characteristics of the reference lines and selected anchor point (optional).
  - **Projection:** Characteristics of the projection lines (optional).
  - **Min. Gap:** Characteristics of the base gap (optional).
  - **Base:** Characteristics of the extended gap measurement (Groove Gap, optional).
  - **ROI:** Coordinates of the selected anchor point and bounding points of the range for cutting out (optional).
  - **Global:** Coordinates of the bounding points of the profile (optional).
  - **Combined:** The combined measurement values (optional).
- **Filter x:** Select the measured value which needs to be filtered.
- **Filter type:**
  - **average:** Activate an average filter with this parameter.
  - **delay:** This parameter activates the delayed output of a measured value. It is possible to delay the output of a measured value by up to 31 measurement sequences.
  - **median:** Activate a median filter with this parameter.
- **Filter size [tap]:** Enter the filter size.
- **Memory block required / total:** The allocation of the filter memory block is displayed in this information field. The filter memory space of the gapCONTROL measurement system is limited.

➪ Confirm your settings with the "OK" button.

The filtered values are labeled as follows: The filter type (*avg*, *del* or *med*) and filter size are added to the name of the filtered measurement in curved brackets. For example, *(med_3)* stands for a median filter of size 3.

5.3 Show the Measured Values

In the individual programs, you have the possibility to display up to eight measured values in the 2D-display.

➪ To do so, press the "Outputs and Results" button and select the "Results" tab.

All the measured values from the active measuring program and all combined and filtered measurement values are available.

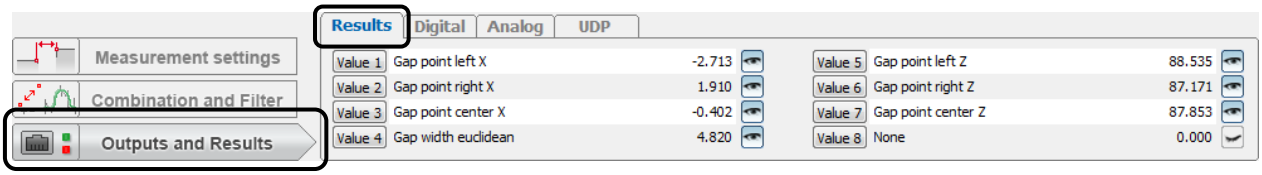


Fig. 5.6: "Results" tab sheet

The values currently displayed are listed in the "Results" tab sheet (see Fig. 5.6).

➪ Press the "Value x" button to configure the display of the respective measured value.

The following dialog is displayed:

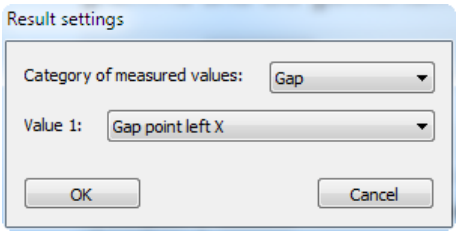


Fig. 5.7: "Result settings" dialog box

Make the following settings:

- **Category of measured values:** Select the category of measured value which to be displayed:
  - **None:** No measured value is selected.
  - **Gap:** Characteristics of the gap measurement.
  - **Flush:** Characteristics of the flush measurement (optional).
  - **Reference:** Characteristics of the reference lines and selected anchor point (optional).
  - **Projection:** Characteristics of the projection lines (optional).
  - **Min. Gap:** Characteristics of the base gap (optional).
  - **Base:** Characteristics of the extended gap measurement (Groove Gap, optional).
  - **ROI:** Coordinates of the selected anchor point and bounding points of the range for cutting out (optional).
  - **Global:** Coordinates of the bounding points of the profile (optional).
  - **Combined:** The combined measurement values (optional).
  - **Filtered:** The filtered measurement values (optional).
- **Value x:** Select the measured value to be displayed.

➪ Confirm your settings with the "OK" button.

Press the button to confirm whether the selected measurement value is to be shown or hidden in the 2D-display.

5.4 Configuration of the Digital Outputs

In order to output OK and nOK measured values, gapCONTROL provides eight digital outputs. At the "Digital out" tab sheet, select the signals to be issued at the digital outputs.

➡ To do so, press the "Outputs and Results" button and select the "Digital" tab.

All the measured values and status signals from the active measuring program and all combined and filtered measurement values are available.

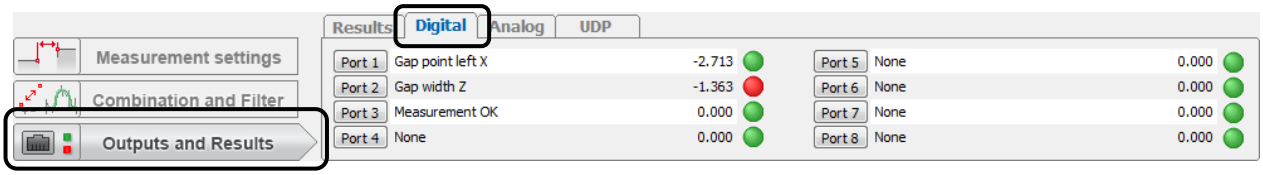


Fig. 5.8: "Digital" tab sheet

The "Digital" tab sheet (see Fig. 5.8) shows the actual values for the digital outputs of gapCONTROL.

➡ Use the "Port x" button in order to configure the according output ports.

The "Digital port settings" dialog is displayed:

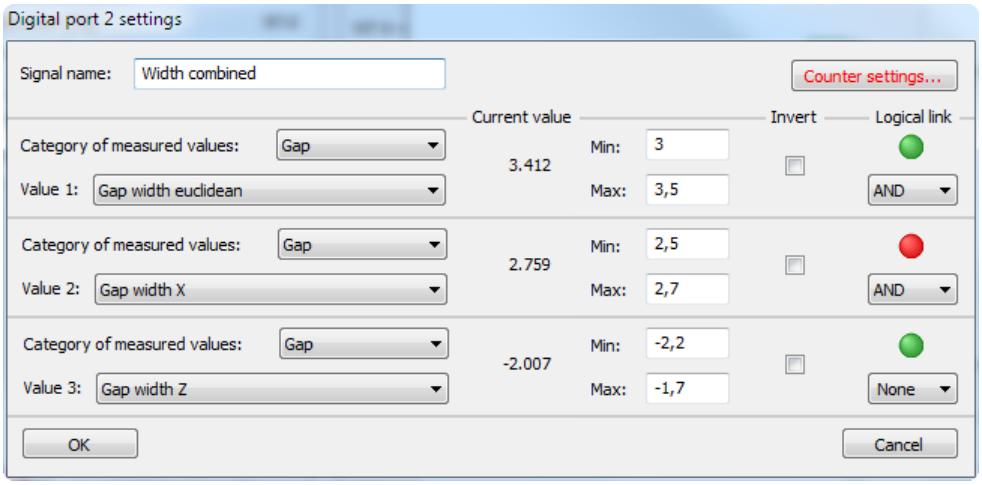


Fig. 5.9: "Digital port settings" dialog box

Make the following settings:

- **Signal name:** Enter a name for the evaluated signal.
- **Category of measured values:** Select the category of measured value which should be issued:
  - **None:** No measured value is selected.
  - **Gap:** Characteristics of the gap measurement.
  - **Flush:** Characteristics of the flush measurement (optional).
  - **Reference:** Characteristics of the reference lines and selected anchor point (optional).
  - **Projection:** Characteristics of the projection lines (optional).
  - **Min. Gap:** Characteristics of the base gap (optional).
  - **Base:** Characteristics of the extended gap measurement (Groove Gap, optional).
  - **ROI:** Coordinates of the selected anchor point and bounding points of the range for cutting out (optional).
  - **Global:** Coordinates of the bounding points of the profile (optional).
  - **Combined:** The combined measurement values (optional).
  - **Filtered:** The filtered measurement values (optional).
  - **Misc:** Digital output ports (optional).
  - **Measurement OK:** Status signal.
- **Value x:** Select the signal which should be issued at the respective port (1 - 8).
- **Min:** The lower limit of the range for the evaluation of the selected measurement value.
- **Max:** The upper limit of the range for the evaluation of the selected measurement value.
- **Invert:** Dependent on the setting of this parameter the selected digital out port behaves as follows:
  - **Inactive:** If the signal is within the specified range a logical 1 (OK) will be issued at the digital output, otherwise a logical 0 (nOK) will be issued. If the measurement value is equal to the range limits a logical 1 (OK) will be issued. In the case of output of a status signal, a logical 1

(OK) will be issued at the digital output if no error has occurred during the measurement. If an error occurs during the measurement, a logical 0 (nOK) will be issued.

- **Active:** If the signal is within the specified range a logical 0 (nOK) will be issued at the digital output, otherwise a logical 1 (OK) will be issued. If the measurement value is equal to the range limits a logical 0 (nOK) will be issued. In the case of output of a status signal, a logical 0 (nOK) will be issued at the digital output if no error has occurred during the measurement. If an error occurs during the measurement, a logical 1 (OK) will be issued.

- **Logical link:** Specify whether the current result of the evaluation has to be logical linked with another signal. You may link up to eight signals. The following algorithms are available for linking measured values:
  - **AND:** Logical AND link.
  - **OR:** Logical OR link.
  - **XOR:** Logical XOR link.

In addition to the evaluation, you can specify whether the signal must meet an adjusted condition over several measurements before it will be issued at the digital output (evaluation of a measurement series). This is, for example, for the elimination of individual measurements, which are irrelevant for the evaluation of the measurement series.

➪ To do so, press the "Counter settings…" button (see Fig. 5.9) in order to show the "Digital port counter settings" dialog box (see Fig. 5.10).

If the evaluation of a measurement series is active for the current port, the font of the "Counter settings..." button appears red or green.

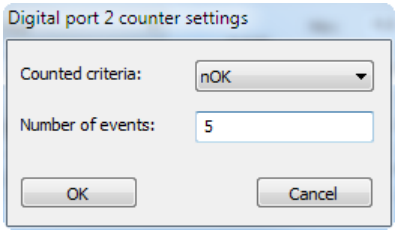


Fig. 5.10: "Digital port counter settings" dialog box

Make the following settings:

- **Counted criteria:** Define the condition for the evaluation of the measurement series:
  - **OK:** The Measurement series is OK if at least N consecutive measurements have been evaluated as OK.
  - **nOK:** The Measurement series is nOK if at least N consecutive measurements have been evaluated as nOK.
- **Number of events:** Enter the number N of measurements for the evaluation of the measurement series.

➪ Confirm your settings with the "OK" button.

Example: Digital output is nOK when the measurement is NOK for five times. This results in the following developing:

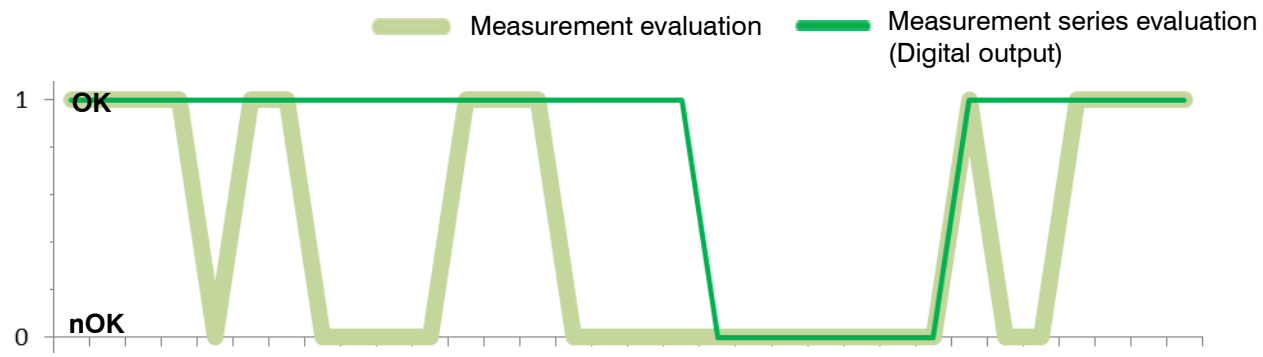


Fig. 5.11: "Digital port counter" Example

➥ Confirm your settings with the "OK" button.

