LASER SPECTROMETER

*wave*Scan USB

User Manual

A·P·E Angewandte Physik & Elektronik GmbH
www.ape-berlin.com ape@ape-berlin.de
Plauener Str. 163 - 165 Haus N 13053 Berlin Germany
Phone +49 30 986 011 30 Fax +49 30 986 011 333

IMPORTANT – READ CAREFULLY BEFORE USE – KEEP FOR FUTURE REFERENCE

This user manual contains user information for the *wave*Scan USB . Read this manual carefully before operating the *wave*Scan USB , particularly Section 1 on safety. The *wave*Scan USB has only to be used as described in this manual. Differing use may endanger safety and voids warranty.

CAUTION - USE OF CONTROLS OR ADJUSTMENTS OR PERFORMANCE OF PROCEDURES OTHER THAN THOSE SPECIFIED HEREIN MAY RESULT IN HAZARDOUS RADIATION EXPOSURE

Symbols Used in This Manual

This Symbol is intended to alert the operator to the danger of exposure to hazardous visible and invisible laser radiation.

This symbol is intended to emphasize the presence of important operating instructions.

Warranty

The warranty conditions are specified in the sales contract. Any unauthorized modification (opening included) of the ***wave*Scan USB** system components or software will void the guarantee and service contract.

Disposal

All electrical and electronic products should be disposed separately from the standard municipal waste system. Proper disposal of your old appliance prevents potential negative consequences for the environment and human health.

Some components of your ***wave*Scan USB** system are marked with the crossed-out wheeled bin symbol covered by the European Directive 2002/96/EC on waste electrical and electronic equipment (WEEE) of the European Parliament and the Council of January 27, 2003. These items must be disposed via designated collection facilities appointed by government or local authorities.

For more information about disposal of your old product, please contact A·P·E GmbH.

Contents

1 Safety Instructions

The European Community requirements for product safety are specified in the "Low Voltage Directive" (2006/95/EC). The "Low Voltage Directive" requires that electronic products comply with the standard EN 61010-1:2010 "Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use". Compliance of this product is certified by the CE mark.

1.1 Laser Safety

Since the *wave*Scan USB is intended to measure the spectrum of lasers all safety instructions relevant to the class of your laser have to be observed!

Because of its special properties, laser light poses safety hazards not associated with light from conventional sources. The safe use of lasers requires that all laser users – and everyone else near the laser system - are aware of the dangers involved. The safe use of the laser depends upon the user becoming familiar with the instrument and the properties of intense and coherent beams of light.

Direct eye contact with the output beam from the laser can cause serious damage and possible blindness.

The greatest concern when using laser equipment is eye safety. In addition to the main beam there are often many smaller beams present at various angles near the laser system.

These beams are formed by specular reflections of the main beam off polished surfaces such as lenses and beam splitters. Although less intense than the main beam, such beams may still be sufficiently intense to cause eye damage. Laser beams are powerful enough to burn skin, clothing, or paint. They can ignite volatile substances such as alcohol, gasoline, ether, and other solvents, and can damage light-sensitive elements in video cameras, photomultipliers, and photodiodes.

The laser beam can ignite substances in its path, even at a distance. The beam may also cause damage if contacted indirectly from reflective surfaces. For these and other reasons, the user is advised to follow the precautions below:

1. Observe all safety precautions in the user manual.
2. Extreme caution should be exercised when using solvents in the area of the laser.
3. Limit access to the laser to qualified users who are familiar with laser safety practices and who are aware of the dangers involved.

4. Never look directly into the laser light source or at scattered laser light from any reflective surface. Never sight down the beam into the source.
5. Maintain experimental setups at low heights to prevent inadvertent beam-eye contact at eye level.
6. As a precaution against accidental exposure to the output beam or its reflection, those using the system should wear safety glasses as required by the wavelength being generated.

Laser safety glasses can present a hazard as well as a benefit; while they protect the eye from potentially damaging exposure, they block light at the laser wavelengths, which prevents the operator from seeing the beam. Therefore, use extreme caution even when using safety glasses.

7. Avoid direct exposure to the laser light. The intensity of the beam can easily cause flesh burns or ignite clothing.
8. Extreme care must be taken during alignment procedures with the free laser beam. Always start the alignment with a beam attenuated to a level that allows save handling.

Take care! There might be back-reflected laser radiation of the laser beam that enters the *wave*Scan USB optical unit!

1.2 Electrical Safety

The ***wave*Scan USB** uses DC voltages in the optical head. It is designed to be operated with protective covers in place. The device complies with protection Class I/EN 61140:2007, degree of ingress protection IP20, according to EN 60529:2010. The equipment must be positioned such that it is easy to disconnect the device at all times.

It is only allowed to run the *wave*Scan USB with the delivered mains adapter.

For the connection of the ancillary equipment only the delivered cables may be applied.

Opening the housing is disallowed for the user. Opening the housing is only allowed for trained service personal. In case it is necessary to open the housing for service purposes the device has to be unplugged from the mains outlet.

The user must not open the top cover of the housing of the *wave*Scan USB optical head!

1.3 Electromagnetic Compatibility

The European requirements for Electromagnetic Compliance (EMC) are specified in the EMC Directive 2004/108/EC. Conformance (EMC) is achieved through compliance with the harmonized standards EN 61000.

Compliance of ***wave*Scan USB** spectrometer system with the (EMC) requirements is certified by the CE mark.

2 Description and Specifications

2.1 Description and Intended Use

The ***wave*Scan USB** is an easy to use, high resolution device for spectral analysis of cw and mode-locked laser systems. It is based on the spinning grating spectrometer technology. With its resolution down to 0.1 nm (depending on the wavelength range), it offers greater precision over a larger wavelength range compared to standard compact CCD based spectrometers. Especially in the spectral region longer than 1.1 μm which is beyond the capability of silicon based CCDs the ***wave*Scan USB** offers an easy way for high resolution measurement. The ***wave*Scan USB** is also an ideal alignment tool because of its high scan rates.
The ***wave*Scan USB** is available in different versions covering scan ranges from 250 ... 6300 nm. The ***wave*Scan USB** comes with integrated entrance slit and focusing optics for use with free laser beams. The ***wave*Scan USB** can optionally be equipped with a SMA, FC/PC, or FC/APC type connector for fiber input.

Figure 2.1: ***wave*Scan USB**

The ***wave*Scan USB** consists of the optical head, the power adapter, and the Control Software that runs on your personal computer under Microsoft Windows[1] operating system. The Control Software manages the data transfer between the optical head and the PC via a full speed USB 2.0 interface and allows for a comfortable graphical display of the spectra as well as data storage and processing.

2.2 Technical Background

The ***wave*Scan** is basically a grating spectrometer in Littrow configuration. The grating rotates with a rate of about six rounds per second. A spectrum is measured every round

[1] Windows is a registered trademark of Microsoft Corporation in the United States and other countries.

trip. With this design a quasi real-time measurement is possible. The optical signal is taken by a fast photodiode placed behind the exit slit. Different spectral versions of the ***wave*Scan** are available which use different photodetectors: Si, InGaAs, or combined Si / InGaAs, depending on the version. At a distinct angle position of the grating a high precision trigger starts the measurement. Following that a fixed number of data points is taken with the system sampling rate. Measurement data is pre-processed in the optical head's micro controller and a subset of the data is transferred to the Control PC. The ***wave*Scan USB** Control Software is the user interface that allows for control of the measurement as well as graphical display and data processing and storage.

2.3 Specifications

2.3.1 Optical Parameters

***wave*Scan** Versions

	Wavelength	Resolution
	200 ... 1100 nm	0.2 nm
	220 ... 540 nm	0.05 nm
	500 ... 1600 nm	0.2 nm
	800 ... 2600 nm	0.5 nm
	1500 ... 6300 nm	3 nm
Wavelength accuracy	± 0.1 nm (configuration dependend)	
Scan rate	~ 6 scans per second	
Laser repetition rate	> 4 MHz or cw (real time measurement)	
	> 1 kHz (accumulation mode)	
Input polarization	preferably horizontal	
Sensitivity	50 μW per nm bandwidth @ 633 nm cw	
Dynamic range	16 bit A/D converter	
Fiber input (optional)	SMA, FC/PC, or FC/APC connector	
	fiber is not included, should be single mode	

2.3.2 Electrical Parameters

Power adapter	input	90 ... 264 VAC, 0.8 ... 0.4 A, 47 ... 63 Hz
	output	12 VDC, 2.5 A
Communication interface	USB 2.0 Full Speed	

2.3.3 Mechanical Parameters

Dimensions (in mm): see outline drawings, Figure 2.2

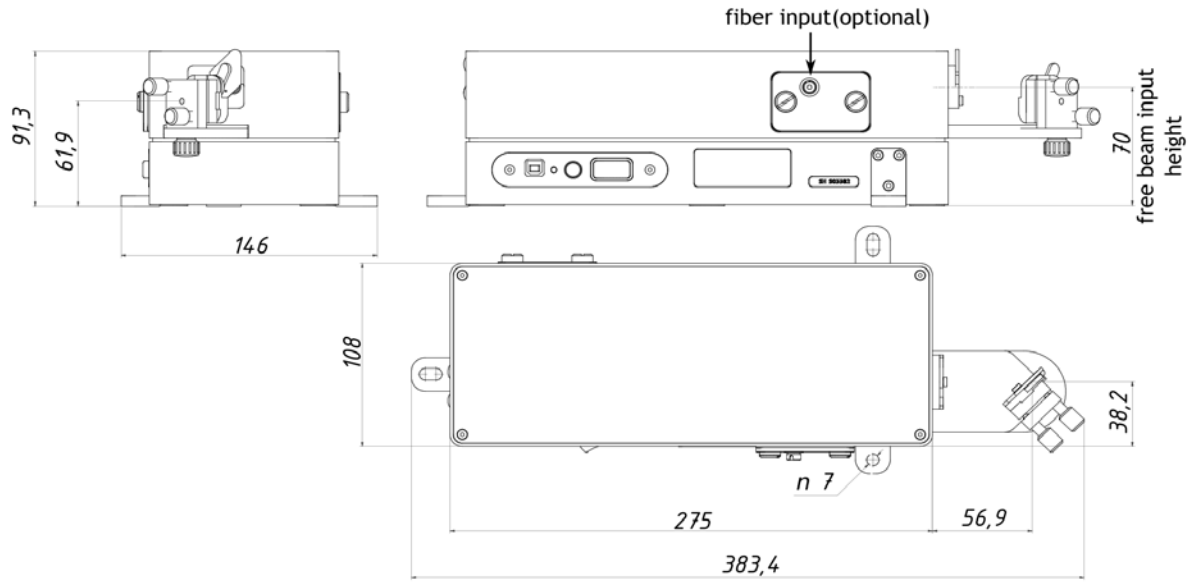


Figure 2.2: ***wave*Scan USB** Outline Drawings

Input beam height	70 mm (free beam)
Weight	4.2 kg
System requirements:	
Operating system	Windows[1] Vista, 7
Processor	min. Pentium IV or equivalent
RAM	min. 2 GB
Hard disc space	~ 500 MB
Interface	one free USB connector
Display resolution	min. 1024 x 768 pixels
Others	CD-ROM drive or
	internet access to download the installer file (only on request)

2.3.4 Environmental Requirements

The ***wave*Scan USB** is intended for operation in indoor, dry and dust reduced rooms. It has to be firmly installed on an optical table or on a similar solid, vibration-free board.

During storage, transport, for the installation and during operation, the ambient conditions must be observed. Ensure reasonable transport conditions, free of major shocks, jolt or fall; protect against frost. Use original packing material for relocation.

Before unpacking the ***wave*Scan USB** wait for at least six hours to allow for acclimatization of all components.

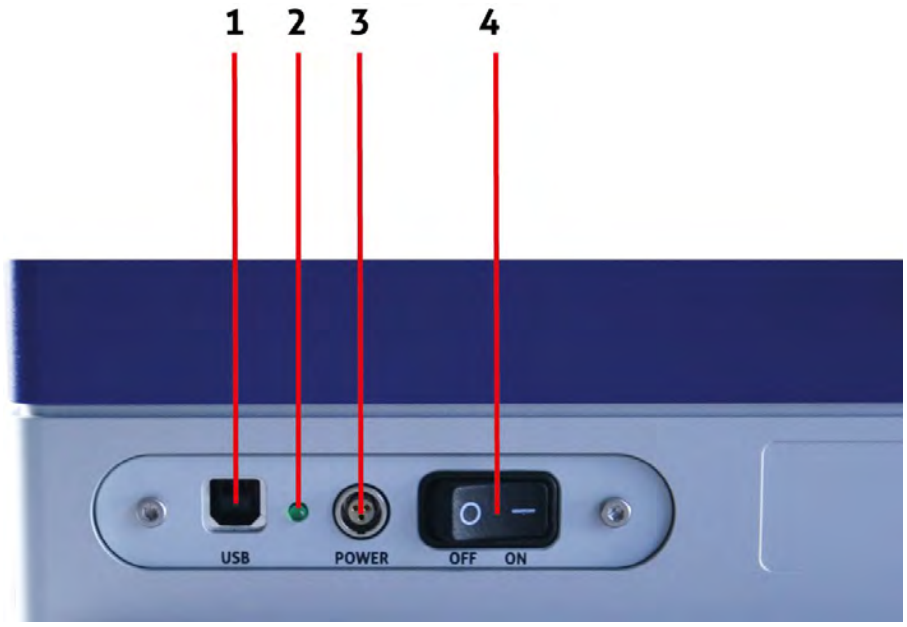
[1]Windows is a registered trademark of Microsoft Corporation in the United States and other countries.

Ambient temperature during transportation:	+5 ... +50 °C
Relative humidity during transportation:	10 % ... 80 %, no condensation
Ambient temperature during operation:	+18 ... +27 °C
Relative humidity during operation:	< 60 %, no condensation

2.4 System Controls and Indicators

1 Input mirror
2 Input mirror alignment flip aperture
3 Beam input
4 Beam input alignment flip aperture
5 Input mirror adjustment screws
6 Fixing screw of input mirror assembly

Figure 2.3: ***wave*Scan USB** front view with beam entrance

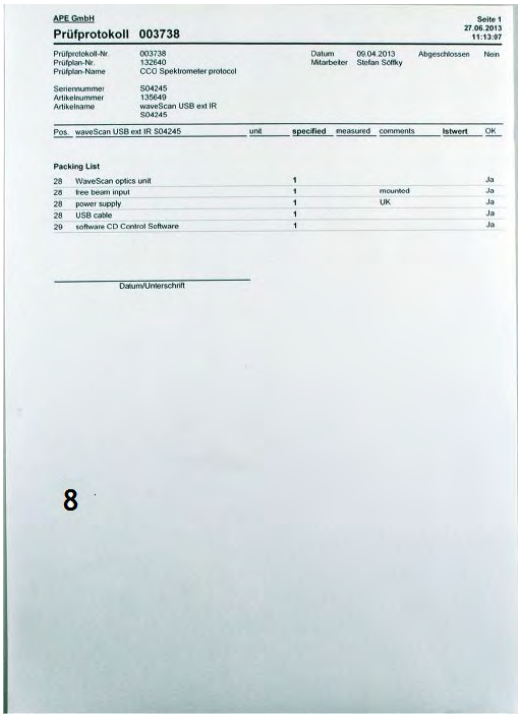


1 USB connector
2 Power ON indicator
3 Power connector
4 Power switch

Figure 2.4: ***wave*Scan USB** side view with connectors and power switch

3 Installation

3.1 Scope of Delivery



- (1) ***wave*Scan** optical head
- (2) Fiber input adapter (optional)
- (3) USB Flash Drive, including installation software
- (4) 12-VDC power adapter

Cables:

- (5) USB cable type A-B

Other:

- (6) Fixing screws (3 x)
- (7) ***wave*Scan USB** user manual
- (8) Test report

3.2 Receiving, Inspection, and General Installation Instruction

On receipt of the ***wave*Scan USB** laser spectrometer:

- Inspect the packing box for signs of rough handling or damage directly at arrival.

If you discover any irregularities:

- Take photographs of the condition of the package, the labels and the inside of the box, if necessary.
- List all defects on the shipping documents and let the delivery company countersign.
- Inform your ***wave*Scan** vendor immediately.

- Use safe lifting practices.
- Before unpacking the ***wave*Scan** wait for at least six hours to allow for acclimatization of all components.
- Unpack the ***wave*Scan USB** system and place it on your optical table.
- Retain the packaging for future use.

3.3 Installation of the Control Software

Do not connect the *wave*Scan USB to the USB interface of your computer before having installed the Control Software on the computer!

Insert the USB flash drive that was included in the delivery and contains the ***wave*Scan USB** Control Software into the USB port of your computer. Navigate to the Flash Drive and start the "setup.exe" via the Windows Explorer. Or download the installer file (only on request), unzip the file and start the setup.exe. Follow the screen instructions. During the installation process you are prompted to select an installation directory for the ***wave*Scan USB** Control Software as well as for the components of the National Instruments runtime engine (see Figure 3.1). We recommend to keep the default entries.

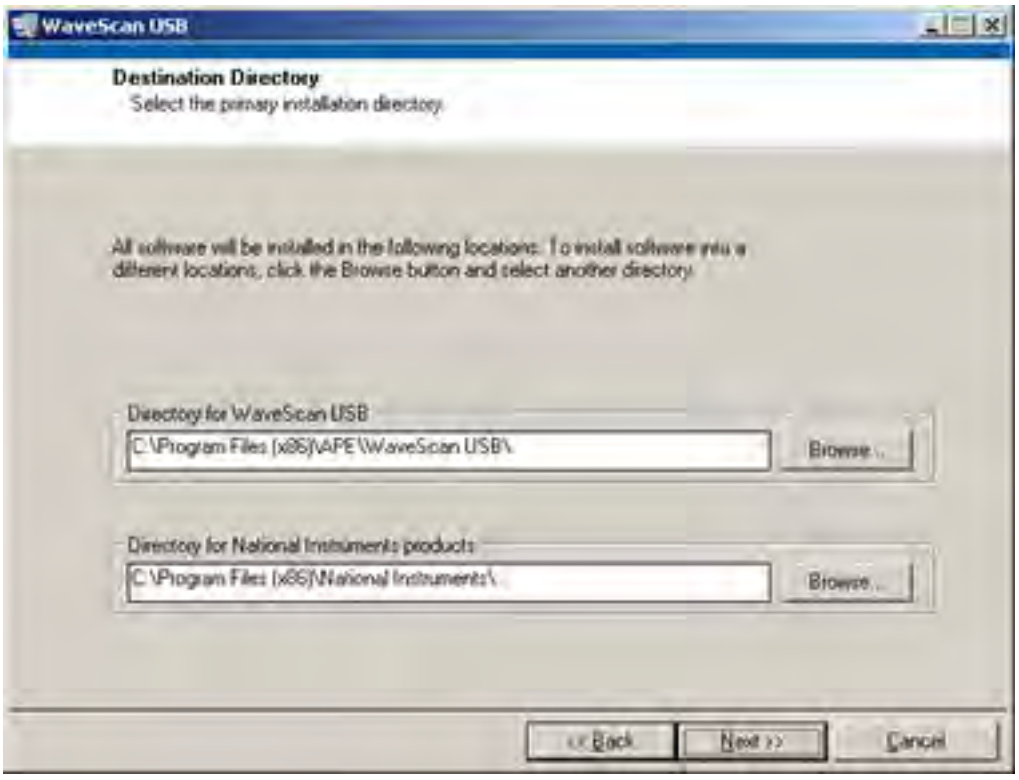


Figure 3.1: Select the installation directories

Further it is required to accept the License Agreement (Figure 3.2).

Figure 3.2: Accept the License Agreement

In the last step the necessary fonts are installed. This requires a further confirmation.

After the installation is completed you have to restart your computer before you can use the software (see Figure 3.3).

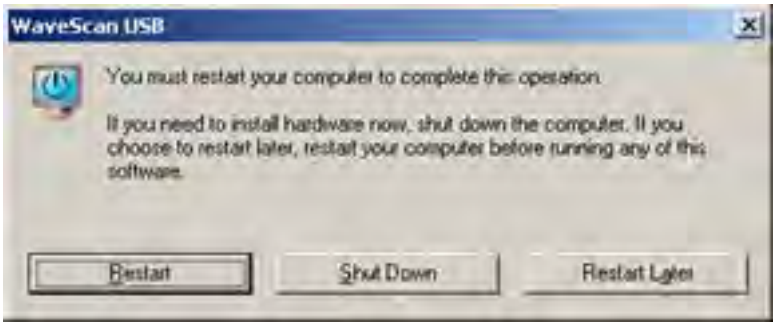


Figure 3.3: Restart your Computer

A program group “APE/waveScan USB” will be created in the start menu of your Windows desktop after successful installation, from where you can start the Control Software by double clicking the program icon.

3.4 Installation of the Optical Head

Place the ***wave*Scan USB** on your optical table in a position where you can comfortably direct the laser beam to be measured onto the input mirror and handle the control elements. See Section 4.1.1 for details of alignment. It should be possible to watch the display of your controlling computer at the same time. The input mirror assembly can be mounted in two configurations allowing for different beam input directions according to Figure 3.4. To change the configuration loosen the knurled fixing screw at the bottom of the mirror assembly (see Figure 3.5).

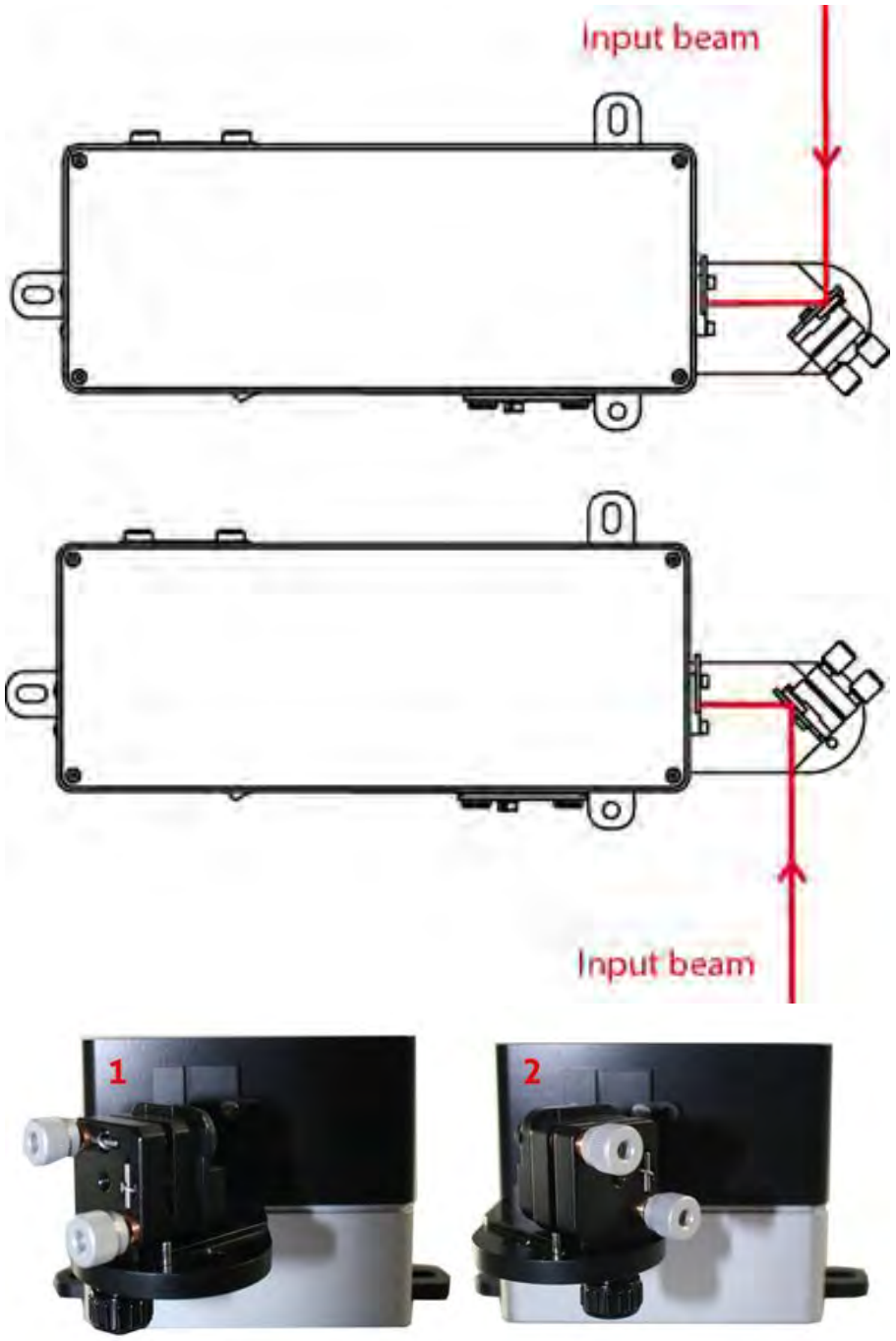


Figure 3.4: Beam input directions. The input mirror assembly can be flipped to allow for beam input from either side.

Figure 3.5: Input mirror assembly. Loosen bottom fixing screw to flip between configurations.

Choose the appropriate configuration and secure the ***wave*Scan** to the table using the fixing mounts (see Figure 3.6) and the delivered screws.

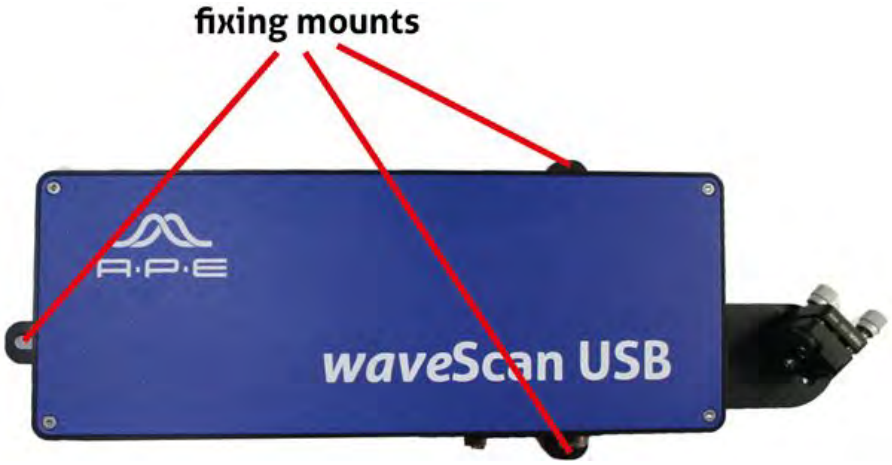


Figure 3.6: Fix the ***wave*Scan USB** on the optical table

3.5 Fiber Input and Parking Position

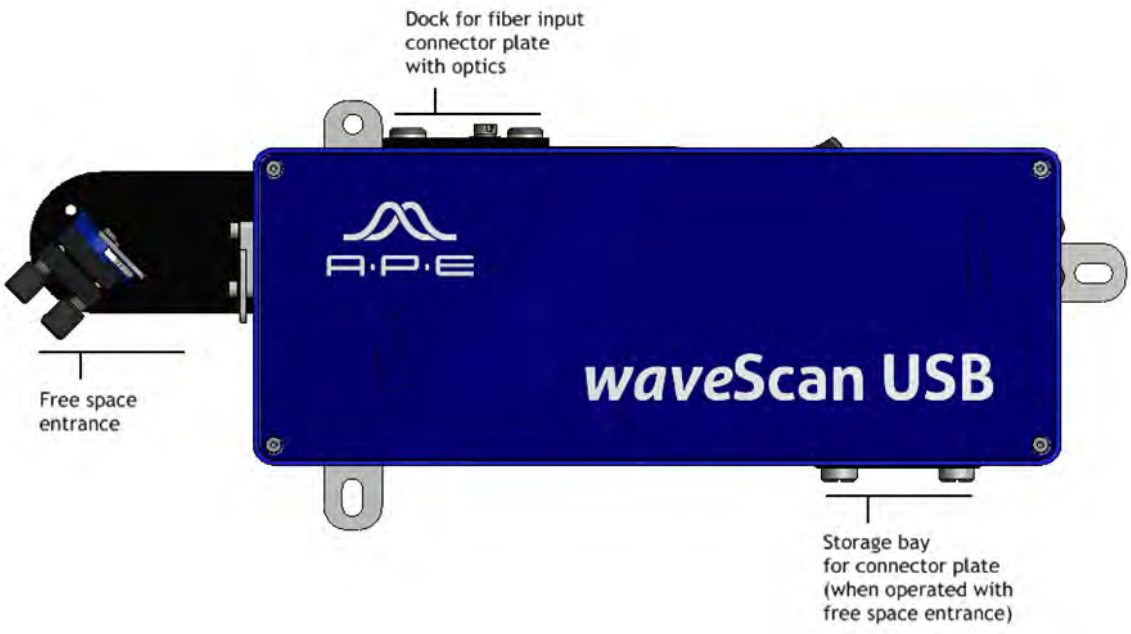


Figure 3.7: Locations of fiber input and storage bay

There is the possibility to use the ***wave*Scan USB** with a fiber adapter (optional), see Figure 2.2.
If you do not use the fiber adapter you can place it into the storage bay (see Figure 3.7).

Caution! Be careful when you put the fiber adapter in place, there is a mirror at its head. Make sure you insert it evenly either into the fiber adapter socket or the storage bay!

Do not turn the screws at the inside of the fiber adapter or else the calibration will be changed!

3.6 Cable Connection

Before connecting the *wave*Scan USB to the USB interface of your computer make sure that you have installed the Control Software on the computer (see Section 3.3).

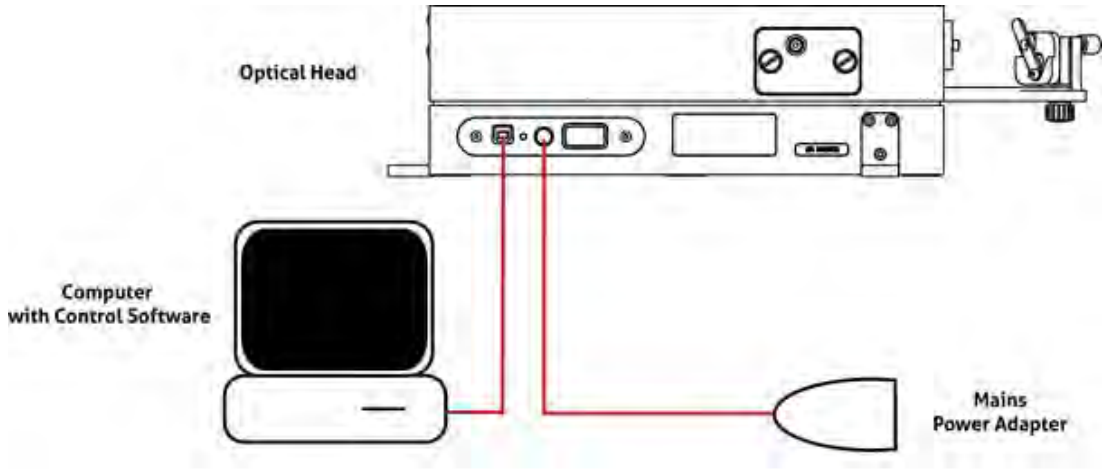


Figure 3.8: Connection scheme

1. Connect the ***wave*Scan USB** optical head ("USB" port) with a free USB port of your computer using the delivered USB cable. The ***wave*Scan USB** has a USB 2.0 Full Speed interface.
2. Connect the delivered AC/DC power adapter with the ***wave*Scan USB** optical head ("DC IN" port) and the mains wall plug.

4 Alignment and Measurement

After having connected all components of the system and installed the ***wave*Scan USB** Control Software on your computer you are ready to start alignment and the first measurement. Proceed as follows:

4.1 Set up Communication

Switch the system ON at the POWER switch of the ***wave*Scan** optical head.

Start the ***wave*Scan USB** Control Software from the Start menu > All Programs of the computer (see Figure 4.1).

Figure 4.1: Starting the Control Software from the Windows Start Menu

The measurement (main) window will open (see Figure 4.2). By starting the A·P·E ***wave*Scan USB** Control Software it automatically tries to initiate communication to the ***wave*Scan** optical head. If communication is properly established the info window displays the status "Connected".

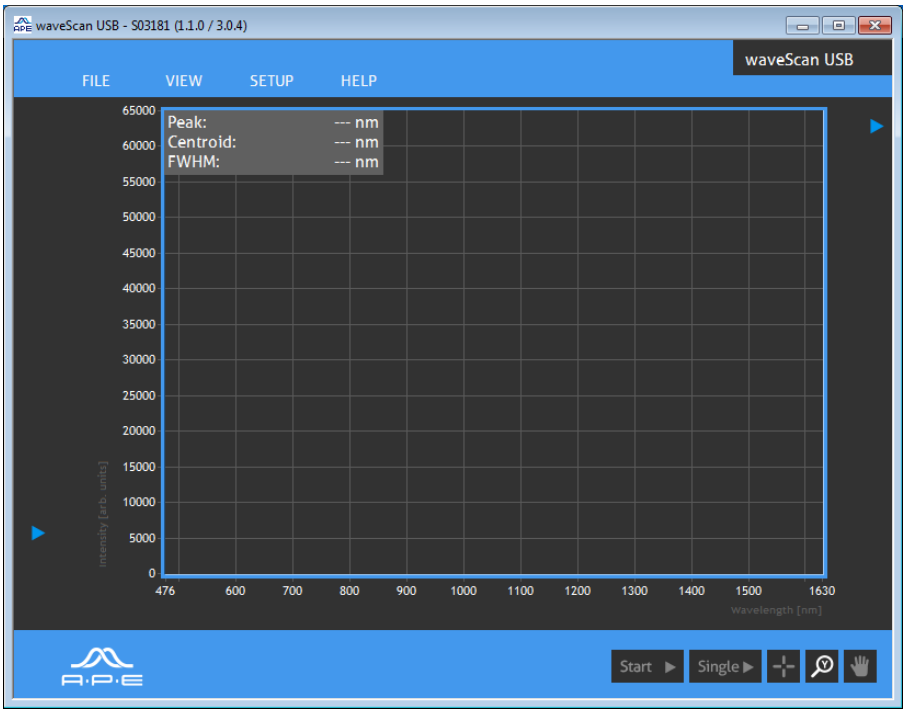


Figure 4.2: ***wave*Scan USB** Control Software main window with info string indicating proper connection

If communication between ***wave*Scan USB** and computer fails the info window shows the status "Disconnected" (see Figure 4.3).