Note: By default, the logical value corresponds to the electrical level (OK = high level, nOK = low level). In case of activating the "Invert level" parameter (see Chapter 3.9), the electrical signal, output at the digital outputs, is inverted (OK = low level, nOK = high level).

5.5 Configuration of the Analog Outputs

gapCONTROL provides four analog outputs. At the "Analog out" tab sheet, select the signals to be issued at the analog outputs.

➡ To do so, press the "Outputs and Results" button and select the "Analog" tab.

All the measured values from the active measuring program and all combined and filtered measurement values are available.

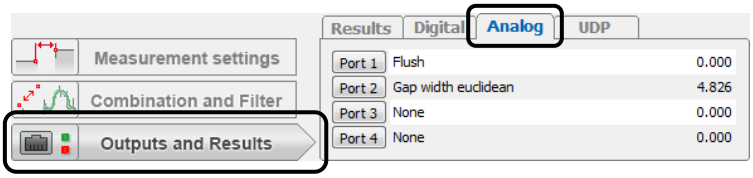


Fig. 5.12: "Analog" tab sheet

The "Analog" tab sheet (see Fig. 5.12) shows the actual values for the analog outputs of gapCONTROL.

➡ Use the "Port x" button in order to configure the according output ports.

The "Analog port settings" dialog is displayed:

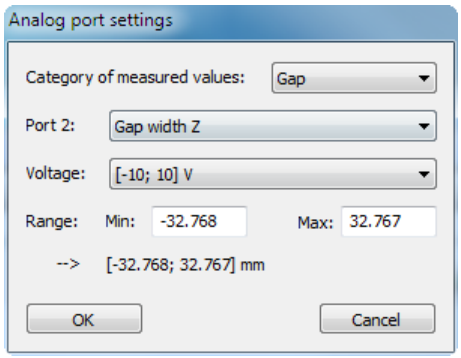


Fig. 5.13: "Analog port settings" dialog box

The following settings are available:

- **Category of measured values:** Select the category of measured value which should be issued:
  - **None:** No measured value is selected.
  - **Gap:** Characteristics of the gap measurement.
  - **Flush:** Characteristics of the flush measurement (optional).
  - **Reference:** Characteristics of the reference lines and selected anchor point (optional).
  - **Projection:** Characteristics of the projection lines (optional).
  - **Min. Gap:** Characteristics of the base gap (optional).
  - **Base:** Characteristics of the extended gap measurement (Groove Gap, optional).
  - **ROI:** Coordinates of the selected anchor point and bounding points of the range for cutting out (optional).
  - **Global:** Coordinates of the bounding points of the profile (optional).
  - **Combined:** The combined measurement values (optional).
  - **Filtered:** The filtered measurement values (optional).
- **Port x:** Select the measured result which should be issued at the respective port (1 - 4).
- **Voltage:** Specify the analog output clamp of the gapCONTROL Output Unit you are using. The specified range of measured values ("Range min" and "Range max") is mapped to the voltage or current range of the output clamp:
  - **[-10; 10] V**
  - **[0; 10] V**
  - **[0; 20] mA**
  - **[4; 20] mA**
- **Range:** Input the possible range of the measured value. The output signal will be scaled so that the range of the measured value is mapped to the voltage range.
  - **Min:** The lower limit of the measured value range.
  - **Max:** The upper limit of the measured value range.

Note: The scaling resolution of gapCONTROL is limited. Setup Software calculates the range next in size from the settings in the "Range" input field for the respective signal. The range actually used is shown in the display "--> [min; max]".

➡ Confirm your settings with the "OK" button.

5.6 Configuration of the Serial Outputs

gapCONTROL has a serial port to output up to 32 measured values. The measured values are transmitted as an ASCII string.

➡ To do so, press the "Outputs and Results" button and select the "Serial" tab.

All the measured values from the active measuring program and all combined and filtered measurement values are available. Also the error code (see Chapter 8.1), the number of the current profile and the status of the digital outputs can be output. The states of the digital outputs can be transmitted as an ASCII string or in binary format (see Chapter 7.2.4).

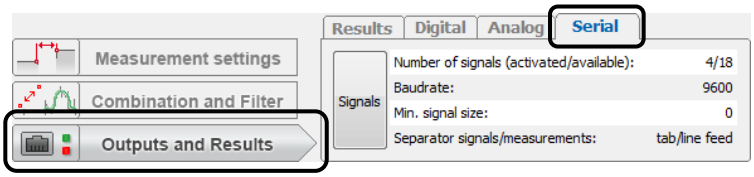


Fig. 5.14: "Serial" tab sheet"

Note: The "Serial" tab sheet is only available if the "Interface/protocol" parameter in the "Advanced scanner settings" dialog box is set to "output unit + serial" (see Chapter 3.9).

The number of output measured values and the configuration of the serial interface are displayed in the "Serial" tab sheet (see Fig. 5.14).

➡ Use the "Signals" button to configure the serial interface.

The following dialog is displayed:

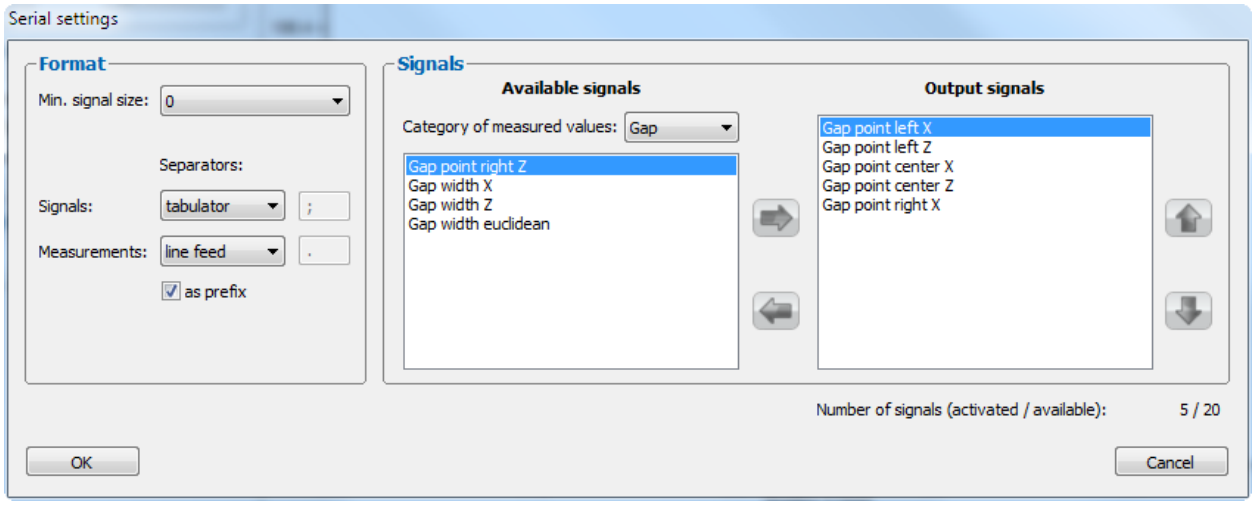


Fig. 5.15: "Serial settings" dialog box

Make the following settings:

- **Min. signal size:** The minimum number of characters which will be transferred per measured value. If the number of characters which are needed for the transmission of a measured value is smaller than the specified parameter, leading spaces will be inserted for the measured value. If the length of the measured value is greater than the specified parameter, the measured value is transferred unchanged.

Separator for measured values:

- **Signals:** Define a separator which will be inserted after each measured value:
  - **tabulator:** A tab character will be inserted as separator.
  - **line feed:** A line feed character will be inserted as separator.
  - **user defined:** Define up to 4 characters which will be inserted after each measured value.

Separator for measurements:

- **Measurements:** Define a separator which will be inserted before or after each measurement:
  - **tabulator:** A tab character will be inserted as separator.

  - **line feed:** A line feed character will be inserted as separator.
  - **user defined:** Define up to 4 characters which will be inserted before or after each measurement.
- **As prefix:** On activating this parameter the separator will be inserted before each measurement. When deactivating this parameter the separator will be inserted after each measurement.

Note: Use the "Interface" tab sheet in the "Advanced scanner settings" dialog (see Chapter 3.9) in order to set the baudrate for the serial interface.

The following port parameters are preset in gapCONTROL and cannot be changed:

- **Data bits:** 8
- **Parity:** none
- **Stop bits:** 2
- **Flow control:** none

In the signals area located on the right side of the dialog select the signals which should be issued at the serial port.

All available signals which are not currently output to the serial port are shown in the "Available signals" list. The signals which will be transmitted via the port are shown in the "Output signals" list.

Proceed as follows to select a signal for output to the serial port:

➪ Select the category of measured value which should be issued:

- **Category of measured values:**
  - **None:** No measured value is selected.
  - **Gap:** Characteristics of the gap measurement.
  - **Flush:** Characteristics of the flush measurement (optional).
  - **Reference:** Characteristics of the reference lines and selected anchor point (optional).
  - **Projection:** Characteristics of the projection lines (optional).
  - **Min. Gap:** Characteristics of the base gap (optional).
  - **Base:** Characteristics of the extended gap measurement (Groove Gap, optional).
  - **ROI:** Coordinates of the selected anchor point and bounding points of the range for cutting out (optional).
  - **Global:** Coordinates of the bounding points of the profile (optional).
  - **Combined:** The combined measurement values (optional).
  - **Filtered:** The filtered measurement values (optional).
  - **Misc:** Additional values.

➪ Select the desired signal in the "Available signals" list.

➪ Press the button .

The desired signal is now moved to the "Output signals" list.

Proceed as follows to deactivate the output of a signal:

➪ Select the desired signal in the "Output signals" list.

➪ Press the button .

The desired signal is now moved to the "Available signals" list.

➪ With the buttons  you can move a selected signal in the "Output signals" list up or down and thus change the order of the output signals.

Note: A maximum of 80 characters per measurement can be transmitted via the serial port. If more characters are transmitted, the residual characters are discarded.

Note: The measured values are transmitted to the serial interface in sensor coordinates. Please refer to the table in Chapter 7.2.4 for the conversion of the measured values to real coordinates.

5.7 Configuration of the Outputs using UDP

Setup Software provides the possibility to output the results via Ethernet using UDP. The measured values are transmitted as an ASCII string.

➡ To do so, press the "Outputs and Results" button and select the "UDP" tab.

All the measured values from the active measuring program and all combined and filtered measurement values are available. Also the error code (see Chapter 8.1), the number of the current profile and the status of the digital outputs can be output. The states of the digital outputs can be transmitted as an ASCII string or in binary format (see Chapter 7.2.4).

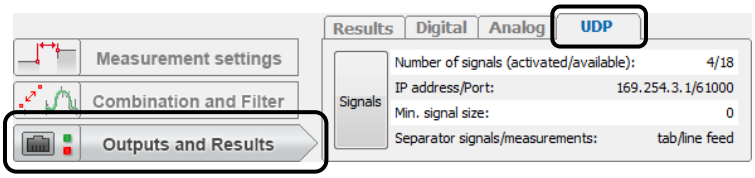


Fig. 5.16: "UDP" tab sheet

Note: The "UDP" tab is only available if the "Interface/protocol" parameter in the "Advanced scanner settings" dialog box is set to "output unit + UDP" (see Chapter 3.9).

The number of output measured values and the configuration for the output using UDP are displayed in the "UDP" tab sheet (see Fig. 5.16).

➡ Use the "Signals" button to configure the output of the measured values using UDP.

The following dialog is displayed:

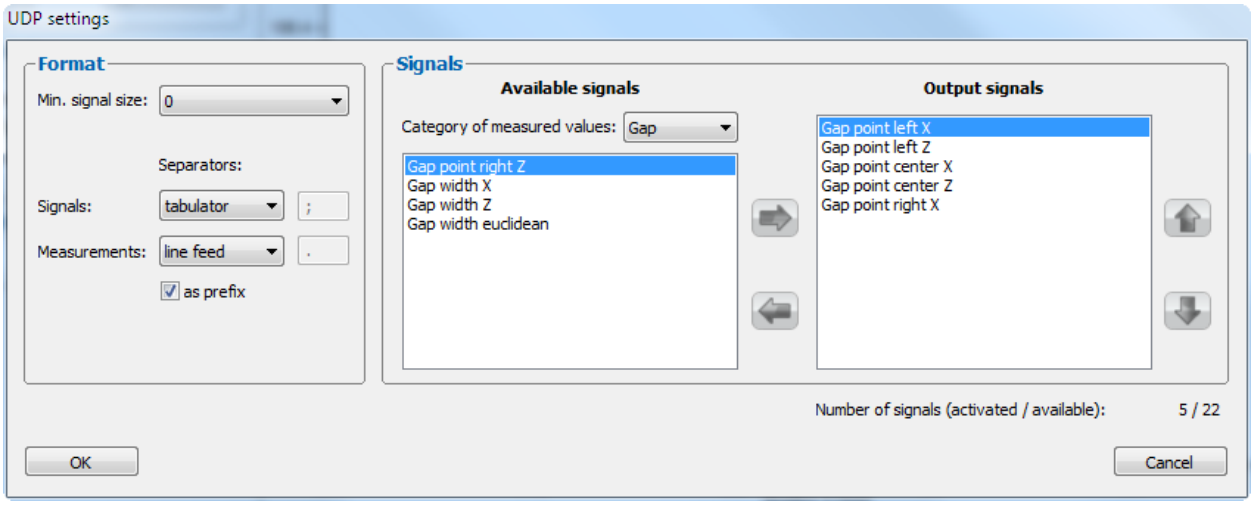


Fig. 5.17: "UDP settings" dialog box

Make the following settings:

- **Min. signal size:** The minimum number of characters which will be transferred per measured value. If the number of characters which are needed for the transmission of a measured value is smaller than the specified parameter, leading spaces will be inserted for the measured value. If the length of the measured value is greater than the specified parameter, the measured value is transferred unchanged.

Separator for measured values:

- **Signals:** Define a separator which will be inserted after each measured value:
  - **tabulator:** A tab character will be inserted as separator.
  - **line feed:** A line feed character will be inserted as separator.
  - **user defined:** Define up to 4 characters which will be inserted after each measured value.

Separator for measurements:

- **Measurements:** Define a separator which will be inserted before or after each measurement:
  - **tabulator:** A tab character will be inserted as separator.

  - **line feed:** A line feed character will be inserted as separator.
  - **user defined:** Define up to 4 characters which will be inserted before or after each measurement.
- **As prefix:** On activating this parameter the separator will be inserted before each measurement. When deactivating this parameter the separator will be inserted after each measurement.

Note: Use the "Interface" tab sheet in the "Advanced scanner settings" dialog (see Chapter 3.9) in order to set the IP address and the UDP port of the receiver (client) of the measured values.

Note: gapCONTROL uses source port 8000 for the UDP connection.

In the signals area located on the right side of the dialog select the signals which should be transferred via Ethernet using UDP.

All available signals which are not currently output are shown in the "Available signals" list. The signals which will be transmitted are shown in the "Output signals" list.

Proceed as follows to select a signal for output:

➪ Select the category of measured value which should be issued:
- **Category of measured values:**
  - **None:** No measured value is selected.
  - **Gap:** Characteristics of the gap measurement.
  - **Flush:** Characteristics of the flush measurement (optional).
  - **Reference:** Characteristics of the reference lines and selected anchor point (optional).
  - **Projection:** Characteristics of the projection lines (optional).
  - **Min. Gap:** Characteristics of the base gap (optional).
  - **Base:** Characteristics of the extended gap measurement (Groove Gap, optional).
  - **ROI:** Coordinates of the selected anchor point and bounding points of the range for cutting out (optional).
  - **Global:** Coordinates of the bounding points of the profile (optional).
  - **Combined:** The combined measurement values (optional).
  - **Filtered:** The filtered measurement values (optional).
  - **Misc:** Additional values.

➪ Select the desired signal in the "Available signals" list.
➪ Press the button  .

The desired signal is now moved to the "Output signals" list.

Proceed as follows to deactivate the output of a signal:

➪ Select the desired signal in the "Output signals" list.
➪ Press the button  .

The desired signal is now moved to the "Available signals" list.

➪ With the buttons  you can move a selected signal in the "Output signals" list up or down and thus change the order of the output signals.

Note: Outputting measured values using UDP is only available for gapCONTROL devices with an Ethernet interface.

Note: A maximum of 80 characters per measurement can be transmitted via Ethernet. If more characters are transmitted, the residual characters are discarded.

Note: The measured values are transmitted via Ethernet using sensor coordinates. Please refer to the table in Chapter 7.2.4 for the conversion of the measured values to real coordinates.

5.8 Configuration of the Outputs using Modbus

Setup Software provides the possibility to output the results using Modbus. The results are output to the serial port and via Ethernet.

➪ To do so, press the "Outputs and Results" button and select the "Modbus" tab.

All the measured values from the active measuring program and all combined and filtered measurement values are available. Also the error code (see Chapter 8.1), the number of the current profile and the status of the digital outputs can be output. The states of the digital outputs are transmitted in binary format (see Chapter 7.2.4).

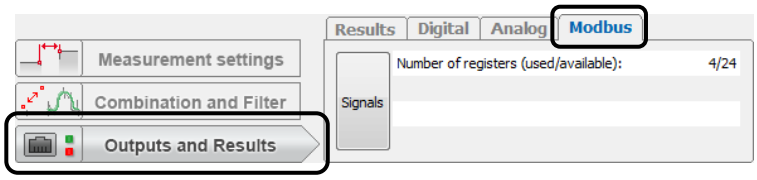


Fig. 5.18: "Modbus" tab sheet

Note: The "Modbus" tab sheet is only available if the "Interface/protocol" parameter in the "Advanced scanner settings" dialog box is set to "modbus" (see Chapter 3.9).

The number of used Modbus registers is displayed in the "Modbus out" tab sheet (see Fig. 5.18).

➪ Use the "Signals" button to configure the Modbus interface.

The following dialog is displayed:

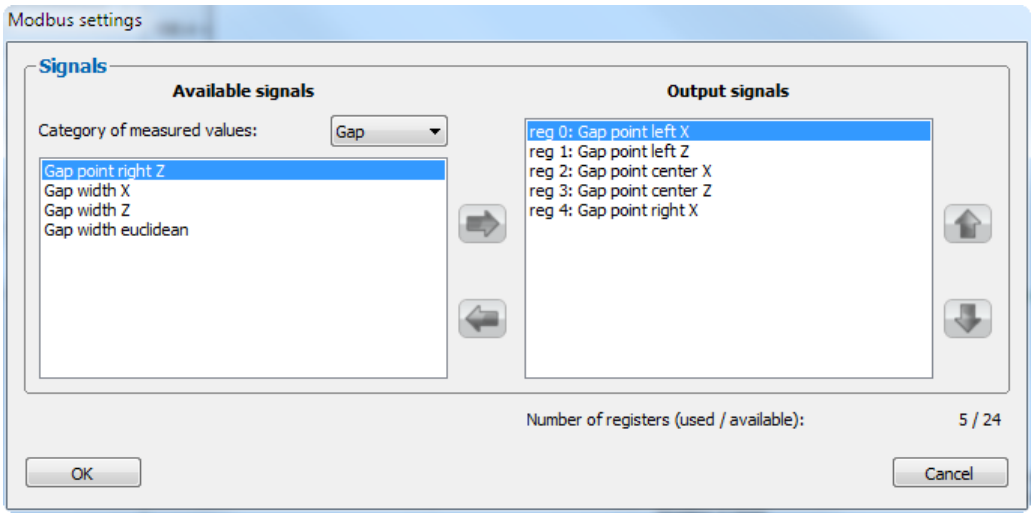


Fig. 5.19: "Modbus settings" dialog box

All available signals which are not currently output are shown in the "Available signals" list. The signals which will be transmitted are shown in the "Output signals" list.

Proceed as follows to select a signal for output:

➪ Select the category of measured value which should be issued:

- **Category of measured values:**
  - **None:** No measured value is selected.
  - **Gap:** Characteristics of the gap measurement.
  - **Flush:** Characteristics of the flush measurement (optional).
  - **Reference:** Characteristics of the reference lines and selected anchor point (optional).
  - **Projection:** Characteristics of the projection lines (optional).
  - **Min. Gap:** Characteristics of the base gap (optional).
  - **Base:** Characteristics of the extended gap measurement (Groove Gap, optional).
  - **ROI:** Coordinates of the selected anchor point and bounding points of the range for cutting out (optional).
  - **Global:** Coordinates of the bounding points of the profile (optional).
  - **Combined:** The combined measurement values (optional).
  - **Filtered:** The filtered measurement values (optional).

- **Misc:** Additional values.

➡ Select the desired signal in the "Available signals" list.
➡ Press the button  .

The desired signal is now moved to the "Output signals" list.

Proceed as follows to deactivate the output of a signal:

➡ Select the desired signal in the "Output signals" list.
➡ Press the button  .

The desired signal is now moved to the "Available signals" list.

➡ With the buttons  you can move a selected signal in the "output signals" list up or down and thus change the order of the output signals.

Note: Up to 24 Modbus registers (16 bits each) can be used. Depending on the type a measured value requires 16 or 32 bits, i.e. one or two registers. When transmitting a 32 bit value the upper 16 bits are stored in the first and the lower 16 bits in the second register.

Note: The measured values are transmitted in sensor coordinates. Please refer to the table in Chapter 7.2.4 for the conversion of the measured values to real coordinates.

5.9 Logging Measured Values

Setup Software makes it possible for you to log measured values to an ASCII file. You have the possibility to perform user-defined evaluations with your measurement data.

Note: In order to run the logging in combination with a connected gapCONTROL measurement system, you need a full version of gapCONTROL Setup Software.

Note: Logging of measured values is only available in the measuring programs.

Select the "File → Activate protocol results..." menu item or press the corresponding button (see Fig. 5.20) in the "General" toolbar.

Fig. 5.20: "Protocol results" button

The "Protocol results" dialog is displayed (see Fig. 5.21). You may make the settings for logging there.

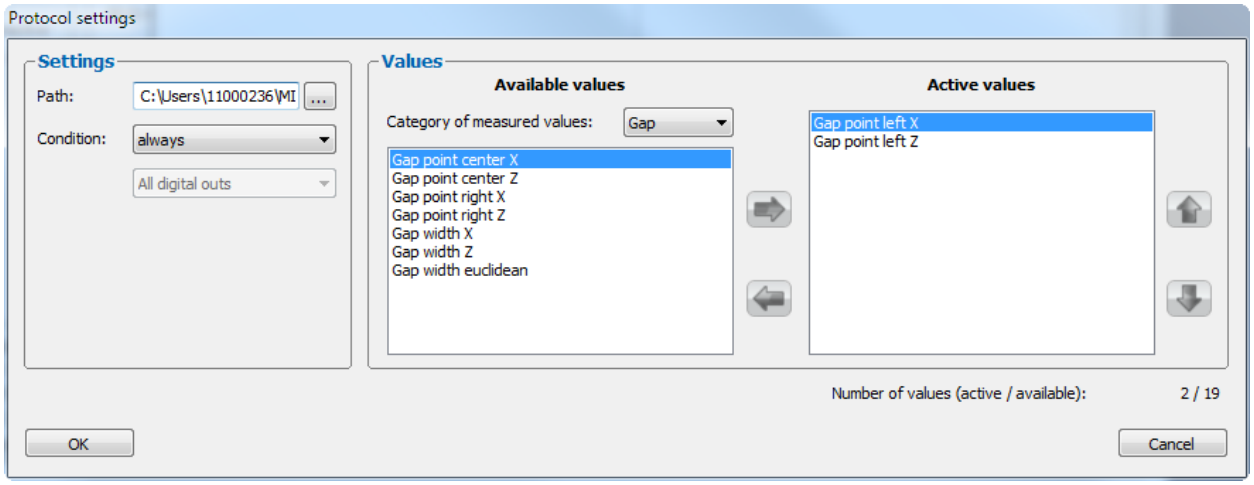


Fig. 5.21: "Protocol results" dialog box

- **Path:** Specify the filename and its complete path where the measured values should be saved. As standard, the file name has the extension ".txt". Use the button "..." in order to select the file using a standard Windows dialog.
- **Condition:** Define the logging condition using this parameter:
  - **always:** All measurement operations are logged.
  - **nOK:**
    - **All digital outs:** Measurement operations where all digital outputs has been evaluated as nOK are logged.
    - **Any digital out:** Measurement operations where at least one digital output has been evaluated as nOK are logged.
    - **Digital out x:** Measurement operations where digital output x has been evaluated as nOK are logged.
  - **OK:**
    - **All digital outs:** Measurement operations where all digital outputs has been evaluated as OK are logged.
    - **Any digital out:** Measurement operations where at least one digital output has been evaluated as OK are logged.
    - **Digital out x:** Measurement operations where digital output x has been evaluated as OK are logged.