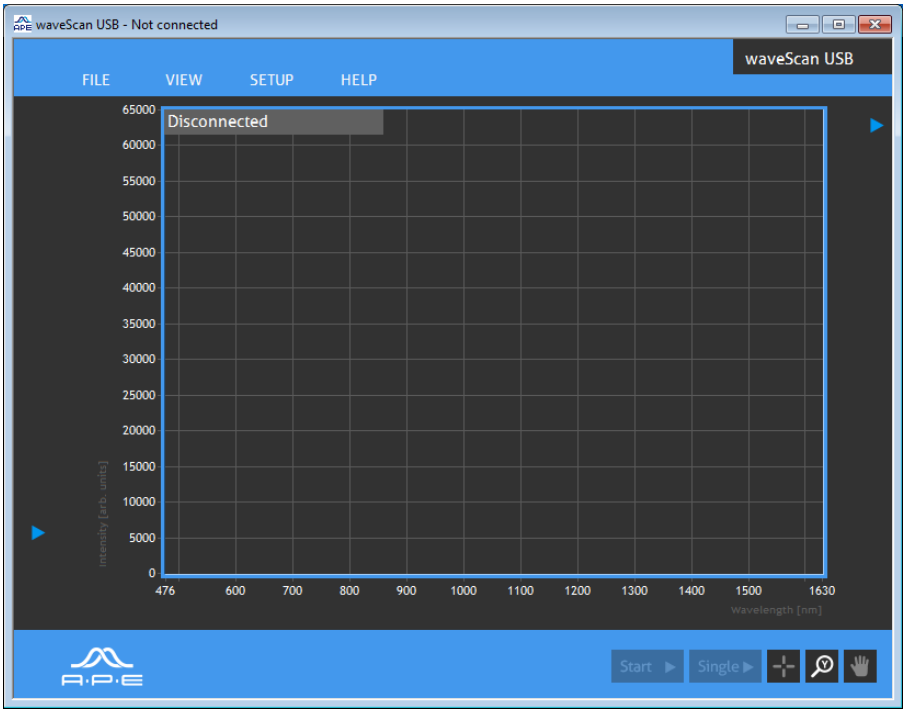


Figure 4.3: ***wave*Scan USB** without communication to the Control Software

In this case check the cable connections and make sure the ***wave*Scan** is switched ON. Wait a few seconds. The software will automatically detect the instrument at the USB port of

the computer and establish the communication. You should now see the connected state as indicated in Figure 4.2. If you do not get any communication between the ***wave*Scan USB** and the computer please refer to Section 7.2 "Troubleshooting".

For details of the controls and functional regions of the measurement window see Chapter 5 "Control Software Reference".

Figure 4.4: Click the "Start" button to start the measurement

Usually you will first see a noise signal only (see Figure 4.5).

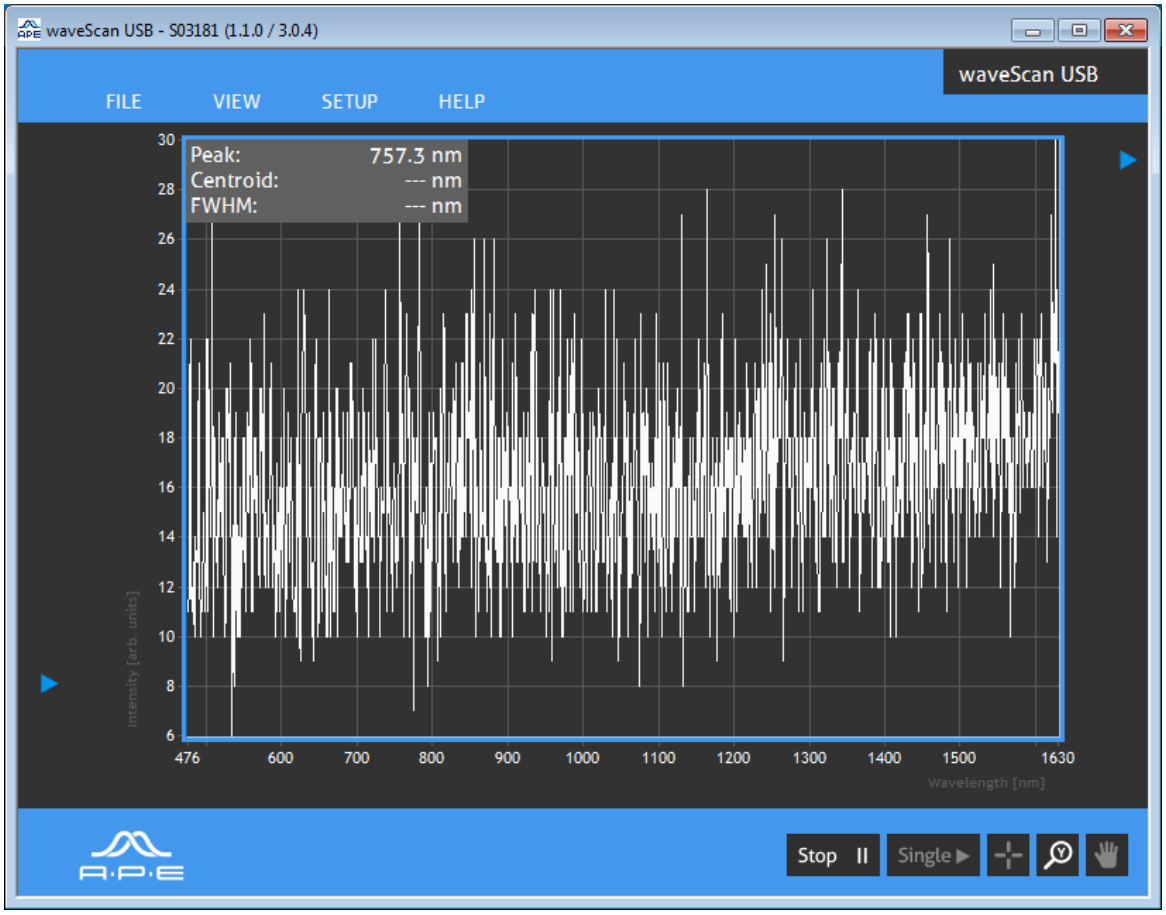


Figure 4.5: Online measurement with noise signal

4.1.1 Alignment of the input beam

Use appropriate optics (e.g., glass plate, beam splitter) to direct a part of the laser beam that is to be measured onto the center of the input mirror of the optical head. See Figure 3.4 for possible input directions and Section 3.4 to learn more about how to change between input configurations.

Close the alignment apertures in front of the input mirror (see Figure 4.6) and in front of the beam input (see Figure 4.7) to assist alignment.

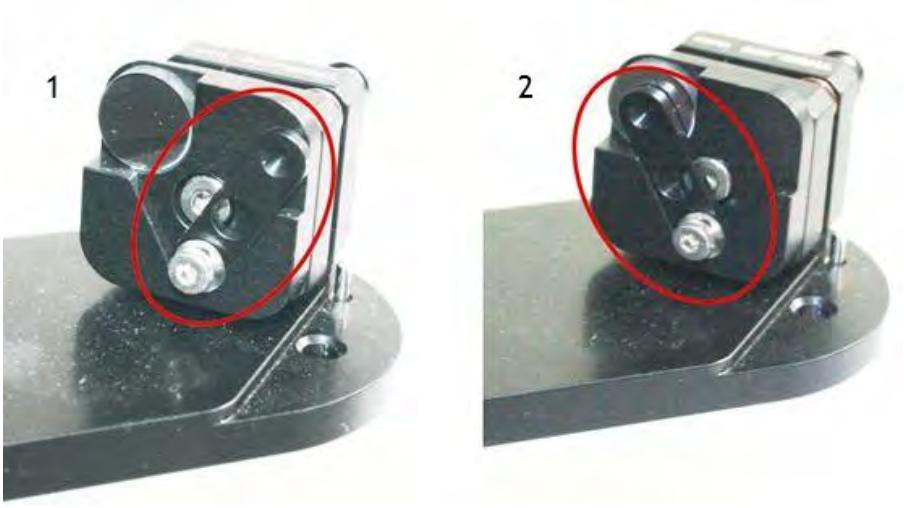


Figure 4.6: Alignment aperture of the input mirror: 1 - open; 2 - closed

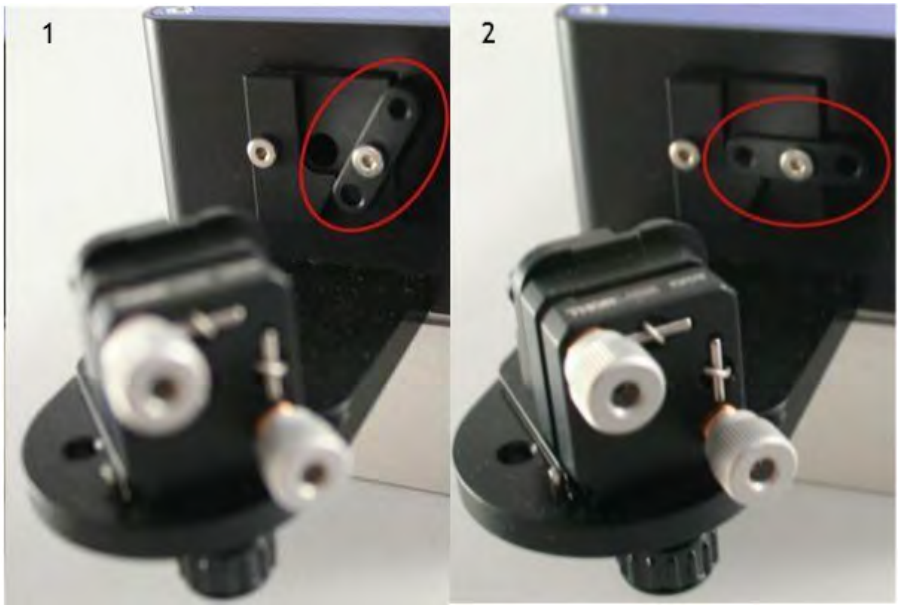


Figure 4.7: Alignment aperture of the beam input: 1 - open; 2 - closed

Make sure that the input polarization is horizontal and the divergence is small. The beam diameter should be between 1 ... 2 mm. Although the sensitivity is much higher, **please note that the detector saturates above 30 mW/nm!** When you have found a spectral signal the input power usually must be reduced to avoid overload.

Adjust the input mirror to have the beam enter the device through the input aperture using the horizontal and vertical adjustment screws (see Figure 4.8).

Figure 4.8: Input mirror adjustment screws: 1 - horizontal; 2 - vertical

4.1.2 Searching for Signal

If you do not know the wavelength of your laser you should start to search for a spectral signal within the widest measuring range possible with your ***wave*Scan** version. You can set the scan range in the menu "Setup → Wavelength window" (see Figure 4.9).

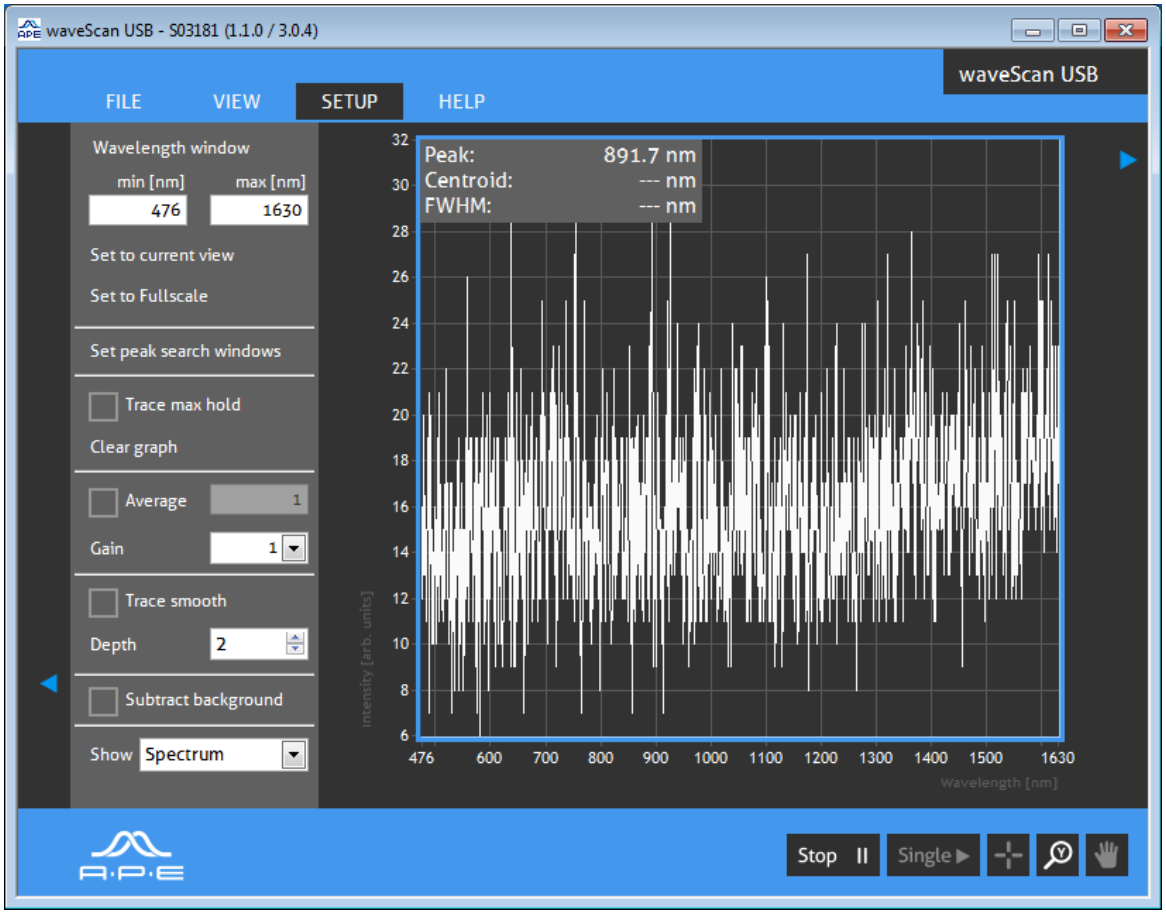


Figure 4.9: Menu selection to set the measuring range

An additional window will open. Click on "Set to Fullscale" in the upper section of the "Wavelength window".
Now carefully adjust the input mirror using the horizontal and vertical adjustment screws (see Figure 4.8). It is recommended to monitor the Control Software simultaneously. Continue until you see a distinct signal peak over the background noise (see Figure 4.10).

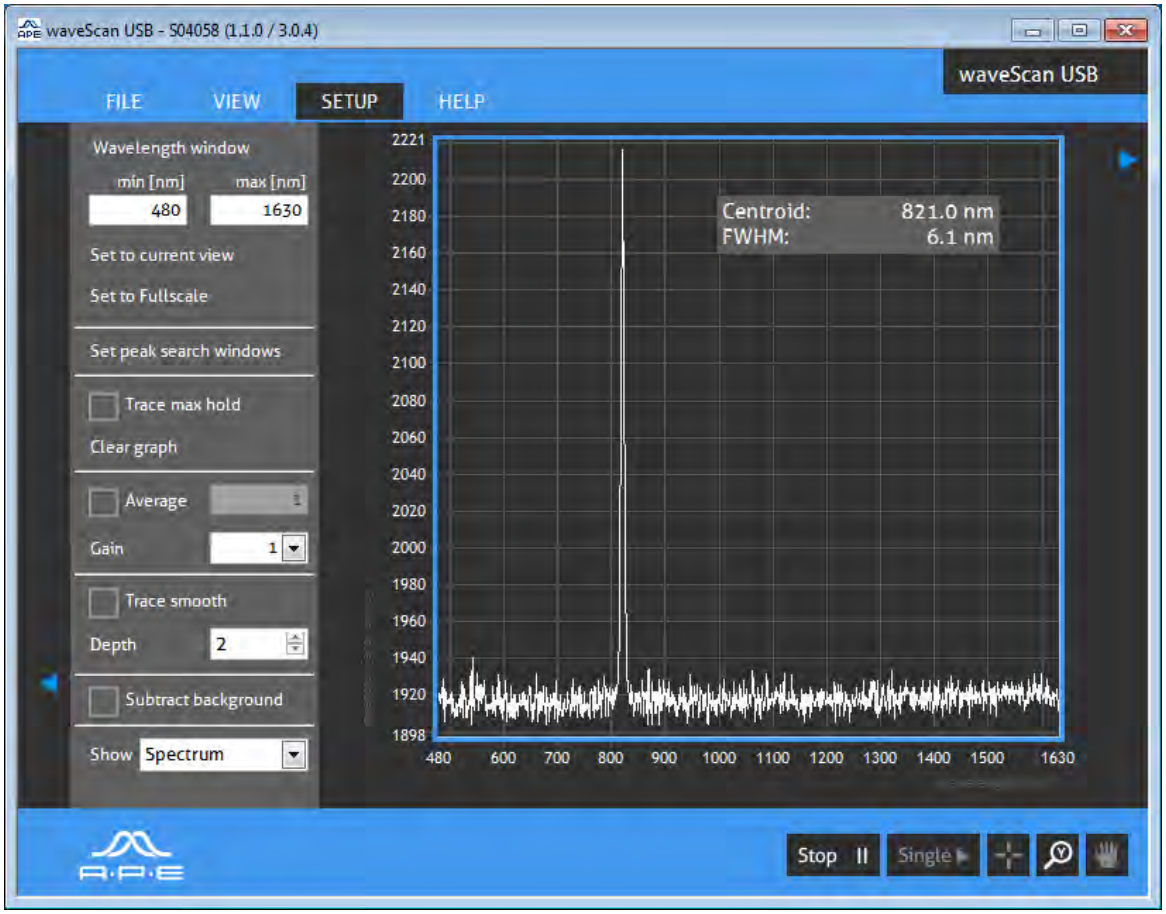


Figure 4.10: Signal peak over background noise

You can left-click on the info window and drag it to any position in the measurement window to not overlap the graph.

Open the alignment apertures.

4.1.3 **Optimizing Alignment**

Once you have found a signal peak you should optimize the adjustment for maximum signal strength.
Choose an appropriate measuring range that covers the wavelength of the signal peak in the Setup menu. Type the minimum and maximum wavelength of the desired measuring range in the respective fields in the "Wavelength window" section and click "OK" (see Figure 4.9).
After that carefully readjust the input mirror using the horizontal and vertical adjustment screws (see Figure 4.8) while watching the measurement window on the display. Maximize the signal peak (see Figure 4.11).

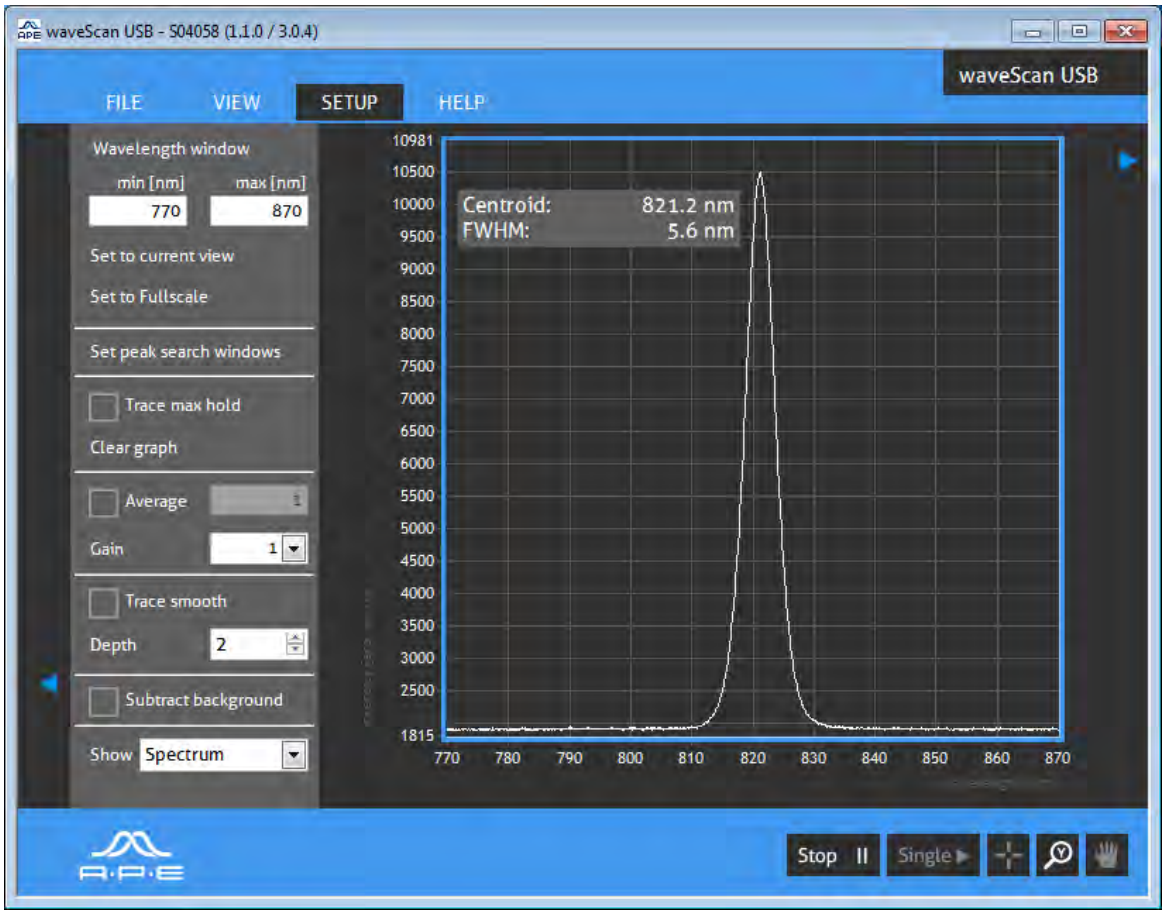


Figure 4.11: Measuring window with maximized signal peak

You can now further narrow or widen the measurement range according to your demands using the "Wavelength window" control in the setup menu. If the signal saturates the detector, i.e., when reaching a signal strength of 65000 digits, (see Figure 4.12) reduce the input power.

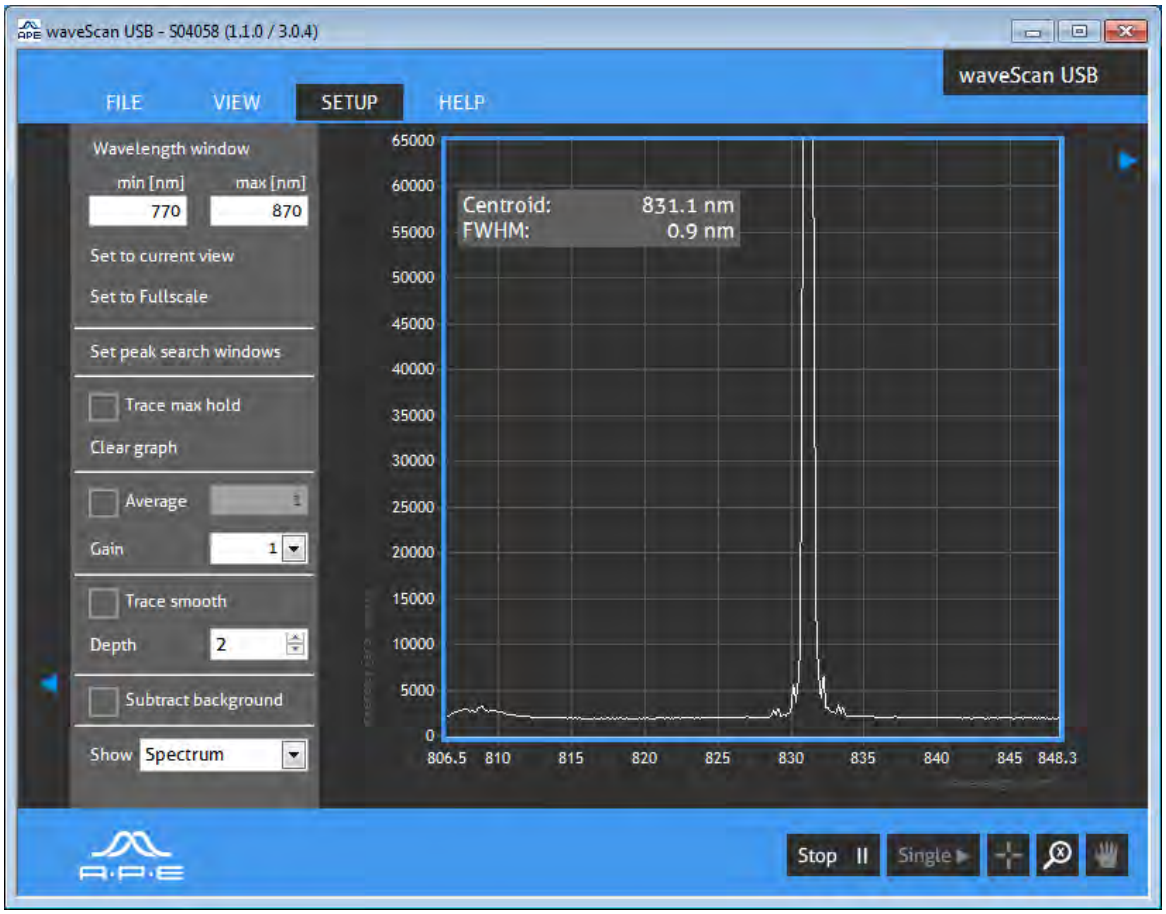


Figure 4.12: Detector saturated

5 Control Software Reference

5.1 "Start" Button

Figure 5.1: Press the "Start" button to start a continuous measurement

Click on this button to start a continuous online measurement. Any old spectrum on the display will be overwritten. The display will be refreshed at the rate the spectra are measured by the ***wave*Scan USB** .

The button turns into the "Stop" button after the measurement is started.

5.2 "Stop" Button

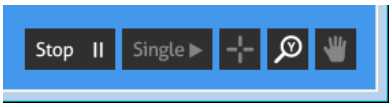


Figure 5.2: Press the "Stop" button to stop the measurement

Click on this button to stop the online measurement. The last measured spectrum will remain on the display and can be saved, zoomed, and so on.

The button turns into the "Start" button after clicking.

5.3 "Single" Button

Figure 5.3: Press the "Single" button to start a single measurement

Click on this button to start a single measurement. An old spectrum on the display will be overwritten.

5.4 "Cursor" Button

Figure 5.4: The "Cursor" tool-button has several different functions.

The "Cursor" button is a tool-button with three different functions:
Do a single left-click on this button to enable the cursors. If the cursors are enabled but not visible in the graph, do a double left-click on this button. This will center the cursors in the currently visible graph area.
If you want to hide the cursors again right-click on this button. This will disable the cursors.
All these functions are also available in the "VIEW → Cursors" submenu, as described in section 5.7.2.7.2.

5.5 "Zoom" Button

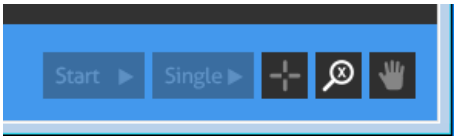


Figure 5.5: Zoom X

Figure 5.6: Zoom Y

This button enables the zoom tool for the graph. You can use it to magnify a section of the graph window without changing the measurement settings (this zoom is only a digital zoom, it does not change the underlying measurement data).
You can choose between the zoom tool for the x- and y-axis of the graph. To switch between both modes do a single right-click on this button.
The currently active mode is shown by the button glyph. The letter inside the magnifying glass icon shows which tool is active. There will be either a "X" for the x-zoom tool or a "Y" for the y-zoom tool inside the icon.
Also the mouse-cursor will change depending on the selected mode while you're pointing at the graph:

Figure 5.7: X-Zoom

Figure 5.8: Y-Zoom

If you want to reset the zoom on one of the axes switch to the corresponding zoom tool mode and double-click with the left mouse button on the zoom button.

5.6 "Panning" Button

Figure 5.9: The "panning" button activates the panning function.

Single-click with the left mouse button on this button to activate the panning tool for the graph. This tool allows you to drag the visible graph area around. It is very useful when you have already applied a zoom to the x or y axis and want to see another section of the graph without having to reset the magnified area.
While the panning tool is active, the mouse cursor will change to a hand symbol when you point at the graph:

To reset the panning to the default position do a double-click with the left mouse button on this button (Note: This will also reset the applied zoom for both graph axes).

5.7 Menu Bar

5.7.1 File

In the "File" menu the following items are available:

- Save
- Load
- Quick save
- Setup quick save
- Service
- Start TCP/IP
- TCP Autostart Server
- Exit

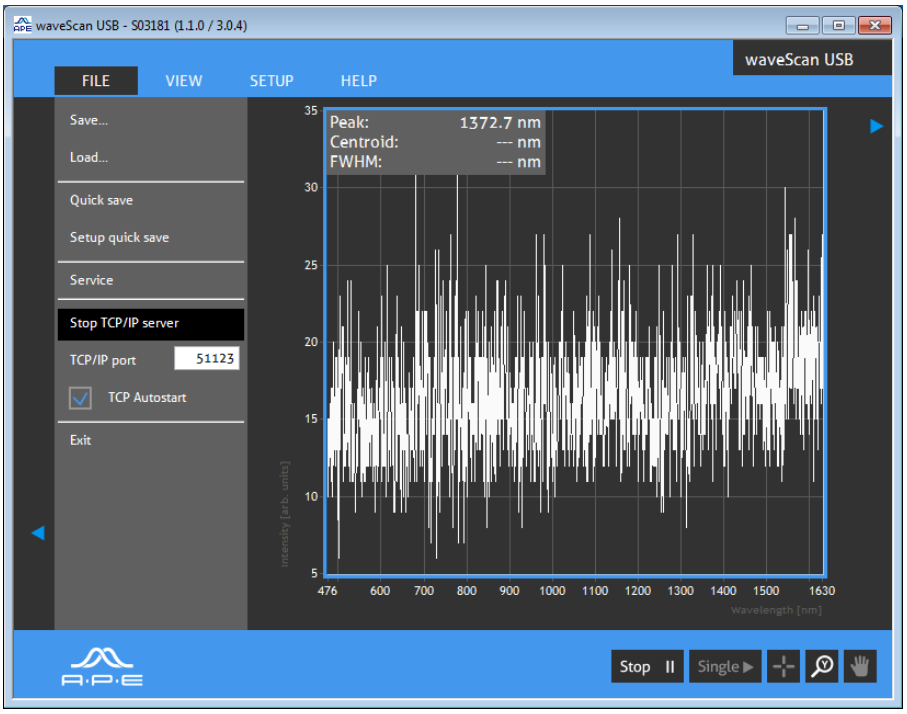


Figure 5.10: File Menu

5.7.1.1 "Save" Menu

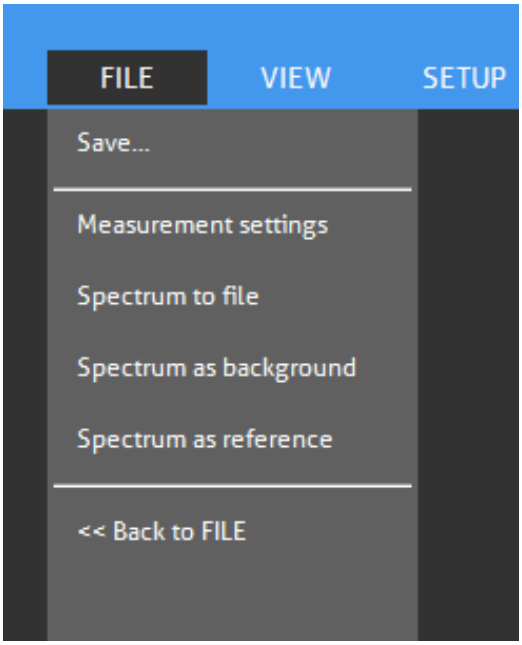


Figure 5.11: File → Save Menu

There are four saving options, each will open a dialog for choosing a file name and location.

- **Save measurement settings**

  The ***wave*Scan USB** Control Software allows you to save your current software settings as a separate file (see Paragraph 5.7.1.1). Use the "Open settings file" function to recall those software settings. This is an easy way to start a measurement with the same settings as in a previous experiment.
- **Save spectrum to file**

  Spectra are saved in ASCII format to allow for easy import into common data processing or graphics software.

  For saving spectra with a preset name at a preset location see Paragraphs 5.7.1.3 "Quick save" and 5.7.1.4 "Setup quick save".
- **Save spectrum as background**

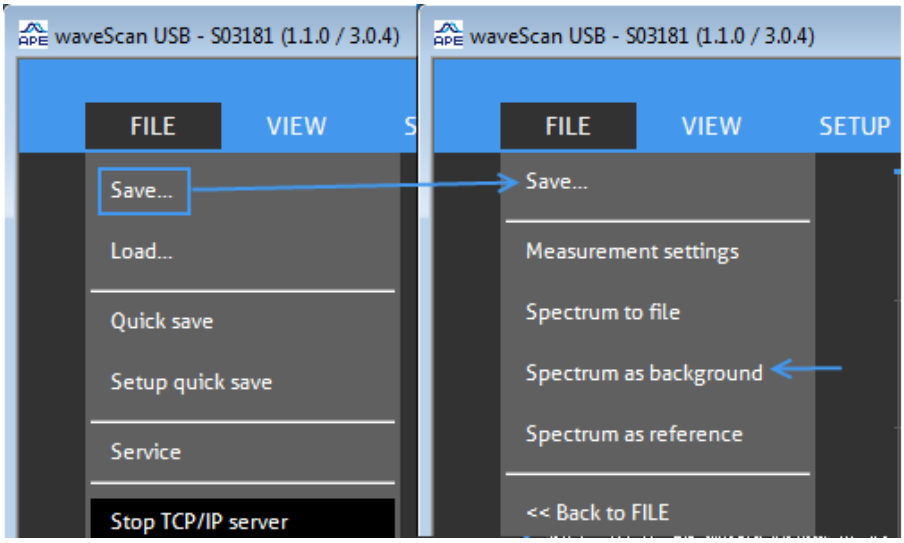


Figure 5.12: Select "Spectrum as background" to save the current spectrum into background memory

The ***wave*Scan USB** software allows to subtract a background signal from the spectrum to be measured (see Paragraph 5.7.3.10 "Subtract Background"). To prepare this function you must take a background spectrum that can be subtracted later. "Spectrum as background" does exactly this. Block the input beam to take a background signal.

The background signal is kept in memory until you either select "Clear graph" (see Paragraph 5.7.3.6) or if you change the wavelength window.

- **Save spectrum as reference**

  The ***wave*Scan USB** software allows you to display a second spectrum as reference besides the currently measured one. "Take current spectrum as reference" loads the current spectrum into the reference memory and displays this as additional green curve in following measurements (see Figure 5.13).

  It is kept in memory until you either select "Clear graph" (see Paragraph 5.7.3.6) or if you change the wavelength window.