Note: You can use the "%" wildcard in the file name. This is then replaced by a counter which is incremented by one for every new start of the logging. In this way you can automatically create a new file for each new log. The counter is reset if you start a measuring program or if you specify a new file name.

All available values which are not currently logged are shown in the "Available values" list. The values which will be logged are shown in the "Active values" list.

Proceed as follows to select a value for logging:

- **Category of measured values:** Select the category of measured value which should be logged:
  - **None:** No measured value is selected.
  - **Gap:** Characteristics of the gap measurement.
  - **Flush:** Characteristics of the flush measurement (optional).
  - **Reference:** Characteristics of the reference lines and selected anchor point (optional).
  - **Projection:** Characteristics of the projection lines (optional).
  - **Min. Gap:** Characteristics of the base gap (optional).
  - **Base:** Characteristics of the extended gap measurement (Groove Gap, optional).
  - **ROI:** Coordinates of the selected anchor point and bounding points of the range for cutting out (optional).
  - **Global:** Coordinates of the bounding points of the profile (optional).
  - **Combined:** The combined measurement values (optional).
  - **Filtered:** The filtered measurement values (optional).
  - **Misc:** Additional values.

➡ Select the desired value in the "Available values" list.

➡ Press the button .

The desired value is now moved to the "Active values" list.

Proceed as follows to deactivate the logging of a value:

➡ Select the desired value in the "Active values" list.

➡ Press the button .

The desired value is now moved to the "Available values" list.

➡ With the buttons you can move a selected value in the "Active values" list up or down and thus change the order of the logged value.

➡ Confirm your settings with the "OK" button in order to start the logging.

In order to stop the logging, use the "File → Deactivate protocol results..." menu item or press the corresponding button (see Fig. 5.20) in the "General" toolbar again.

Note: The "Protocol status" area is located on the left side of the individual measuring program (see Fig. 3.2). The current logging status (active/inactive) is displayed in this area.

An example log file can be seen in Fig. 5.22.

	A	B	C	D	E	F	G	H	I	J	K	L
1	www.micro-epsilon.com											
2	gapCONTROL Setup Software: Threshold Points Gap											
3												
4	gapCONTROL 2711-25 (500) v33-08											
5	SN: 109060020											
6	No. of profiles [1/s]: 25											
7	Last loaded parameters: D:\SVN_Projekte\Produkte\gapCONTROL\Setup Software\Signalgraphen\last\last_settings.gc1											
8												
9	Date	Time	Profile no.	Gap point le	Gap point le	Gap point ce	Gap point ce	Gap point rig	Gap point rig	Gap width X	Gap width Z	Flush [mm]
10	02.10.2015	12:15:41:192	406447	-6.987	102.226	-0.170	100.639	6.648	99.053	13.635	-3.173	0.000
11	02.10.2015	12:15:41:232	406448	-6.986	102.226	-0.169	100.639	6.649	99.053	13.635	-3.173	0.000
12	02.10.2015	12:15:41:272	406449	-6.987	102.228	-0.173	100.640	6.641	99.052	13.628	-3.176	0.000
13	02.10.2015	12:15:41:312	406450	-6.984	102.225	-0.168	100.639	6.648	99.054	13.632	-3.171	0.000
14	02.10.2015	12:15:41:352	406451	-6.984	102.225	-0.170	100.638	6.645	99.052	13.629	-3.173	0.000
15	02.10.2015	12:15:41:392	406452	-6.989	102.228	-0.172	100.640	6.646	99.052	13.635	-3.176	0.000
16	02.10.2015	12:15:41:432	406453	-7.001	102.229	-0.183	100.640	6.636	99.052	13.637	-3.177	0.000
17	02.10.2015	12:15:41:472	406454	-6.989	102.226	-0.174	100.638	6.642	99.051	13.631	-3.175	0.000
18	02.10.2015	12:15:41:512	406455	-6.983	102.225	-0.168	100.640	6.648	99.055	13.631	-3.170	0.000
19	02.10.2015	12:15:41:552	406456	-6.992	102.225	-0.170	100.640	6.653	99.055	13.645	-3.170	0.000
20	02.10.2015	12:15:41:592	406457	-6.996	102.227	-0.175	100.640	6.646	99.053	13.642	-3.174	0.000
21	02.10.2015	12:15:41:632	406458	-6.999	102.232	-0.178	100.643	6.644	99.055	13.643	-3.177	0.000
22	02.10.2015	12:15:41:672	406459	-6.991	102.227	-0.171	100.643	6.650	99.059	13.641	-3.168	0.000
23	02.10.2015	12:15:41:712	406460	-6.982	102.228	-0.169	100.640	6.644	99.052	13.626	-3.176	0.000
24	02.10.2015	12:15:41:752	406461	-6.996	102.231	-0.173	100.644	6.650	99.057	13.646	-3.174	0.000
25	02.10.2015	12:15:41:792	406462	-6.981	102.227	-0.165	100.641	6.651	99.055	13.632	-3.172	0.000
26	02.10.2015	12:15:41:832	406463	-6.998	102.232	-0.175	100.645	6.649	99.058	13.647	-3.174	0.000
27	02.10.2015	12:15:41:872	406464	-6.994	102.231	-0.174	100.642	6.647	99.054	13.641	-3.177	0.000
28	02.10.2015	12:15:41:912	406465	-6.980	102.226	-0.166	100.641	6.648	99.057	13.628	-3.169	0.000
29	02.10.2015	12:15:41:952	406466	-6.983	102.229	-0.166	100.641	6.652	99.054	13.635	-3.175	0.000
30	02.10.2015	12:15:41:992	406467	-6.992	102.230	-0.168	100.642	6.657	99.055	13.649	-3.175	0.000
31	02.10.2015	12:15:42:032	406468	-6.988	102.229	-0.168	100.642	6.652	99.056	13.640	-3.173	0.000
32	02.10.2015	12:15:42:078	406469	-6.991	102.229	-0.167	100.642	6.658	99.056	13.649	-3.173	0.000
33	02.10.2015	12:15:42:112	406470	-6.847	102.122	-1.073	100.579	4.702	99.036	11.549	-3.086	0.000
34	02.10.2015	12:15:42:152	406471	-6.989	102.228	-0.167	100.642	6.656	99.056	13.645	-3.172	0.000
35	02.10.2015	12:15:42:192	406472	-6.988	102.225	-1.157	100.631	4.675	99.037	11.663	-3.188	0.000

protoco44l

Fig. 5.22: Example log file

6 "Result Monitor" Analysis Program

Use the "Result Monitor" program for statistical analysis of the results of the active measuring program and to save the analysis data in an Excel-compatible format. The analysis data is saved as .csv file. The program includes two 2D-displays showing up to two measured values over time.

Proceed as follows to carry out astatistical evaluation of measured values:

- In the "Program selector" input field (see Fig. 3.1), choose the measuring program whose results you want to analyze. The system displays the selected program in the "Active program" input field.
- Parameterize the selected measuring program (see Chapter 4). To do this click on the button of the activated measuring program. You get to the view of the measuring program.
- In the "Navigation" menu, start the "Result Monitor" program (see Chapter 3.18).

Fig. 6.1: "Result Monitor" analysis program

Display elements and parameters in the "Result Monitor" analysis program:

A **"General" toolbar:** Using this toolbar, you can select the data source (see Chapter 3.5), save profile sequences (see Chapter 3.6), save and load parameters (see Chapter 3.13.13) and reset the selected parameters to the default settings (see Chapter 3.13.16).

B **Scanner settings:** You change the settings of gapCONTROL with these values (see Chapter 3.7). In offline mode (see Chapter 3.5) this input field will be replaced by the "File settings" input field (see Chapter 3.10).

C **"Display" toolbar:** Using this toolbar, you scale the 2D-display and activate various options for mouse interaction (see Fig. 6.2).

Fig. 6.2: "Display" toolbar in the "Result Monitor" analysis program

Resets the 2D-display to the complete value range. This resets the settings of the 2D-display such that the system visualizes the complete analysis over time of the selected measured values.

Activates or deactivates automatic scaling of the vertical axis of the 2D-display. If automatic scaling is activated, the vertical axis of the 2D-display automatically adapts to the lowest and highest values of the measured values that you chose for analysis.

Activates or deactivates "Zoom" mode. In this mode you can zoom in parts of the 2D-display and so directly set the scaling of the 2D-display with your mouse.

Activates or deactivates "Move" mode. In this mode you can move the history of the measured values on the 2D-display.

Activates or deactivates "Display extended information of a measuring point" mode.

Note: Use the mouse wheel in order to zoom in and out the 2D-display. You can combine the mouse wheel with the Ctrl-key to scale the time axis of the 2D-display. Combine the mouse wheel with the Shift-key to scale the measurement value axis of the 2D-display.

D **"Measurement" toolbar:** You can use this toolbar to set the various search areas and limits for measurement (see Fig. 6.3).

Fig. 6.3: "Measurement" toolbar in the "Result Monitor" analysis program

Activates or deactivates "Set evaluation lines" mode. Using the evaluation lines, you limit the measured values that are used for statistical evaluation in the 2D-display.

Removes the evaluation range. All the recorded values are used for statistical evaluation.

Activates or deactivates "Set marker lines" mode. Using this setting, you define two marker lines that are used to acquire undershoots or overshoots (peaks).

Removes the marker lines.

E **"Navigation" menu:** Click on this button to call the "Navigation" menu (see Chapter 3.18).

F **Status line:** Status and error messages are displayed on the status line (see Chapter 8.1).

1 **2D-display:** This display visualizes the analysis over time of the selected measured values.

2 **Analysis of measured values:** In this area, you can choose measured values and the algorithm for the statistical evaluation.

3 **Data transfer:** Specify the buffer size and control the data transfer.

4 **Data export:** Export the buffered measured values and the determined statistical characteristics.

Proceed as follows to analyze the developing of a measured value:

➪ Click on the "Signal x" button.

The following dialog is displayed:

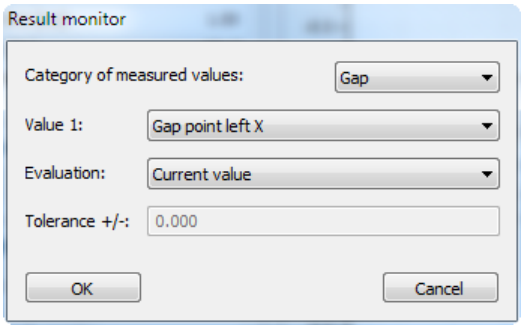


Fig. 6.4: "Result Monitor" dialog box

Make the following settings:

- **Category of measured values:** Choose the category of measured values that you want to evaluate:
  - **None:** No measured value is selected.
  - **Gap:** Characteristics of the gap measurement.
  - **Flush:** Characteristics of the flush measurement (optional).
  - **Reference:** Characteristics of the reference lines and selected anchor point (optional).
  - **Projection:** Characteristics of the projection lines (optional).
  - **Min. Gap:** Characteristics of the base gap (optional).
  - **Base:** Characteristics of the extended gap measurement (Groove Gap, optional).
  - **ROI:** Coordinates of the selected anchor point and bounding points of the range for cutting out (optional).
  - **Global:** Coordinates of the bounding points of the profile (optional).
  - **Combined:** The combined measurement values (optional).
  - **Filtered:** The filtered measurement values (optional).
  - **Misc:** Digital outputs
- **Value x:** Select the measured value that you want to analyze.
- **Evaluation:** Select the algorithm for the statistical evaluation:
  - **Current value:** The currently measured value.
  - **Minimum value:** The lowest measured value.
  - **Maximum value:** The highest measured value.
  - **Mean value:** The average value.
  - **No. of min. peaks:** The number of undershoots of the lower marker line.
  - **No. of max. peaks:** The number of overshoots of the upper marker line.
  - **No. of peaks:** Number of undershoots of the lower marker line and of overshoots of the upper one.
  - **Standard deviation:** The standard deviation of the measured values.
  - **Capability gauge measurement (CGM):** The capability index is calculated as follows: 0.2*abs(2* tolerance value)/(6* standard deviation)**.**

    Note: For 50 measured values, the above specifications are sufficient for checking the measurement capability ("Statistical Procedures for Machine and Process Qualification"; 3rd edition; Edgar Dietrich, Alfred Schulze; Carl Hanser Verlag Munich Vienna) if the following condition is fulfilled: CGM >= 1.33 (method 1).