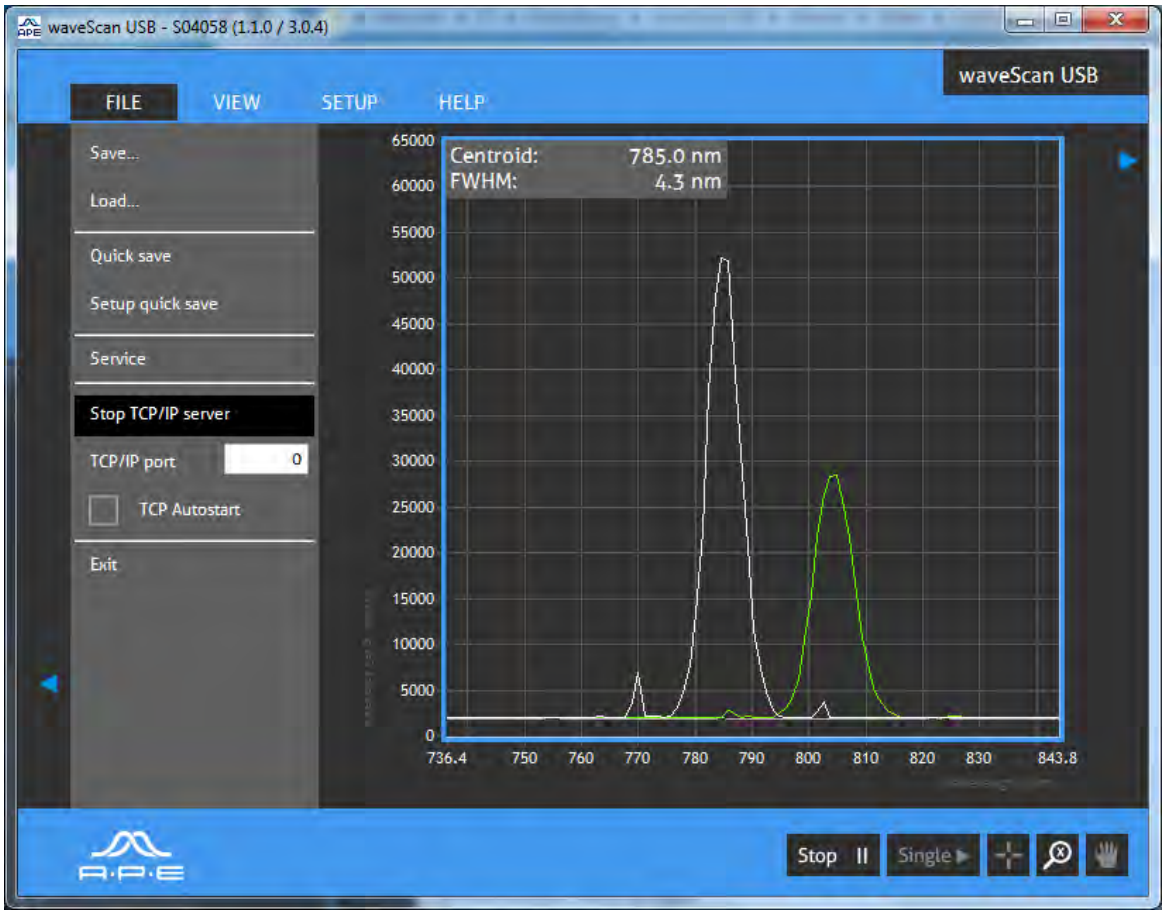


Figure 5.13: Reference spectrum displayed as additional green curve (with background subtracted)

5.7.1.2 "Load" Menu

- **Load measurement settings**

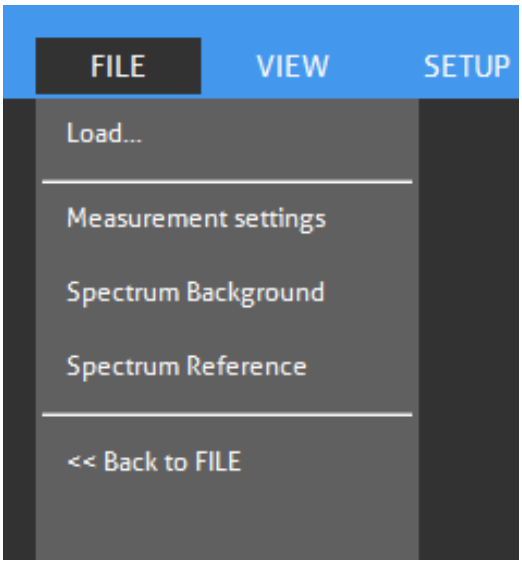


Figure 5.14: Select "Open settings file" to import presaved software settings

The ***wave*Scan USB** Control Software allows you to save your current software settings in a separate file (see Paragraph 5.7.1.1). Use this function to recall these software settings. This is an easy way to start a measurement with the same settings as in a previous experiment.

- **Load spectrum background**

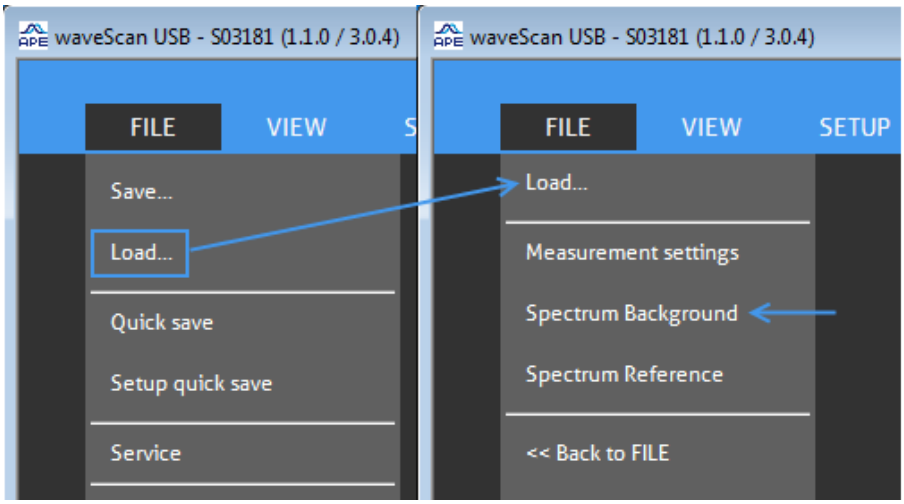


Figure 5.15: Select "Load background" to load a background spectrum from a file into display

"Load background" allows you to load an additional background spectrum from a previously saved data file and display the respective curve along with the currently measured spectrum. See Paragraph 5.7.1.1 to learn about how to save a spectrum.

In the current version it is not possible to subtract this spectrum from the measurement curve.

- **Load Spectrum reference**

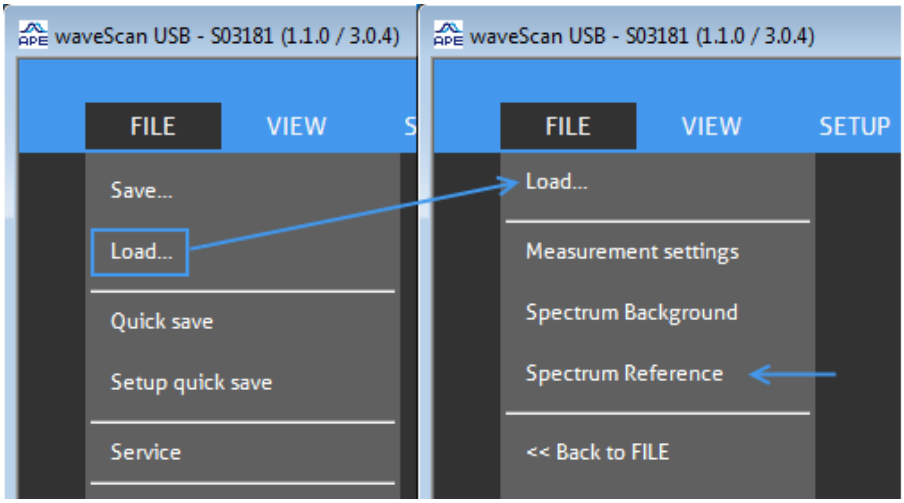


Figure 5.16: Select "Spectrum reference" to load a reference spectrum from a file

"Spectrum reference" allows you to load an additional reference spectrum from a previously saved data file and display the respective curve along with the currently measured spectrum. See Paragraph 5.7.1.1 to learn about how to save a spectrum.

In the current version it is not possible to perform a background subtraction from this spectrum.

5.7.1.3 Quick Save

Figure 5.17: Select "Quick save" to save the current spectrum with a preset name at a preset location

This menu item allows you to quickly save the current spectrum with a preset file name at a preset location.

Before you use this function you must choose the filename presets in the "Filename formatting" dialog that you can access through the "Setup quick save" item (see Paragraph 5.7.1.4).

5.7.1.4 Setup quick save

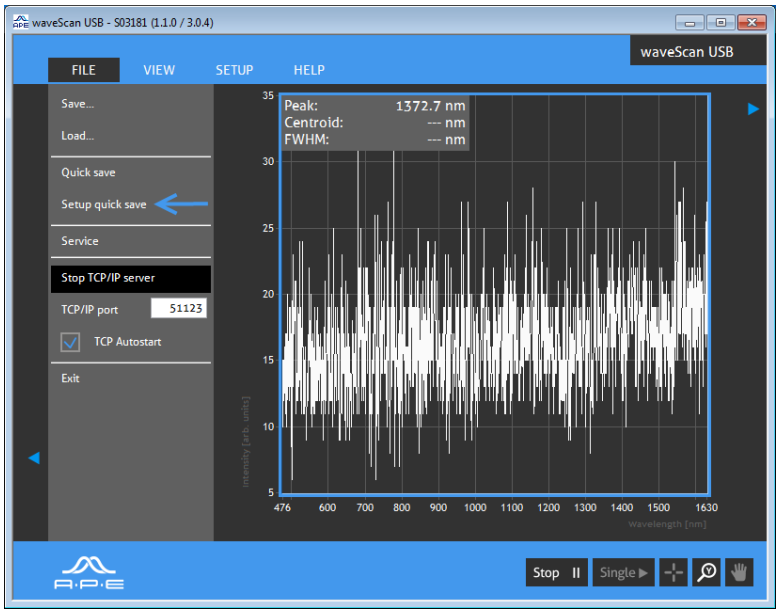


Figure 5.18: Select "Setup quick save" to open the "Quicksave Options" dialog

Select this item to open the "Quicksave Options" dialog (see Figure 5.19 and 5.20). In this dialog you can select a folder for quick saving and a format for the filename when using the quick save function.

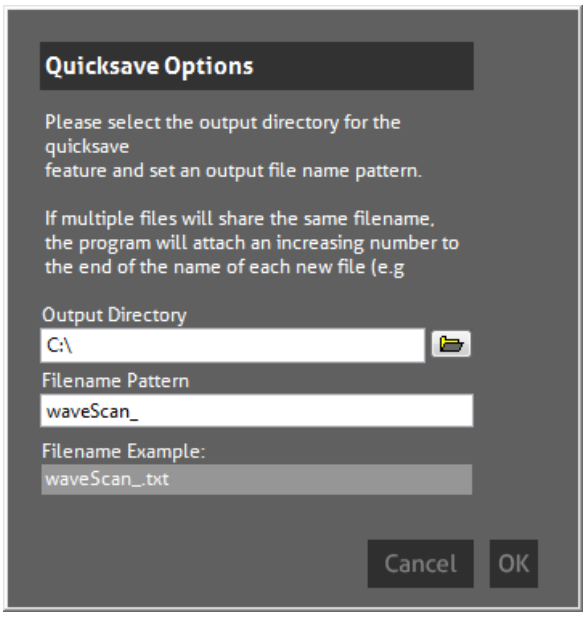


Figure 5.19: Quicksave Options for naming files with increasing numbers

Type the desired text into the text field. The software will automatically add an increasing number to thjs text if another file with this name already exists in the selected output directory.

For example:

waveScan_0.txt
waveScan_1.txt
waveScan_2.txt
.
.
.

You can also use some placeholders in the Filename Pattern, that will automatically be replaced during the Quicksave operation.
The following placeholders are currenty available:

$Y → year (4 Digits, e.g. "2015")
$y → year (2 Digits, e.g. "15" for 2015)
$m → month
$D → day
$H → hour (in 24hr format)
$M → minute
$S → seconds

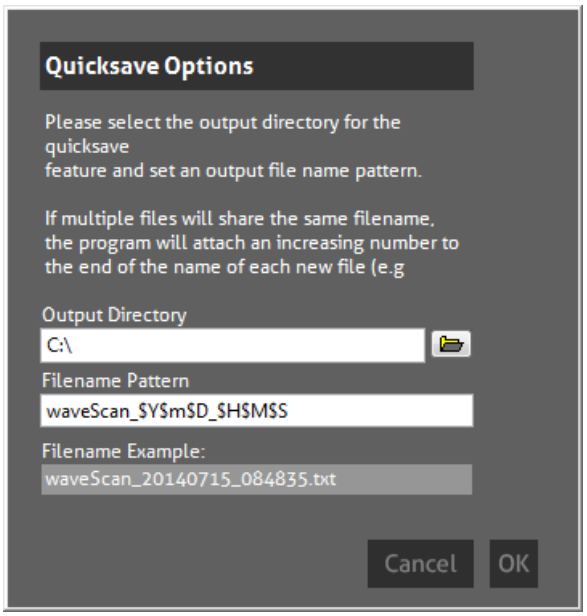


Figure 5.20: Quicksave options for filenames with time stamps

5.7.1.5 Service

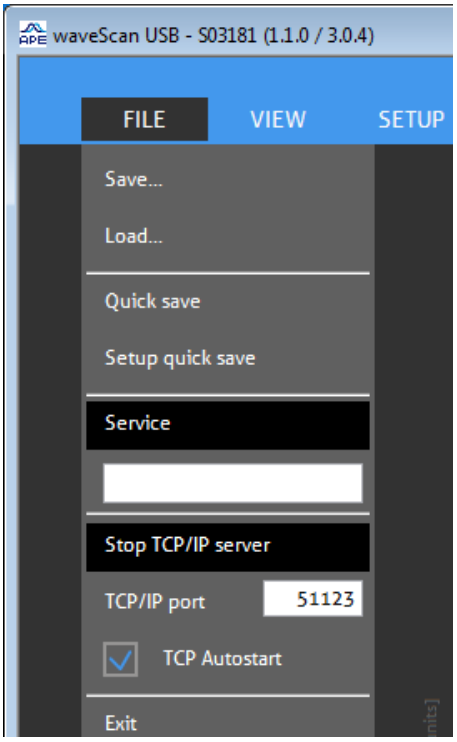


Figure 5.21: Selecting "Service" opens a dialog to enter the service password

The service mode is used for service functions like software updates or remote support. Use this function only after consultation with A·P·E or your local service provider. They will tell you the service password if required.

5.7.1.6 TCP/IP Server

The ***wave*Scan USB** Software includes a TCP/IP software interface for interaction and data exchange with other applications. Enter a port address and press “Start TCP/IP server” for activating the server. The server will now listen for clients and establish a connection if possible. The commands are described in Chapter 6.

5.7.1.7 TCP/IP Autostart

Selecting the TCP Autostart check box will start the server with the same settings after the next program start.

5.7.1.8 Exit

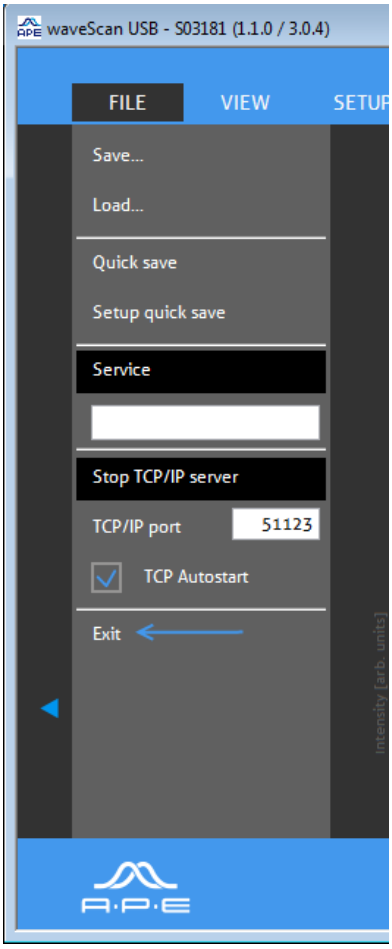


Figure 5.22: Select "Exit" to quit the ***wave*Scan USB** Control Software

Select "Exit" to quit the ***wave*Scan USB** Control Software.

5.7.2 View

The following items are available in the "View" menu:

- Log scale X
- Full scale X
- Log scale Y
- Autoscale Y
- Full scale Y
- Manual zoom
- Info string
- Infostring Options
- Cursors
- Math Operations
- Use light theme

5.7.2.1 Log Scale X

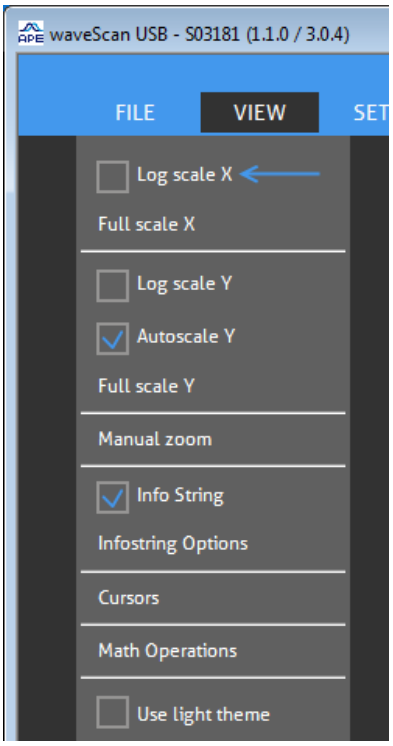


Figure 5.23: Select "Log scale X" to show a logarithmic wavelength axis

"Log scale X" sets the wavelength (X-) axis of the graph to a logarithmic display mode.

5.7.2.2 Full Scale X

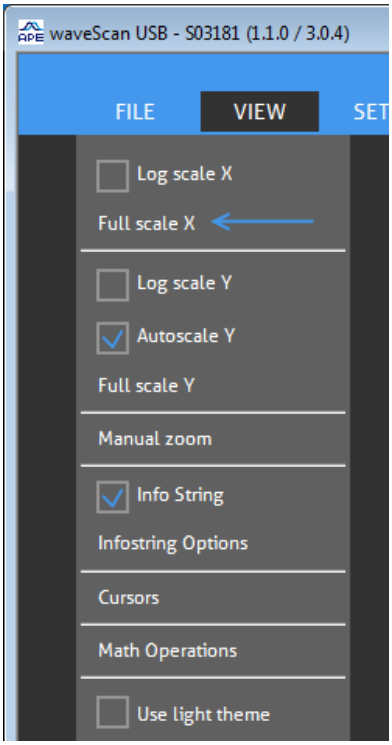


Figure 5.24: Select "Full scale X" to set the wavelength axis to the full wavelength range

"Full scale X" sets the wavelength (X-) axis of the graph to the full range selected in the "Set wavelength" menu (see Paragraph 5.7.3.1).