- **Tolerance +/-:** The tolerance value for calculating the capability index.

To control data transfer, proceed as follows (see Fig. 6.5):

- In the "Buffer size" area, enter the buffer size. The buffer size determines the maximum number of measured values that are used for statistical evaluation. If the maximum number of measured values is reached, the system deletes the oldest values from the buffer and inserts the current ones into it.
- Click on the "Start data transfer" button to start or resume measured value transfer.
- Click on the "Pause data transfer" button to stop measured value transfer.
- Click on the "Clear buffer" button to clear the contents of the buffer.

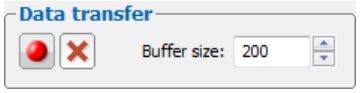


Fig. 6.5: "Data transfer" dialog

Proceed as follows to export the buffered measured values to be monitored and the determined statistical characteristics (see Fig. 6.6):

- In the "Path" field, enter the folder in which you want to save the file.
- In the "Name" field, enter the name of the file to which you want to export the data.
- In the "Append date and time to filename" field, specify whether you want the date and time to be appended to the filename.
- Press the "Export data" button to export the data.

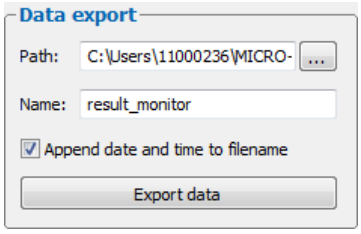


Fig. 6.6: "Data export" dialog

7 Working with the gapCONTROL Measurement System

The gapCONTROL measurement system measures two-dimensional profile data, evaluates the profile data, determines measured values and evaluates them. The measured values are output at various ports. Setup Software is used for parameterization of the measurement system and for the visualization of the measurement results. If the parameterization has been completed, the software can be closed and the measurement system can be disconnected from the PC. The gapCONTROL measurement system then continues to operate as an independent unit and performs the measurements. Handling the measurement system and the interfaces is described in the following.

Note: Exit the software first and **afterwards** disconnect the connection between the measurement system and the PC.

7.1 Operating Modes

In measuring mode there are two different operating modes available which can be configured in Setup Software (see Chapter 3.9).

7.1.1 Continuous Measurement

gapCONTROL measures continuously at the specified scan rate.

7.1.2 Triggered Measurement

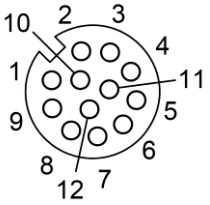
Depending on the type of sensor, the following interfaces are available for triggering gapCONTROL:

	gapCONTROL 2611/2911	**gapCONTROL 2711**
RS422	half-duplex	full-duplex
Digital in	yes	no

Each trigger signal triggers a measurement operation. For technical details, please refer to instruction manual of the measurement system used.

RS422 interface		
Pin	**Assignment**	**PC2600/2900-x wire color**
4	GND-In1	green
11	RS422 -	gray-pink
12	RS422 +	red-blue

Digital input		
Pin	**Assignment**	**PC2600/2900-x wire color**
4	GND-In1	green
6	In1	yellow



Round connector

Fig. 7.1: gapCONTROL 2611/2911 trigger input (RS422 interface half-duplex and digital input, view on solder pin side of connector)

Pin	Assignment	SC2700-x wire color
1	RX +	white
2	RX -	brown
5	GND	gray

Counter-clockwise direction

Fig. 7.2: gapCONTROL 2711 trigger input ("RS422" jack, view on solder pin side of connector)

7.2 Measurement Value Output

7.2.1 Pin Assignment of the Analog Outputs

For detailed information on the pin assignment and operating mode of the analog outputs please refer to the gapCONTROL manual and to the documentation of the used fieldbus coupler and output clamp.

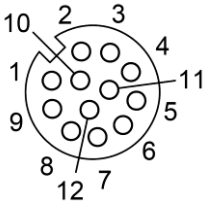
7.2.2 Pin Assignment of the Digital Outputs

For detailed information on the pin assignment and operating mode of the digital outputs please refer to the gapCONTROL manual and to the documentation of the used fieldbus coupler and output clamp.

7.2.3 Pin Assignment of the Serial Interface

The gapCONTROL measurement system comes with a serial output for supplying selected measurement values (see Chapter 5.6). Depending on the type of sensor, the port is present as a RS422 port half-duplex (gapCONTROL 2611/2911) or full-duplex (gapCONTROL 2711).

Pin	Assignment	PC2600/2900-x wire color
4	GND-In1	green
11	RS422 -	gray-pink
12	RS422 +	red-blue



Round connector

Fig. 7.3: gapCONTROL 2611/2911 RS422 interface half-duplex (view on solder pin side of connector)

Pin	Assignment	SC2700-x wire color
1	RX1 +	white
2	RX1 -	brown
3	TX2 +	green
4	TX2 -	yellow
5	GND1	gray
6	GND2	pink

Counter-clockwise direction

Fig. 7.4: gapCONTROL 2711 RS422 interface full-duplex (view on solder pin side of connector)

7.2.4 Convert the Measured Values to real Coordinates

The measured values are transferred to the serial port (ASCII or Modbus, see Chapters 5.6 and 5.7) and to the Ethernet interface (UDP or Modbus, see Chapters 5.7 and 5.8). In doing so, the values are transferred in sensor coordinates. Please use the following table for the conversion of the measured values to real coordinates:

Measured values	Conversion
X coordinates [mm]	y = (x - 32768) * a;
Z coordinates [mm]	y = (x - 32768) * a + b;
Angle [°]	y = 0.01 * x;
Offset [mm]	y = (x - 32768) * a + b;
Sigma [mm]	y = x * a;
Height/Width [mm]	y = x * a;

Where:

- x: Measured value in scanner coordinates.
- y: Converted measurement value in mm or degree.
- a: Scaling factor.
- b: Offset.

The constants a and b have the following values, depending on the type of sensor:

Type of sensor	a	b
gapCONTROL 2611-10	0.0005	55
gapCONTROL 2611-25	0.001	65
gapCONTROL 2611-50	0.002	95
gapCONTROL 2611-100	0.005	250
gapCONTROL 2711-25	0.001	100
gapCONTROL 2711-50	0.002	210
gapCONTROL 2711-100	0.005	450
gapCONTROL 2911-10	0.0005	55
gapCONTROL 2911-25	0.001	65
gapCONTROL 2911-50	0.002	95
gapCONTROL 2911-100	0.005	250

When transmitting the states of the digital outputs you may choose to transfer the states as ASCII string or in binary format (see Chapters 5.6 and 5.7). The states of all eight digital outputs are transmitted. Using the ASCII format one character ("0" or "1") is used for each output. Using the binary format one bit is used for each output; in other words, one byte is used to transmit the states of all eight outputs.

7.3 Loading of "User modes"

The gapCONTROL measurement system is able to save parameter configurations (User modes, see Chapter 3.13.17). The individual configurations can be loaded via different interfaces. For further details, please refer to the instruction manual of the measurement system used.

Additionally gapCONTROL offers the possibility to load the user modes using the serial interface and via Ethernet. Depending on the type of sensor, the following ports are available:

	gapCONTROL 2611/2911	gapCONTROL 2711
RS422 (ASCII)	half-duplex	full-duplex
RS422 (Modbus RTU)	half-duplex	full-duplex
Ethernet (Modbus TCP)	yes	yes
Ethernet (TCP)	yes	yes
Digital in	yes	no

Note: For further information on loading user modes please refer to the document "Quick Reference gapCONTROL" (see Chapter 3.14, Section 4 "Documentation").

Note: gapCONTROL Setup Software provides the possibility of loading user modes. To do this, either select the menu item "Parameters → Load parameters from gapCONTROL..." or press the corresponding button (see Fig. 3.61) in the "General" toolbar (see Chapter 3.13.18).

7.3.1 Loading of User Modes using the Serial Port (ASCII)

Configuration of the serial port:

- **Data bits:** 8
- **Parity:** none
- **Stop bits:** 2
- **Flow control:** none
- **Baudrate:** adjustable, see Chapter 3.9

Please use the following commands:

- Load user mode: Use the following command in order to load an user mode:

  ```
  setq 0xf0f00624 0x[User mode no.]0000000
  ```

  Example: Use the following command in order to load user mode 2:

  ```
  setq 0xf0f00624 0x20000000
  ```

- Get the actual user mode no.: Use the following command in order to retrieve the number of the user mode currently used:

  ```
  getq 0xf0f00624
  ```

  gapCONTROL replies as follows:

  ```
  #q 0xf0f00624 0x[User mode no.]0000000
  ```

Note: Specify [User mode nr.] in hexadecimal format.

7.3.2 Loading of User Modes using Modbus

You may use the serial port (Modbus RTU) or the Ethernet interface (Modbus TCP) in order to load user modes using Modbus. The commands may be implemented as single write commands or as multiple write commands.

Note: In case of using single write commands the register 32 has to be written last.

Please use the following commands:

- Load user mode: Write the following holding registers in order to load an user mode:

Register	Value	Description
37	0x[User mode no.]000	0x0000 for user mode 0, 0x1000 for user mode 1, … , 0xf000 for user mode 15
36	0x0000	-
35	0xf0f0	gapCONTROL address for user modes (upper 16 bit)
34	0x0624	gapCONTROL address for user modes (lower 16 bit)
33	0x0000	-
32	0x0002	Corresponds to "setq"

- Get the actual user mode no.: Write the following holding registers in order to retrieve the number of the user mode currently used:

Register	Value	Description
35	0xf0f0	gapCONTROL address for user modes (upper 16 bit)
34	0x0624	gapCONTROL address for user modes (lower 16 bit)
33	0x0000	-
32	0x0003	Corresponds to "getq"

The user mode currently used is available at the register 37 now
(Format: 0x[User mode no.]000, e.g. 0x2000 for user mode 2).

7.3.3 Loading of User Modes via Ethernet (TCP)

Use a TCP Client (Port 502) in order to load user modes via Ethernet (TCP).

Please use the following command:

- Load user mode: Use the following binary byte sequence in order to load a user mode:

Value	Description
0xf4	Transaction identifier (arbitrary, you may use any number instead of 0xf406)
0x06	
0x00	Protocol identifier (always 0)
0x00	
0x00	Command length
0x13	
0x01	Unit identifier (adjustable: 1 - 247)
0x10	Function code 16 (Multiple write command)
0x00	Start register
0x20	
0x00	Number of registers
0x06	
0x0c	Number of bytes
0x00	Corresponds to "setq"
0x02	
0x00	-
0x00	
0x06	gapCONTROL address for user modes (lower 16 bit)
0x24	
0xf0	gapCONTROL address for user modes (upper 16 bit)
0xf0	
0x00	-
0x00	
0x[User mode no.]0	0x00 for user mode 0, 0x10 for user mode 1, … , 0xf0 for user mode 15
0x00	-

8 Appendix

8.1 Status and Error Messages, Error Codes

The status line in each of the measuring programs shows a range of status and error messages. The following messages can appear:

Message	Description	Action	Error code
Active: gapCONTROL [Type]([Option])[Version]	No error. Measurement is active.	-	0
Wrong driver version CMU	The wrong version of the CMU driver has been installed.	Install the new driver as described in Chapter 2.5 and 2.6.	-
Internal error	An unknown error has occurred.	Close Setup Software and reset the controller to the default settings by reconnecting the power supply.	-
gapCONTROL-parameters invalid	The parameters transferred to gapCONTROL are invalid.		
Error while data transfer	An error occurred during data transfer.		
No gapCONTROL found	gapCONTROL is not connected to the computer via IEEE1394 and Ethernet respectively or the power supply of gapCONTROL is switched off or the CMU-driver has not been installed.	Check the IEEE1394/Ethernet connection and check whether the scanner is switched on and supplied with power. Check the IEEE1394/Ethernet cable for defects. Also check whether the CMU driver for the system is installed (see Chapter 2.5 and 2.6).	-
No free gapCONTROL found	All scanners connected to the computer are already being used by other programs.	Close the other programs accessing gapCONTROL.	-
gapCONTROL S/N not found	Setup Software was last used with a different model of gapCONTROL.	Open the "Advanced scanner settings" dialog box and press the "Connect" button to select the current gapCONTROL (see Chapter 3.9).	-
gapCONTROL is already in use	The currently used scanner is already used by other programs.	Close the other programs accessing gapCONTROL or select another scanner in the "Advanced scanner settings" dialog and press "Connect" (see Chapter 3.9).	-
Invalid device	The currently operated device is no gapCONTROL measurement system.	Select a gapCONTROL device in the "Advanced scanner settings" dialog and press "Connect" or close Setup Software and connect gapCONTROL to the PC (see Chapter 3.9).	-
Unsupported device			

Data transfer interrupted	The data transfer between gapCONTROL and the PC has been interrupted.	Check the IEEE1394/Ethernet connection between gapCONTROL and the PC. Check the IEEE1394/Ethernet cable for defects. Close Setup Software, reconnect gapCONTROL to the PC and restart the software.	-
Invalid firmware for […]	The firmware of gapCONTROL doesn't support the desired feature […].	Please refer to the contact address printed on the inside cover of this manual.	-
Inconsistent: No. of profiles too high	The selected value for the parameter "No. of profiles" is too high. Please refer to Quick Reference gapCONTROL to get more information.	Decrease the value for the parameter "No. of profiles" (see Chapter 3.7).	-
Inconsistent: No. of profiles too high for evaluation	The selected value for the parameter "No. of profiles" is too high for evaluation of the measurement.	Decrease the value for the parameter "No. of profiles" (see Chapter 3.7)or decrease the number of measured values output via analog/digital/serial/ethernet interface (see Chapter 5.4, 5.5, 5.6, 5.7 and 5.8).	-
Inconsistent: Exposure time / No. of profiles	The selected scanner settings "Exposure time" and "No. of profiles" are mutually exclusive.	Type in consistent values for the parameters "Exposure time" and "No. of profiles" (see Chapter 3.7).	-
Inconsistent: Meas. field / Points p. profile / No. of profiles	The selected scanner settings "Measuring field", "Points per profile" and "No. of profiles" are mutually exclusive. Please refer to Quick Reference gapCONTROL to get more information.	Type in consistent values for the parameters "Measuring field", "Points per profile" and "No. of profiles" (see Chapter 3.7, 3.9).	-
Inconsistent: Serial out / No. of profiles	The profile frequency set is too high for the transmission of measurement data via the serial interface.	Reduce the value for the parameter "No. of profiles" (see Chapter 3.7) or alter the parameters of the serial interface or reduce the number of measured values transmitted (see Chapter 5.6).	-
Inconsistent: Serial out / Length of output string > 80 characters	The number of characters supplied at the serial port is too high.	Decrease the number of measured values supplied at the serial port (see Chapter 5.6).	-
Inconsistent: UDP out / Length of output string > 80 characters	The number of characters supplied via Ethernet is too high.	Decrease the number of measured values supplied via Ethernet (see Chapter 5.7).	-
Inconsistent: Modbus out / No. of registers	The maximum number of modbus registers is exceeded.	Reduce the number of activated signals using the Modbus (see Chapter 5.8).	-
Inconsistent […]	The shown scanner parameters […] are mutually exclusive.	Type in consistent values for the shown parameters […].	-
Corrupt profile	The transferred profile is corrupt.	Deactivate the filter (see Chapter 3.8) or reset the parameters to the default settings (see Chapter 3.13.16).	-

Too much parameters for evaluation	The number of required parameters of the active measuring program is too high.	Decrease the number of combined and filtered values (see Chapter 5.1 and 5.2). Decrease the number of measured values output via analog/digital/serial/ethernet interface (see Chapter 5.4, 5.5, 5.6, 5.7 and 5.8).	-
Too few points for evaluation	There are too few points per profile available to evaluate the measurement.	Increase the number of points per profile or reduce the number of combined and filtered measurement values (see Chapter 3.7, 5.1 and 5.2).	-
A Gigabit Ethernet connection is required	When using the "Display Image Data" program gapCONTROL 2911 requires a Gigabit Ethernet connection.	Use a Gigabit Ethernet interface.	-
Measurement settings: Min. gap distance too high	The minimal distance of the base gap is too high.	Reduce the minimum width and change the alignment of the base gap (see Chapter 3.13.4).	101
No points in region of interest	There are no measuring points in the range defined for gap evaluation (cutting out).	Enlarge the range for gap evaluation (cutting out, see Chapter 3.13.1). Change the distance to the object to be measured. Increase the exposure time (see Chapter 3.7).	120
Too few points for left reference line	There are not enough measuring points in the ranges for the calculation of a reference/projection line.	Enlarge the reference range (straight lines, see Chapter 3.13.6).	130
Too few points for right reference line			
Too few points for projection line			
Too few points for reference line			
Too few points for flush	There are not enough measuring points in the ranges for the calculation of flush lines or centers of gravity.		
Parallel reference lines, no intersection point	An intersection point couldn't be calculated as the reference lines are parallel.	Check the reference range (straight lines, see Chapter 3.13.6).	131
Intersection point out of range	The calculated intersection point is outside the range to be displayed.		132

Wrong parameters left reference line Wrong parameters right reference line Wrong parameters reference line Wrong parameters projection line	The parameters transferred to gapCONTROL are invalid.	Restart Setup Software.	138
Arithmetic error left reference line Arithmetic error right reference line Arithmetic error projection line Arithmetic error reference line	An arithmetical error has occurred when calculating the reference/projection line.	Check the ranges for line fitting (see Chapter 3.13.6).	139
Too few points for gap	There are no measuring points contained in the range for searching the gap.	Increase the range for searching the gap.	140
No left gap point found No right gap point found No threshold point found No gap point found	No associated point was found when determining the gap.	Check the thresholds for searching the gap (see Chapter 3.13.7).	141
Interpolation left gap point failed Interpolation right gap point failed Interpolation threshold point failed Interpolation gap point failed	The start or end point of the gap could not be calculated.	Reduce the range for searching the gap.	143
Wrong parameters for left gap point Wrong parameters for right gap point Wrong parameters for threshold point Wrong parameters gap point	The parameters transferred to gapCONTROL are invalid.	Restart Setup Software.	148
Arithmetic error left gap point Arithmetic error right gap point Arithmetic error threshold point Arithmetic error gap point	An arithmetical error has occurred when determining the gap.	Check the settings of the measuring program.	149
Reference offset out of range	The gradient of the reference line is too large.	Change the range for fitting the lines (see Chapter 3.13.6).	150
Left projection point out of range Right projection point out of range Projection point out of range Gap top point out of range	The projected point is outside the valid range.	Change the range for fitting the lines (see Chapter 3.13.6), check the thresholds for searching the gap (see Chapter 3.13.7).	151
Loading profiles	The profile sequence is being loaded in the RAM (Offline mode).	Wait until the profile sequence has been completely loaded.	-

Ready	The system is ready to play the loaded profile sequence (Offline mode).	Press the play button in the "File settings" input field (see Chapter 3.10) to play the profile sequence.	-
Play: gapCONTROL [Type] ([Option])[Version]	No error. A profile sequence is being played (Offline mode).	-	-
Couldn’t open file	The specified name or path was incorrect.	Select the correct directory containing your recorded profile sequence.	-
Invalid file	The profile sequence opened cannot be played with the Setup Software.	Select a correct profile sequence that has been recorded with the Setup Software.	-
Unsupported file			

8.2 Notes and Tips on Using gapCONTROL

Please note the following when operating the Setup Software:

1 To be able to use gapCONTROL Setup Software, the gapCONTROL measurement system requires a firmware version ≥ 30. Check the firmware version on the status line if necessary (see Chapters 3.4 and 8.1).

2 Never disconnect the connection between gapCONTROL and the PC while using the software.
Never disconnect the power supply of gapCONTROL while the software is running.
Never activate the standby mode or hibernation of your computer when the measurement system is connected to the computer.

This may cause the operating system to shut down unintentionally.

3 To use the full version of gapCONTROL Setup Software, either a gapCONTROL measurement system or an ICONNECT dongle is required. You can license the ICONNECT dongle by using the "License" entry in the Windows Start menu.

4 Only use version 6.4.6 of the CMU driver which is delivered on the CD. If a different driver or a different version of the CMU driver for the gapCONTROL is installed at a later date then it will not be possible to operate the scanner with gapCONTROL Setup Software.

5 The measuring programs show the saturation in the "Scanner settings" input field. This is greatly influenced by the exposure time and affects the way in which the profile data are calculated. The saturation should be between 60 % and 80 % during a measurement.

6 There may be a discrepancy between the set point value and the actual value for the number of scans per second if the number of scans is set too high or the processing power of the PC is insufficient.

7 Use the "Points per profile" parameter in the "Scanner settings" input field to define the resolution in the directions of the X axis.

8 The "Exposure time" parameter in the "Scanner settings" input field specifies the exposure time for the scanner. The value is also influenced by the "No. of profiles" parameter. The actual value of "No. of profiles" has priority over the "Exposure time" parameter. This results from the inequality "1/(No. of profiles) >= (Exposure time)". This means, for example, with the setting "Exposure time [ms]: 20" and "No. of profiles [1/s]: 100" the "Exposure time" value is adjusted. The new value for the "Exposure time" parameter is 10 ms.

9 Save the actual parameters before you start to record a profile sequence. You can then load them again before you play back the profile sequence.

10 Select the "? → Help" menu item or press the <F1> key directly in a measuring program to display help information about that measuring program.

11 Proceed as follows if you cannot see a profile in the 2D-display and no error messages are displayed in the status line: Restore the default settings via the "Parameters → Reset…" menu entry. Valid parameters are now loaded into the "Scanner settings", and the complete measuring range is displayed in the 2D-display.

12 The Setup Software CD contains examples of profile sequences and parameters in the directory "[CD]:\Examples".

8.3 Key Shortcuts

Use key shortcuts to work faster! The following shortcuts are available:

Key combinations	Action
F1	Online help
Ctrl + Alt + F12	Exit program
Ctrl + F5	Toggle pause mode
F5	Transfer a current profile from the scanner when pause mode activated
Ctrl + F1	Online mode
Ctrl + F2	Offline mode
Ctrl + F3	Save profile
Ctrl + F6	Activate/Deactivate protocol results
Ctrl + O	Load parameters from file
Ctrl + S	Save parameters to file
Ctrl + R	Reset parameters
Ctrl + Alt + O	Load parameters from gapCONTROL
Ctrl + Alt + S	Save parameters to gapCONTROL
Ctrl + F7	Adjusting basic settings
Ctrl + F8	Adjusting gapCONTROL Network Settings

8.4 Manual/Subsequent Installation of the Driver for IEEE1394

8.4.1 Subsequent Installation of the Driver for IEEE1394 on Windows 8

If the installation of the driver wasn't completed successfully while installing Setup Software, you may install the driver subsequently.

Note: The driver only has to be installed for using the IEEE1394 interface. No driver is required for gapCONTROL devices with an Ethernet interface.