5.7.2.3 Log Scale Y

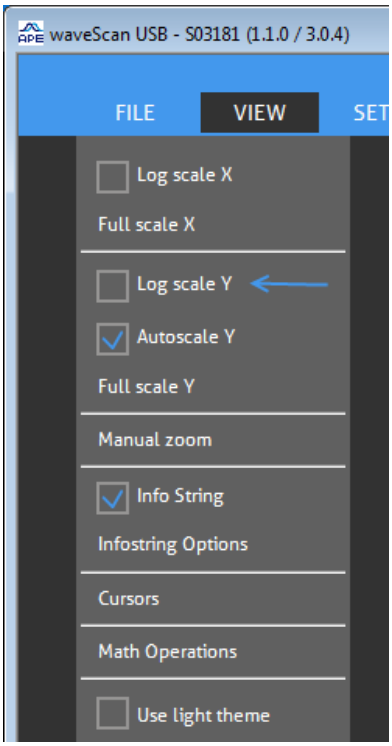


Figure 5.25: Select "Log scale Y" to show a logarithmic intensity axis

"Log scale Y" sets the intensity (Y-) axis of the graph to a logarithmic display mode.

5.7.2.4 Autoscale Y

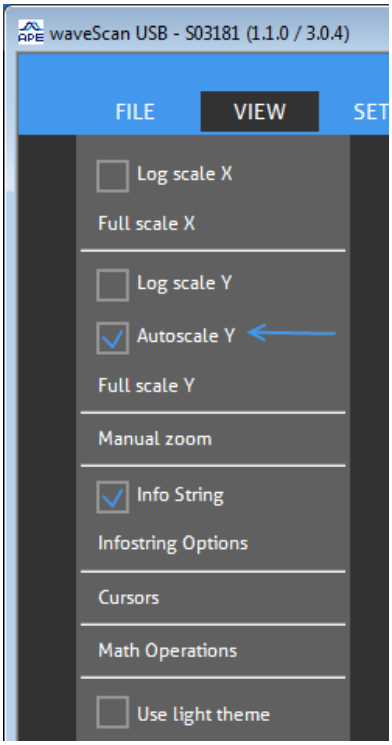


Figure 5.26: Select "Autoscale Y" to fit the intensity axis to the actual data range

"Autoscale Y" fits the scale of the intensity (Y-) axis of the graph to the data range of the current spectrum.

5.7.2.5 Full scale Y

“Full scale Y” sets the intensity (Y-) axis of the graph to the full available range (0 . . . 65000).

5.7.2.6 Manual Zoom

Select this item to open the "Manual zoom" menu (see Figure 5.27 and 5.28). In this dialog you can manually select the ranges of the displayed axis.

In the upper area you can select the minimum and maximum of the wavelength (X-) axis (see Figure 5.27). Checking the "Full Scale" checkbox will show the full transmitted wavelength range. Please note that these settings refer to the displayed graph only. The actual wavelength data range that is transmitted from the ***wave*Scan** optical head and that determines the pixel resolution (nm per data point) is set in the "Wavelength window" (see Paragraph 5.7.3.1).

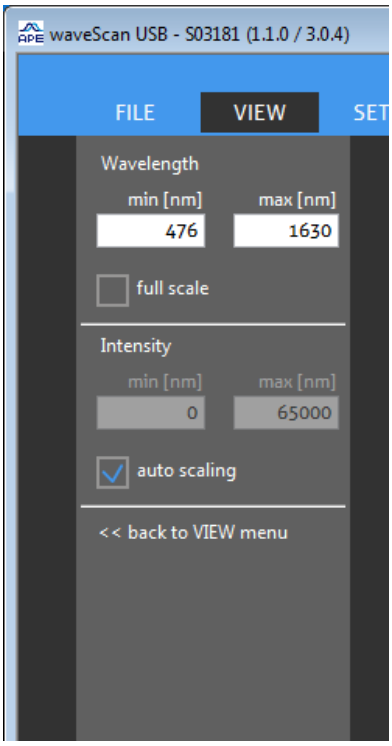


Figure 5.27: Select minimum and maximum of the wavelength scale (intensity scale is set to "automatic" in this picture)

In the lower area you can select the minimum and maximum of the intensity (Y-) scale (see Figure 5.28).

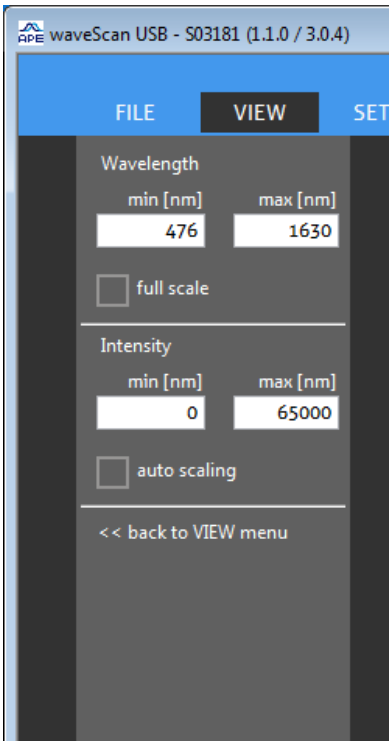


Figure 5.28: Select minimum and maximum of the intensity scale

Alternatively you can set this to "automatic" by activating the respective checkbox. In

"automatic" mode the scale of the intensity (Y-) axis of the graph is automatically fit to the data range of the current spectrum. This is equivalent to the menu item "Autoscale Y" (see Paragraph 5.7.2.4).

5.7.2.7 Info String

Activating this checkbox will display an info box in the graph window with selectable information.

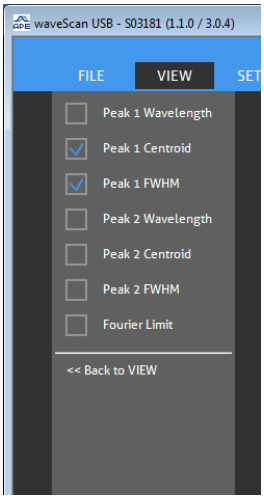


Figure 5.29: Select "Infostring options" to select the information displayed in the info string

5.7.2.7.1 **Infostring options** Select the menu item "Info string > Show info" to select the type of information displayed in the info string. There are the following items to choose from:

- Peak 1 wavelength
- Peak 1 Centroid
- Peak 1 FWHM (full width at half maximum)
- Peak 2 wavelength
- Peak 2 Centroid
- Peak 2 FWHM (full width at half maximum)

The Peak 2 entries are available only if a second peak search window is specified (see Paragraph 5.7.3.4).

Additionally, in the upper line of the info string the information "Connected" or "Disconnected" is always displayed.

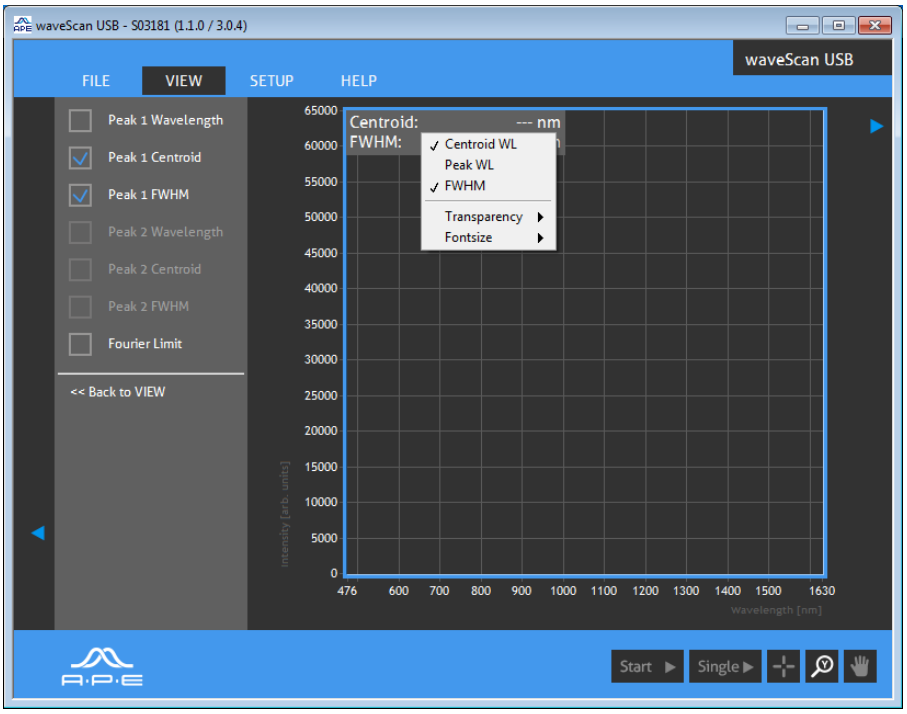


Figure 5.30: Right-click on the info string for additional configuration options

Right clicking on the info string box gives access to the same selection as well as control over transparency and fontsize of the info box.

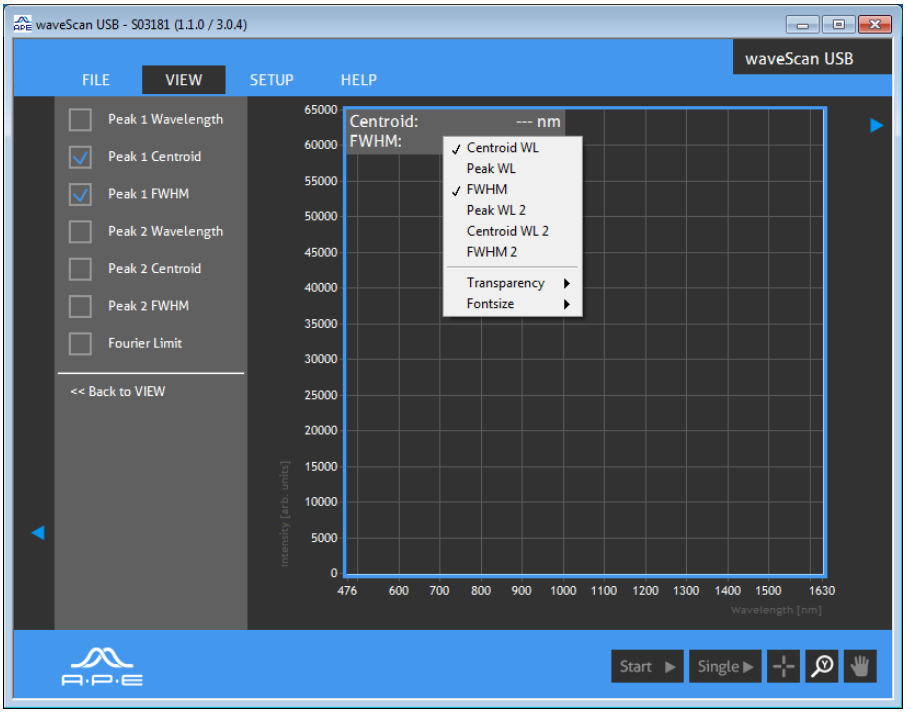


Figure 5.31: Additional items in "Info string → Show info" when second peak search window is set

Please note that only the parameters of the peak with the highest intensity in the set wavelength window are shown on the display.

Figure 5.32: Right-click on the info string and select fontsize to choose the fontsize for the info string

Select the menu item "Info string" → "Size" to change the fontsize of the info string between 16 and 50.

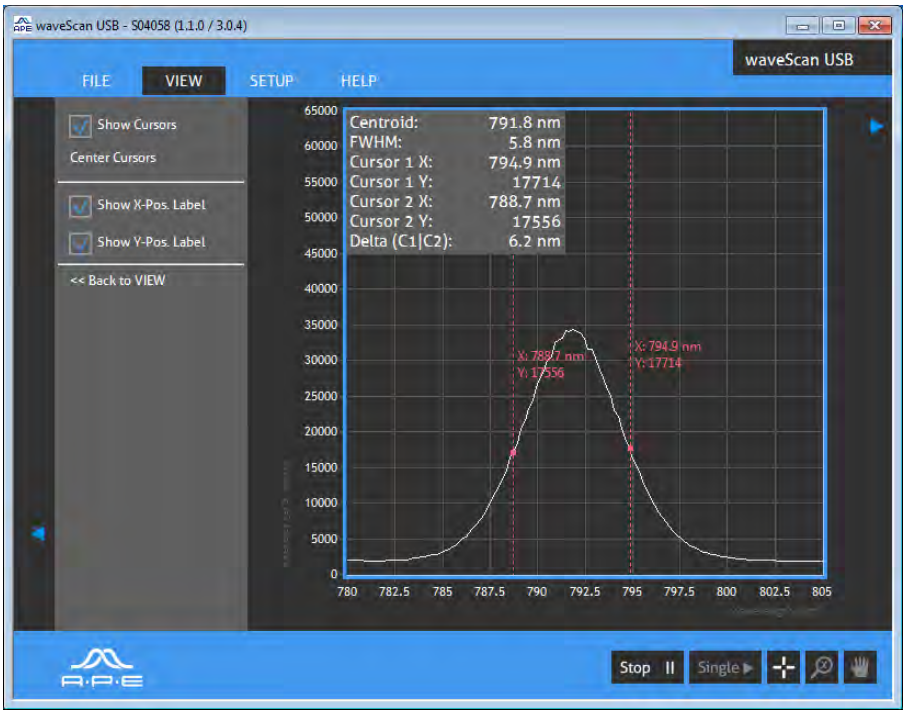


Figure 5.33: Cursors with activated position labels

5.7.2.7.2 **Cursors** Setting the Show Cursors check box activates the cursors in the graph window. With activated cursor tool the cursors can be moved by left-clicking the corre-

sponding cursor line and moving the mouse while holding the left mouse button. If the cursors are outside the visible range of the graph window they can be centered by clicking the “Center Cursors” function in the cursor menu. The check boxes “Show X-Pos. Label" and "Show Y-Pos. Label" control the visibility of the cursor position labels. The X-Pos. Label shows the wavelength position of the curser while the Y-Pos.Label shows the intensity value of the cross point between the cursor line and data curve.

Figure 5.34: Spectrum data curve with activated fit function

5.7.2.7.3 **Math Operations** The check box “Nonlinear Curvefit” activates the fit function for the spectrum data. There are three fit types (Gauss, Lorentz and Sech2) selectable. The fit result is shown as a red line curve in the graph window.

5.7.2.7.4 **Use light theme** With this option a brighter layout for the user interface can be activated.

5.7.3 Setup

The "Setup" menu provides the following items:

- Wavelength window
- Set to current view
- Set to Fullscale
- Set peak search windows
- Trace max hold
- Clear graph
- Average

- Gain
- Trace smooth
- Subtract background
- Show

5.7.3.1 Wavelength Window

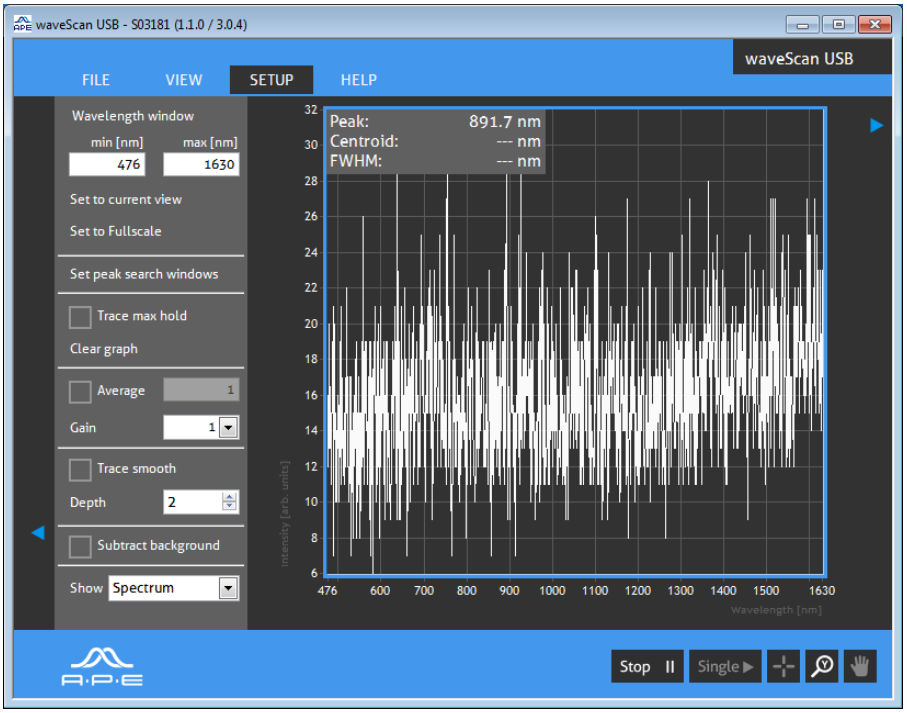


Figure 5.35: Setup Menu

When a measurement is started a set of 1024 data points is transferred from the ***wave*Scan** optical head to the control computer with each scan (at a rate of six scans per second). With the settings in the "Wavelength window" you determine the wavelength range that these 1024 data points are distributed equidistantly in. The maximum possible range ("full scale") is determined by physical properties of your particular instrument (detector, grating, adjustment in connection with calibration), and cannot be changed by the user.
Set the wavelength window by typing the minimum and maximum wavelength into the respective fields in the upper area "Wavelength window" of the Setup menu (see Figure 5.35).

5.7.3.2 Set to current view

With this function the wavelength window is adapted to the actual shown wavelength range of the spectrum range. This is useful to achieve the best data resolution for the displayed spectral data.

5.7.3.3 Set to Fullscale

Click on the “full scale” string to get the maximum possible range from the spectrometer.

5.7.3.4 Set peak search windows

The ***wave*Scan USB** automatically searches for one or two peaks in the measured spectrum and displays the peak wavelength, centroid wavelength, and full width at half maximum (FWHM) of these peaks in the info string (see Paragraph 5.7.2.7.1 for information on how to set up the info string information). In the "Set peak search window" sub menu you can set the wavelength windows in that the peaks are searched for. You can lock these search windows to the selected "Wavelength window" (see Figure 5.36), or you can set minimum and maximum wavelength for each search window separately (see Figure 5.36 and 5.37). The peak search windows do not need to be within the "Wavelength window", but must be within the maximum possible range (full scale).

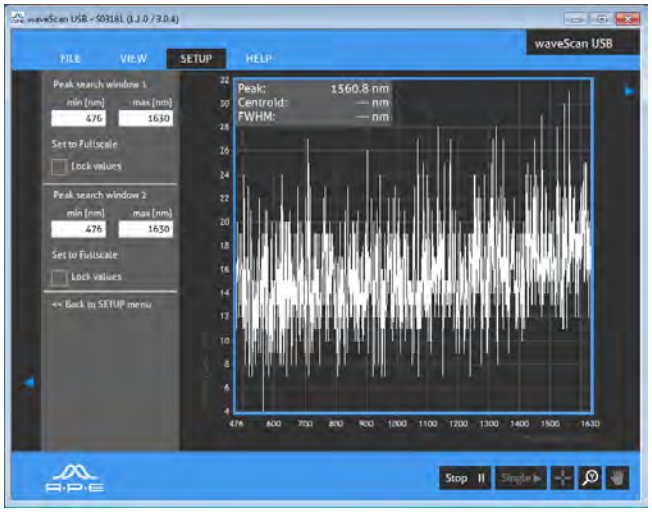


Figure 5.36: Select minimum and maximum wavelength for "Peak search window 1" in "Set peak search windows"

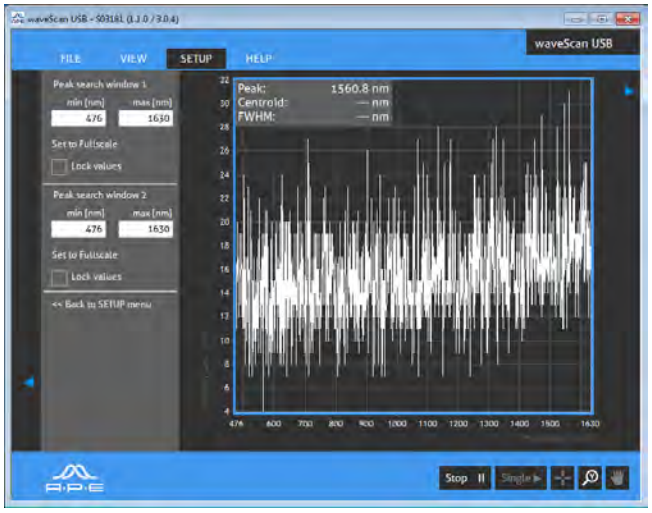


Figure 5.37: Select minimum and maximum wavelength for "Peak search window 2" in "Set peak search windows"

If you have selected two different windows for peak search additional lines with information on the second peak can be displayed in the info string (see Figure 5.38).

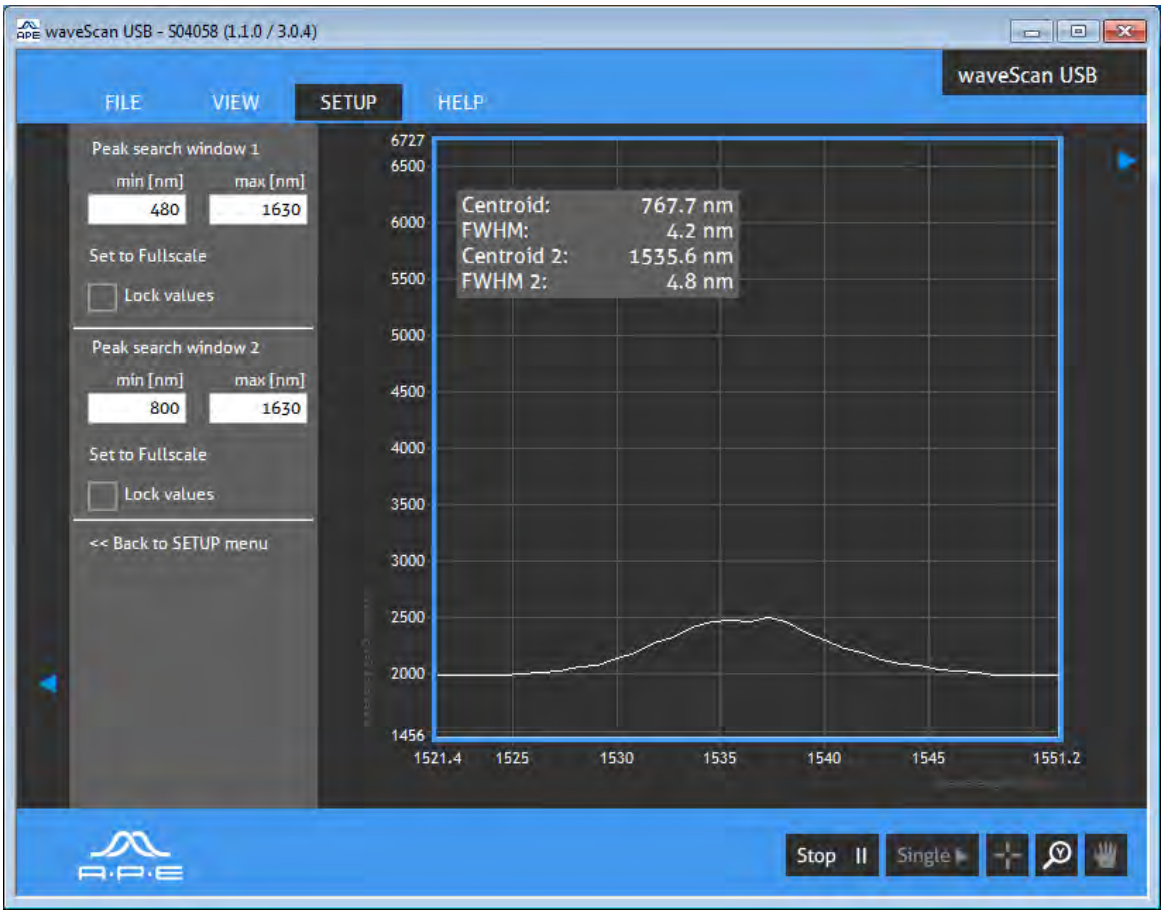


Figure 5.38: Info string with separate information on two different peaks: first peak is displayed in the graph, second peak lies outside the chosen wavelength window

It is important to note that when changing the wavelength window both the background and the reference memory are reset to zero. This is because displaying a reference measurement or performing a background subtraction is done on a point-by-point basis assuming the same abscissa for each data point.

5.7.3.5 Trace Max Hold (= "accumulation mode")

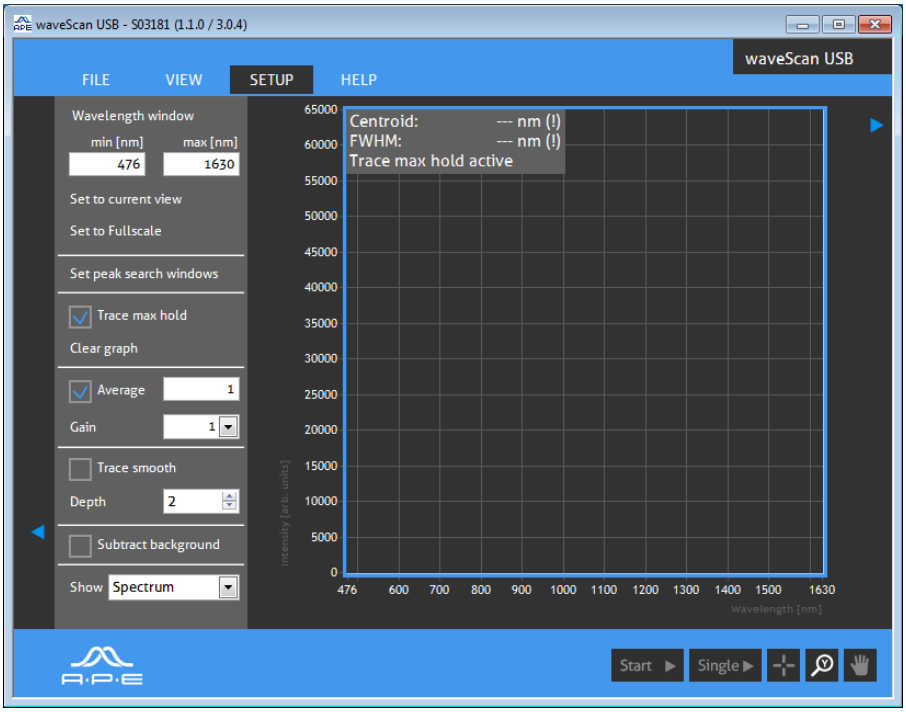


Figure 5.39: Select "Trace max hold"(= "accumulation mode"), to display an envelope of the measured spectra

With this function activated the ***wave*Scan** collects and displays the maximum intensities that occur for each data channel (each of the 1024 wavelength points) over an unlimited time, until you deactivate this function or stop the measurement.

This function is very important for low repetition rate lasers!

5.7.3.6 Clear Graph

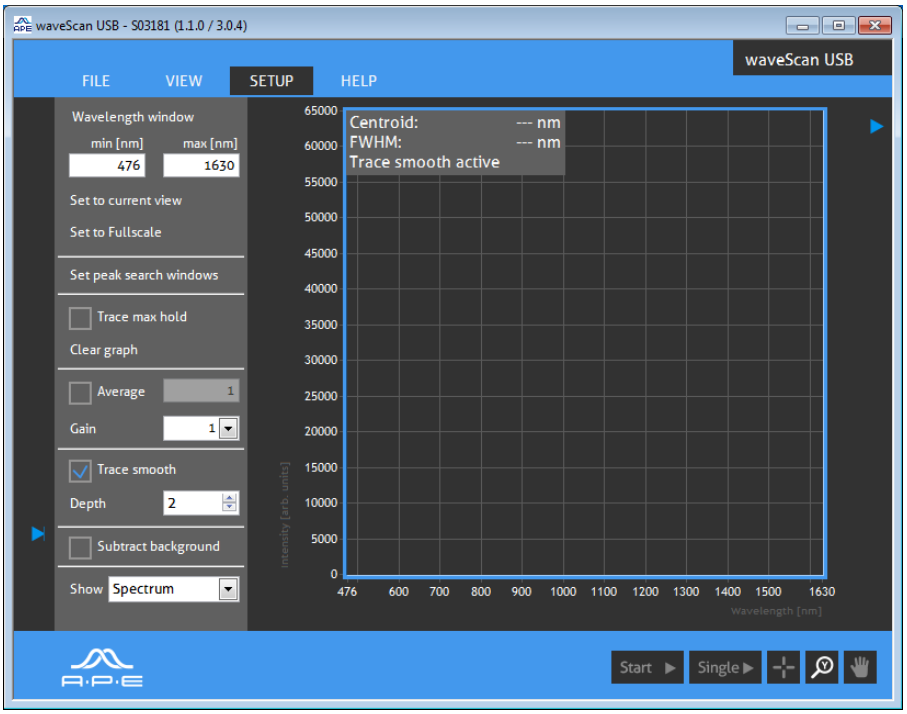


Figure 5.40: Select "Clear graph" to clear all displayed graphs

"Clear graph" deletes all graphs in memory: the current spectrum, the reference spectrum, and the background. Additionally, the "Trace max hold"(= "accumulation mode") memory, if activated, is reset to zero.

5.7.3.7 Average

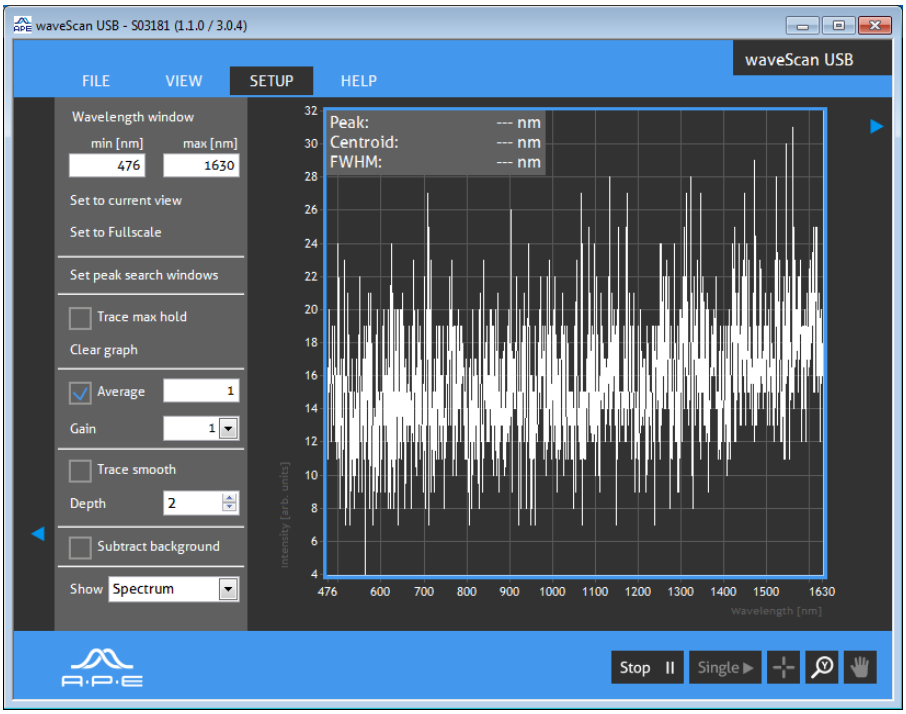


Figure 5.41: Select "Average" to activate averaging

The ***wave*Scan USB** Control Software allows you to average over a certain number of measurements. If activated, the displayed spectrum is actually an average over the last N measured spectra. To use this function activate "Average" in the "Setup" menu and type the number of measurements N into the now available box "Average" (see Figure 5.42).

Figure 5.42: Type the number of measurements to average over into the box "Average"

5.7.3.8 Gain

For weak signals the detected signal of the spectrometer can be amplified. The amplification is controlled by the gain setting in the setup menu.

5.7.3.9 Trace Smooth

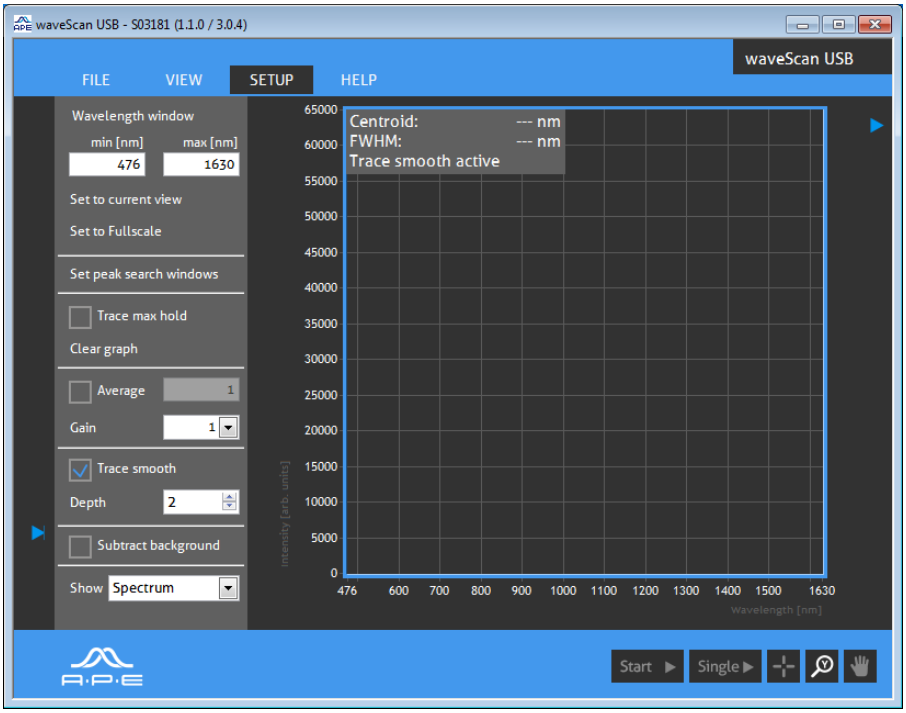


Figure 5.43: Select "Trace smooth" to apply a smoothing function to the displayed spectrum

Very noisy signals can be smoothed with a mathematical smooth function where for each data point the mean over its neighboring points is calculated. The number of used neighboring points is controlled with the “Depth” value

5.7.3.10 Subtract Background

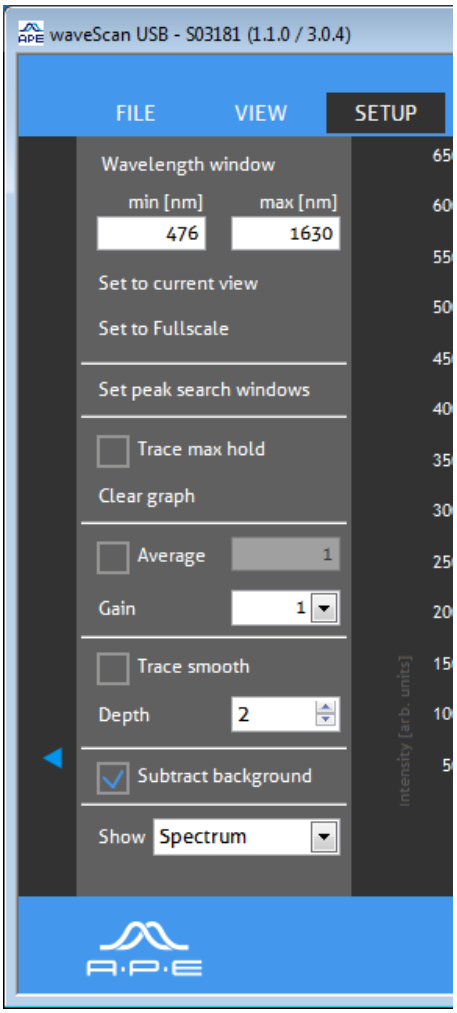


Figure 5.44: Select "Subtract background" to subtract the previously taken background signal from the current spectrum

Selecting "Subtract background" allows you to subtract a background signal from the spectrum to be measured (see Figure 5.45).