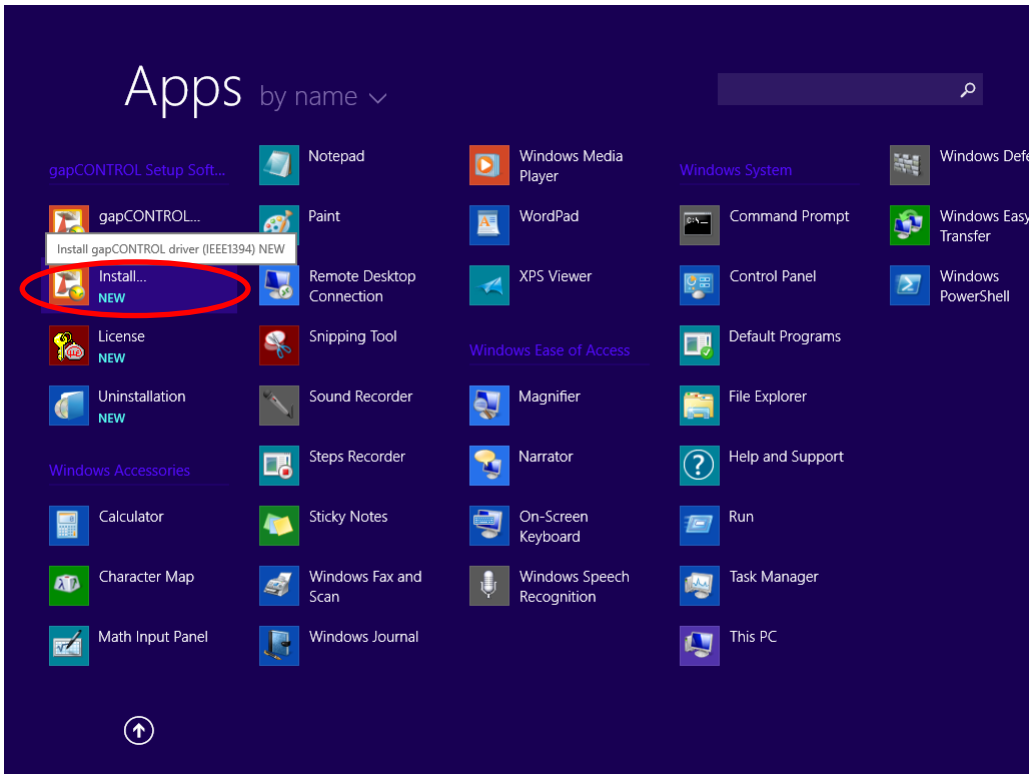


Fig. 8.1: Windows 8 subsequent driver installation - step 1

➡ Open the overview of your Apps and select the "Install gapCONTROL driver (IEEE1394)" App (see Fig. 8.1).

The "gapCONTROL driver (IEEE1394)" dialog will appear on the screen.

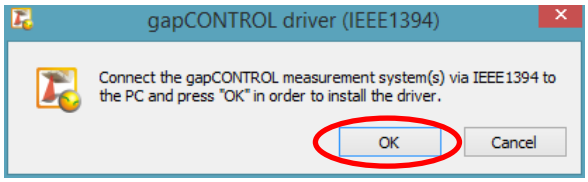


Fig. 8.2: Windows 8 subsequent driver installation - step 2

➡ Connect gapCONTROL to the PC and click on "OK" to confirm (see Fig. 8.2).

The "Windows Security" dialog appears:

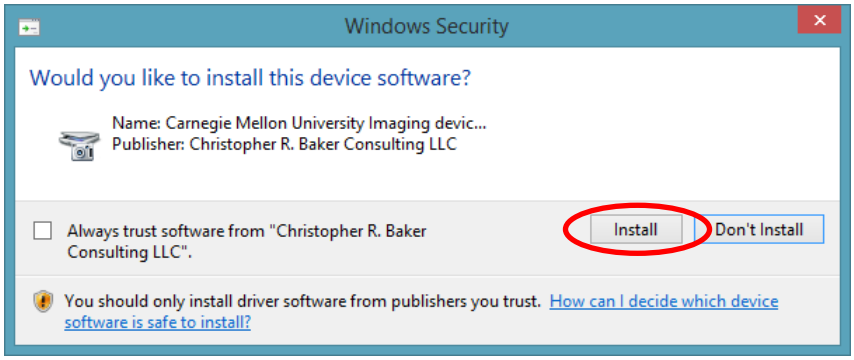


Fig. 8.3: Windows 8 subsequent driver installation - step 3

➡ Click on "Install" to confirm this dialog (see Fig. 8.3).

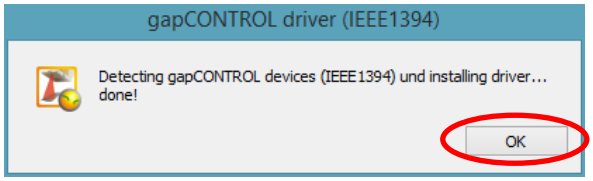


Fig. 8.4: Windows 8 subsequent driver installation - step 4

➡ Click on "OK" (see Fig. 8.4).

The gapCONTROL driver is now installed.

Note: Only use version 6.4.6 of the CMU driver which is delivered on the CD. If a different driver or a different version of the CMU driver for gapCONTROL is installed later then it will not be possible to operate the gapCONTROL measurement system with Setup Software.

8.4.2 Manual Installation of the Driver for IEEE1394 on Windows 8

In case of an incorrect installation of the driver, you have to install the driver manually.

Note: The driver only has to be installed for using the IEEE1394 interface. No driver is required for gapCONTROL devices with an Ethernet interface.

➡ Call up the installation dialog via the Device Manager (Windows Desktop → Charms bar →Settings → Control Panel → System and Security → System → Device Manager). gapCONTROL is located under "Imaging Devices" or under "Other Devices".

The installation dialog will then appear on the screen.

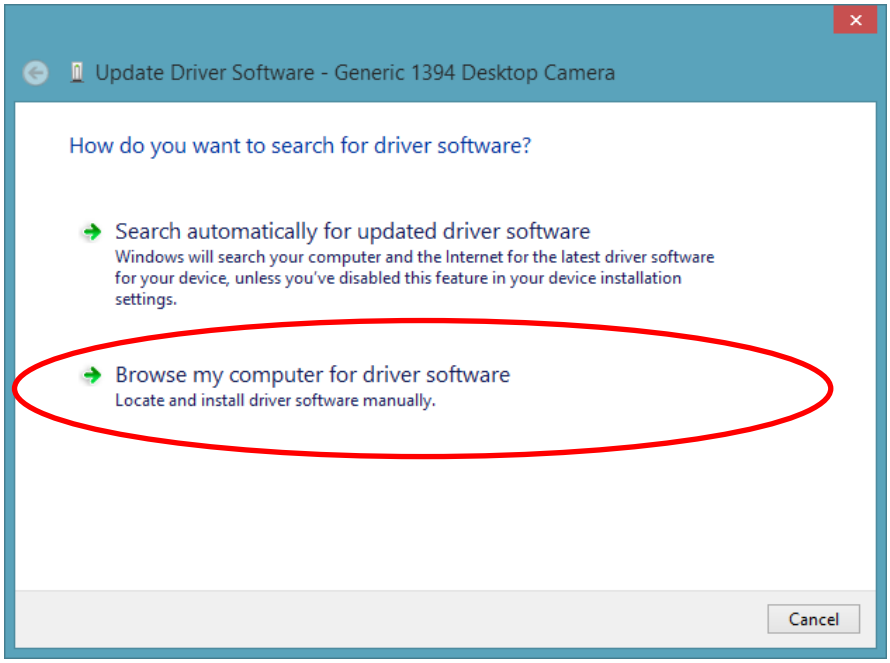


Fig. 8.5: Windows 8 manual driver installation - step 1

➡ Select "Browse my computer for driver software" (see Fig. 8.5).

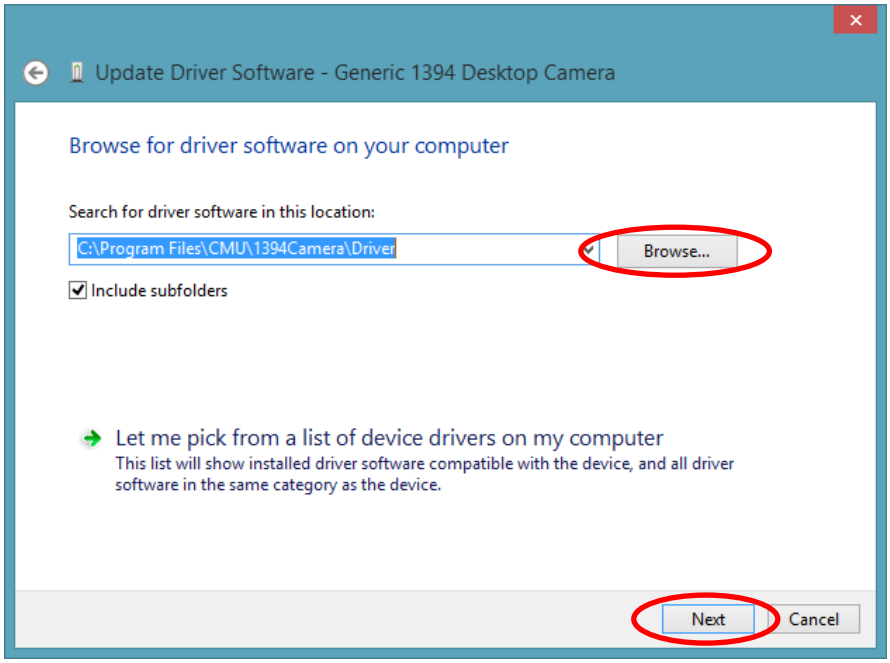


Fig. 8.6: Windows 8 manual driver installation - step 2

➡ Select "Browse…" (see Fig. 8.6).

A standard Windows dialog is displayed for the selection of the path containing the driver files.

➡ In the folder tree, select "C: → Program Files → CMU → 1394Camera → Driver" and confirm with "OK".

➡ Click on "Next" to confirm the "Update Driver Software" dialog (see Fig. 8.6).

The "Windows Security" dialog appears:

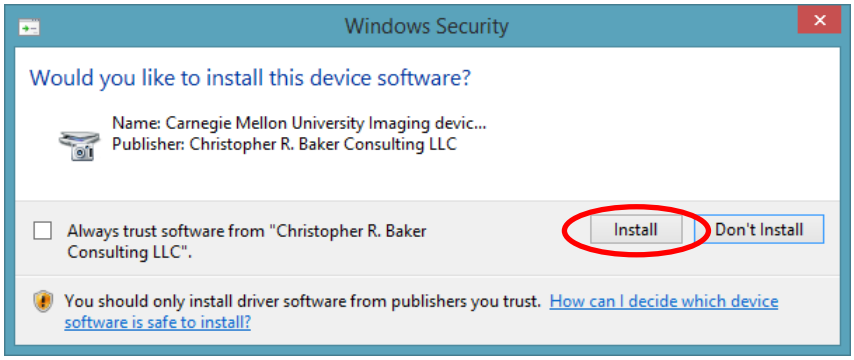


Fig. 8.7: Windows 8 manual driver installation - step 3

➡ Click on "Install" to confirm this dialog (see Fig. 8.7).

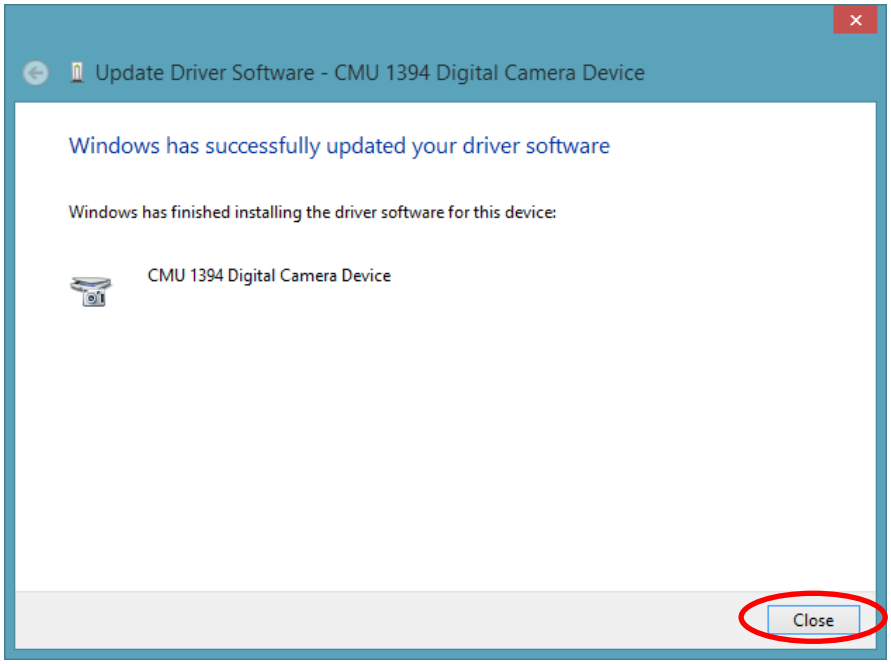


Fig. 8.8: Windows 8 manual driver installation - step 4

➡ Click on "Close" in the next dialog (see Fig. 8.8).

The gapCONTROL driver is now installed.

Note: Only use version 6.4.6 of the CMU driver which is delivered on the CD. If a different driver or a different version of the CMU driver for gapCONTROL is installed later then it will not be possible to operate the gapCONTROL measurement system with Setup Software.

8.4.3 Manual Installation of the Driver for IEEE1394 on Windows 7

In case of an incorrect installation of the driver, you have to install the driver manually.

Note: The driver only has to be installed for using the IEEE1394 interface. No driver is required for gapCONTROL devices with an Ethernet interface.

➥ Call up the installation dialog via the Device Manager (Control Panel → System → Hardware → Device Manager). gapCONTROL is located under "Imaging Devices" or under "Other Devices".

The installation dialog will then appear on the screen.

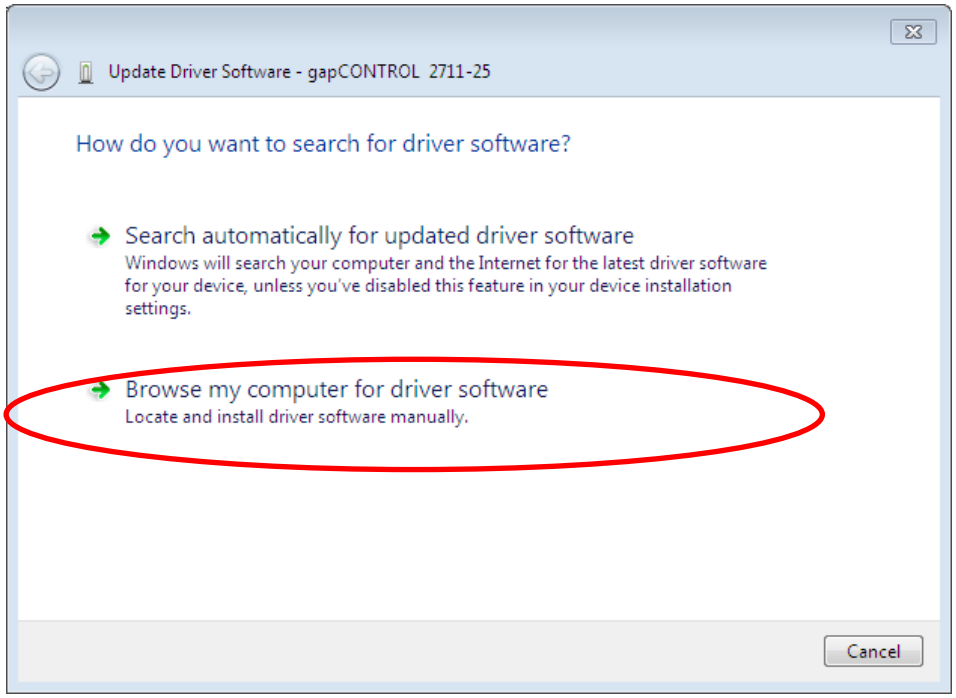


Fig. 8.9: Windows 7 manual driver installation - step 1

➥ Select "Browse my computer for driver software" (see Fig. 8.9).

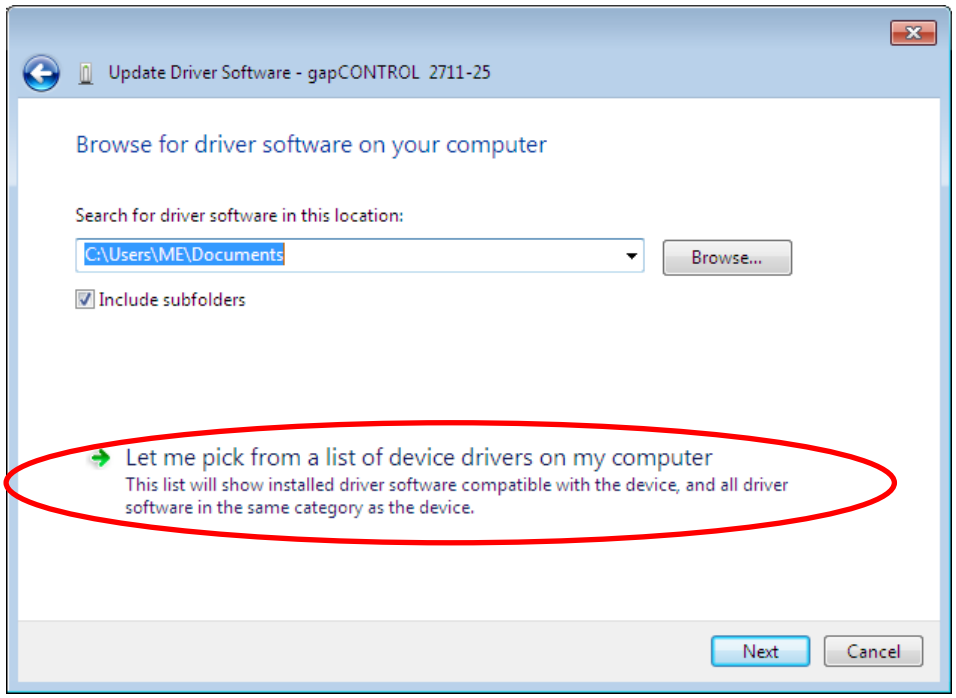


Fig. 8.10: Windows 7 manual driver installation - step 2

Select "Let me pick from a list of device drivers on my computer" (see Fig. 8.10).

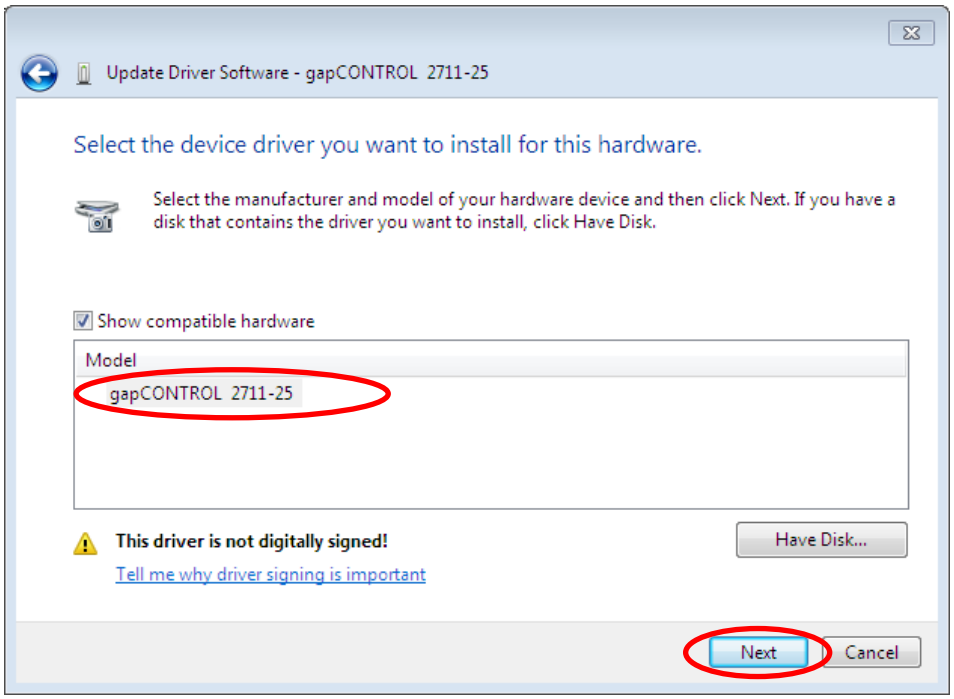


Fig. 8.11: Windows 7 manual driver installation - step 3

Select "gapCONTROL" from the list and click on "Next" to confirm (see Fig. 8.11).

The "Windows Security" dialog appears:

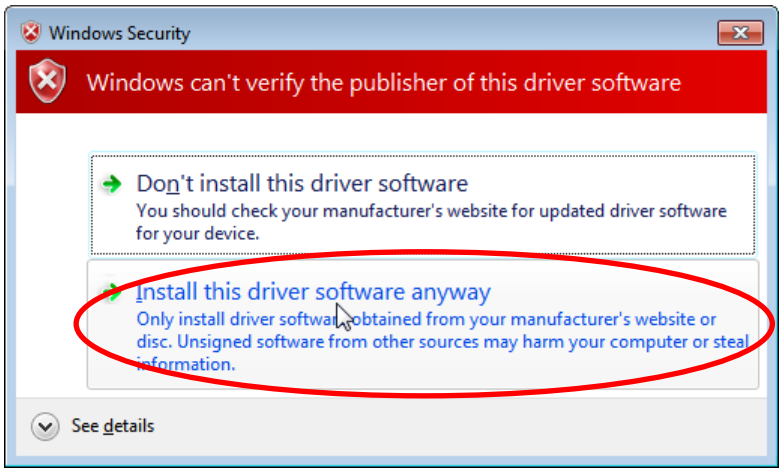


Fig. 8.12: Windows 7 manual driver installation - step 4

Select "Install this driver software anyway" in this dialog (see Fig. 8.12).

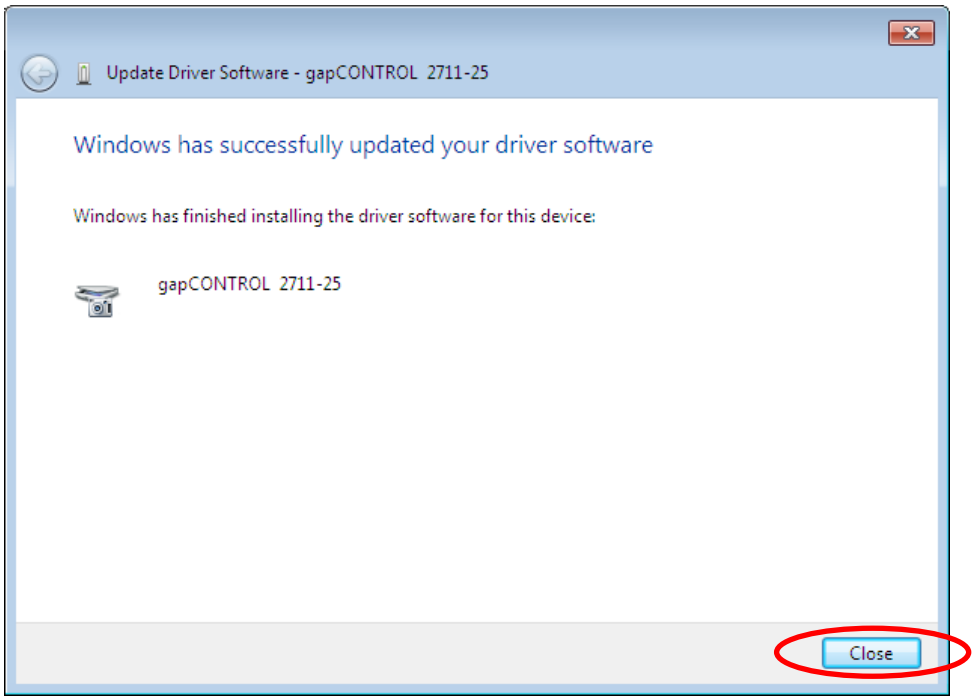


Fig. 8.13: Windows 7 manual driver installation - step 5

➡ Click on "Close" in the next dialog (see Fig. 8.13).

The gapCONTROL driver is now installed.

Note: Only use version 6.4.6 of the CMU driver. If a different driver or a different version of the CMU driver for gapCONTROL is installed later then it will not be possible to operate the gapCONTROL measurement system with Setup Software.

Note: If you are requested to choose the driver files manually you will find the files in the installation directory of Setup Software: *[Installation path]\Driver-CMU1394.*

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