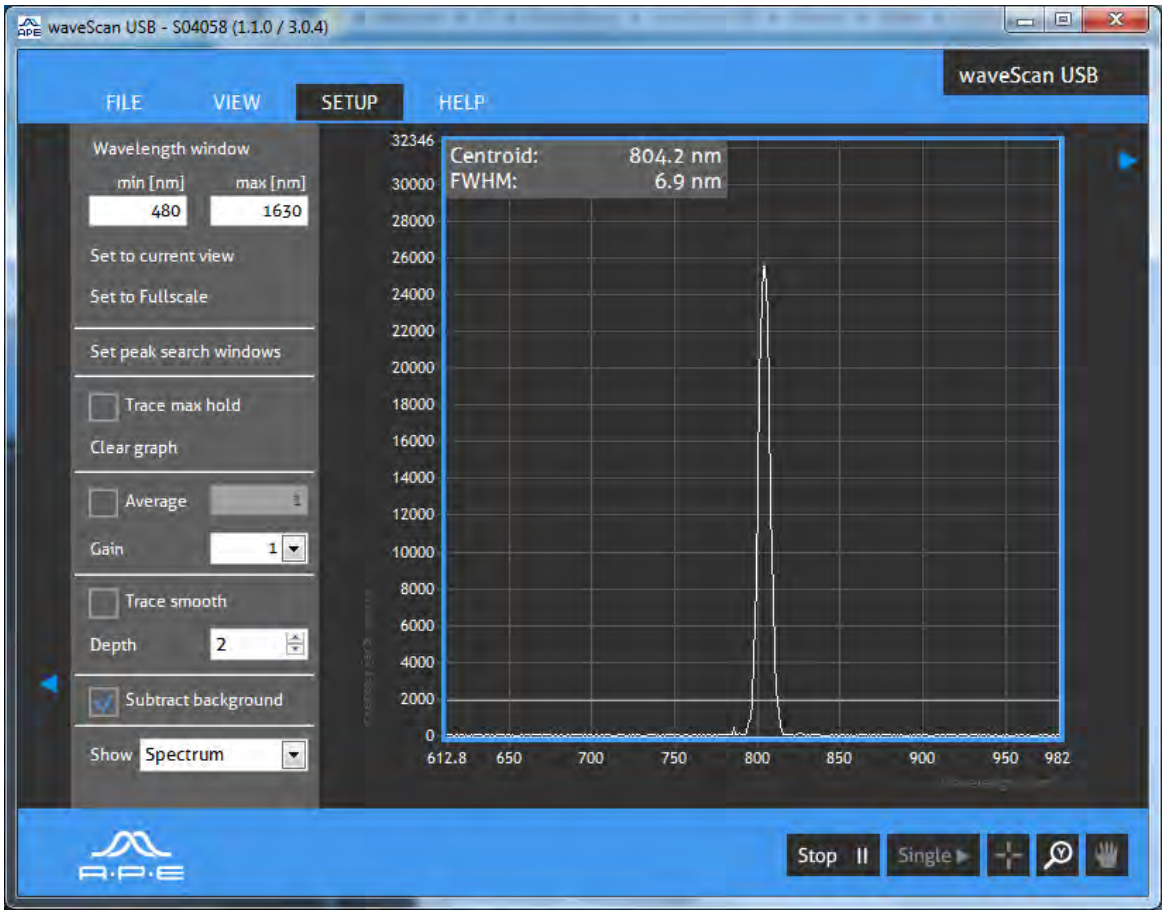


Figure 5.45: Measurement with background subtracted

Before you can use this function you must take a background spectrum with the respective function "Spectrum as background" (see Paragraph 5.7.1.1).

5.7.3.11 **Show**

With the “Show” drop-down menu the displayed data can be switched between spectrum (the data transferred for the selected wavelength window), 0-Order, Dark and Spectrum (Raw).

5.7.4 Help Menu

The Help Menu provides the following Items:

- A·P·E Website
- A·P·E Calculator
- Open terminal
- About waveScan USB
- Show Setup Info

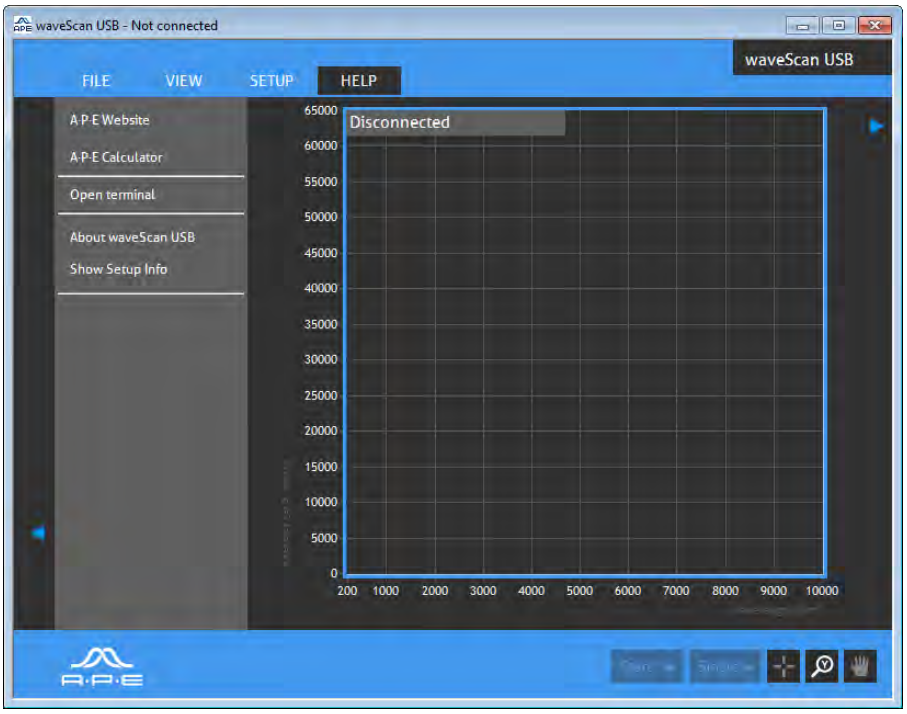


Figure 5.46: Help Menu

5.7.4.1 A·P·E Website

Visit A·P·E 's website for more information on the ***wave*Scan USB** and support.

5.7.4.2 A·P·E Calculator

The A·P·E Calculator helps to easily solve often needed (non)linear equations. This includes Sum Frequency Generation (SFG), Difference Frequency Generation (DFG), the wavelength relations in an Optical Parametric Oscillator (OPO) as well as in coherent anti-Stokes Raman scattering (CARS) spectroscopy.

The conversion between wavelength, wavenumber, and frequency as well as different characterizations of pulses can be calculated.

The A·P·E Calculator is available on A·P·E 's website and for devices with Android™ OS 1.6 and upwards as well as BlackBerry Tablet OS 2.0 and upwards and BlackBerry 10-Smartphone and now also for iOS devices with operating system version 6.1 or higher. This includes the iPhones 3GS, 4, 4S and 5 as well as all iPads since the second and all iPod Touches since the third generation.

5.7.4.3 Open terminal

For diagnostic purposes a terminal window can be opened for sending requests to the Control Software. For instance the software and firmware version can be requested with the *idn? command. The full command list is described in chapter 6.

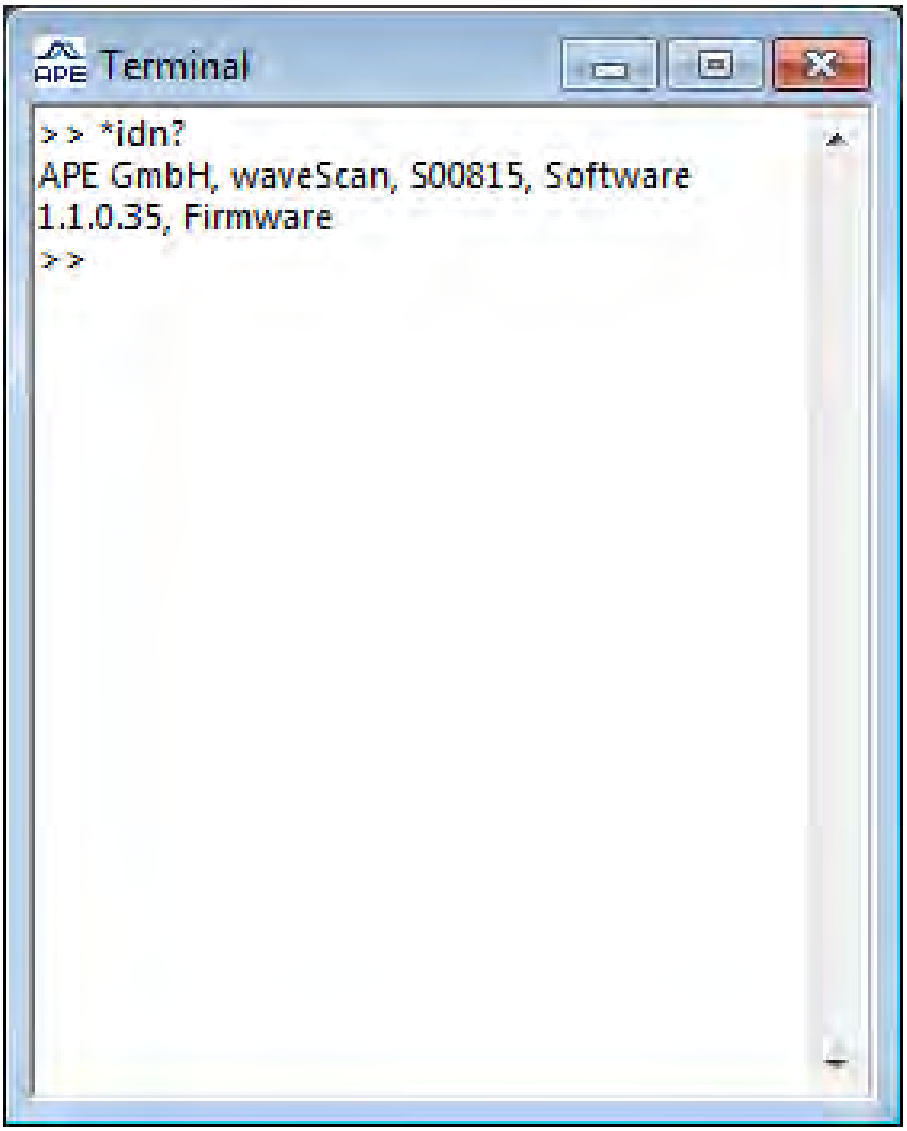


Figure 5.47: Terminal Window

5.7.4.4 About *wave*Scan USB

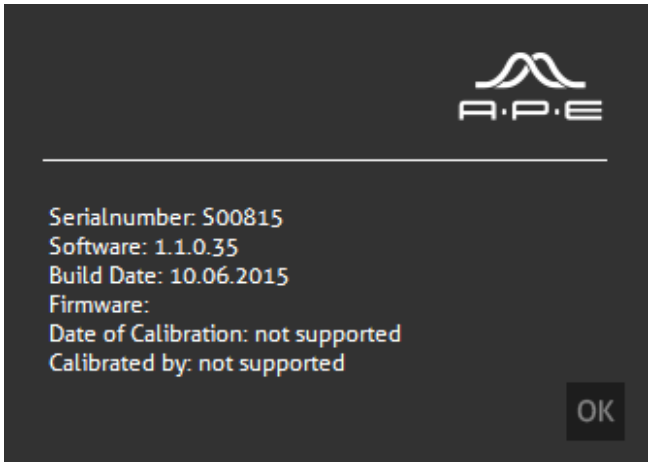


Figure 5.48: About ***wave*Scan USB**

This option shows information about the device's serial number, both software and firmware and the build date. Please refer to this information when you contact A·P·E with questions regarding your ***wave*Scan USB** .

5.7.4.5 Show Setup Info

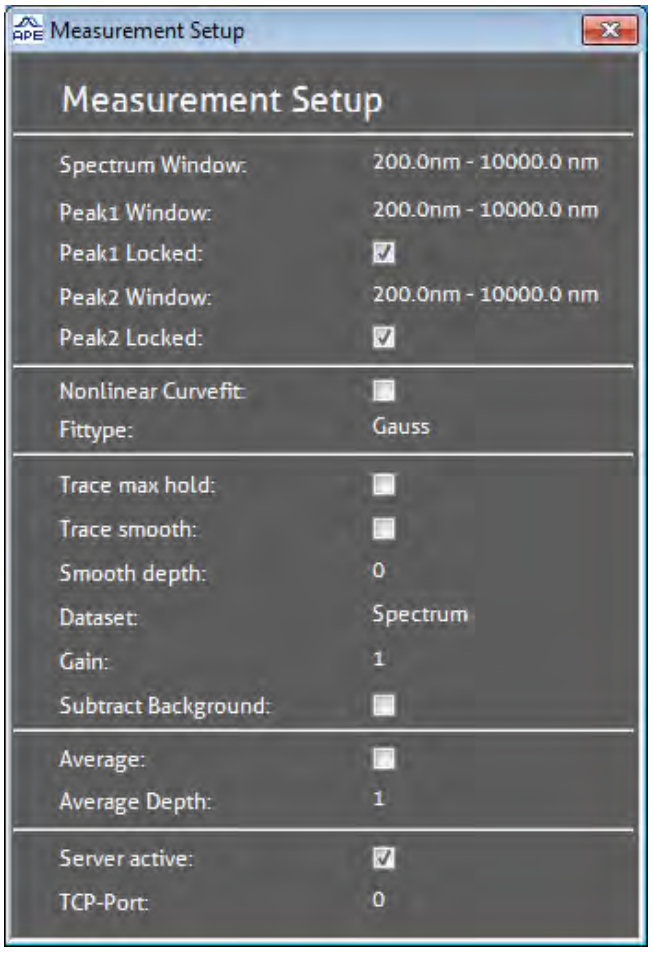


Figure 5.49: Measurement Setup

The Measurement Setup window summarizes the parameters and options that are chosen for the current measurement. It is an easy way to overview and check your current settings.

5.8 Context Menus

Some of the functions that have already been discussed in the respective paragraphs explaining the items of the menu bar are also available through context menus. Context menus are available for the info string and for the measurement graph. Right-click into the respective area to open the context menus.

5.8.1 Info String Context Menu

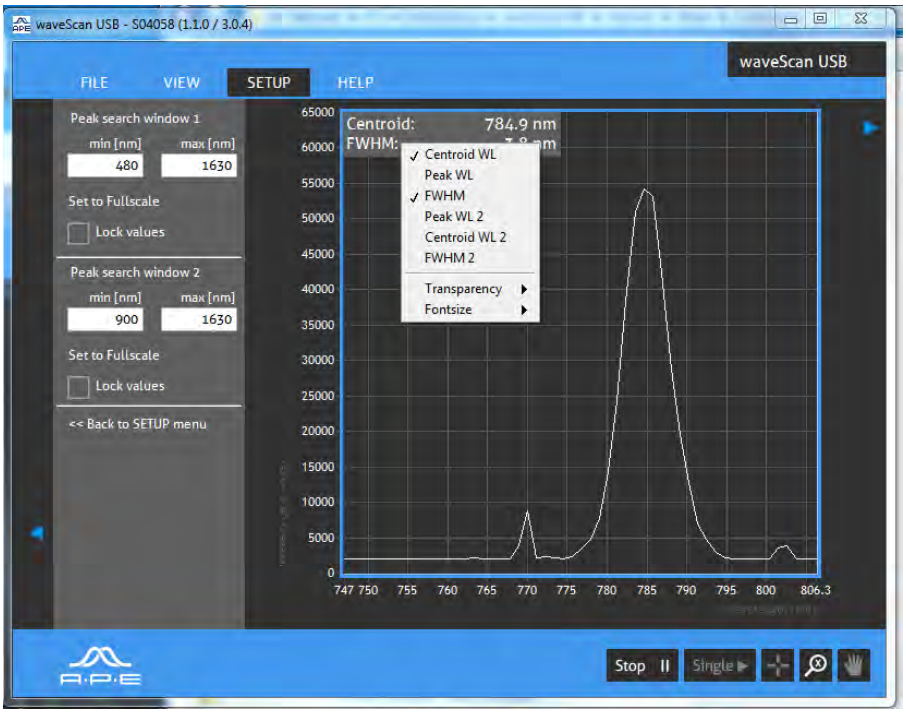


Figure 5.50: Context menu of the info string

Available function	Explained in paragraph
"Centroid WL"	5.7.2.7.1
"FWHM"	5.7.2.7.1
"Peak WL 2"	5.7.2.7.1
"Centroid WL 2"	5.7.2.7.1
"FWHM"	5.7.2.7.1
"Transparency"	5.7.2.7.4
"Fontsize"	5.7.2.7.1

5.8.2 Graph Context Menu

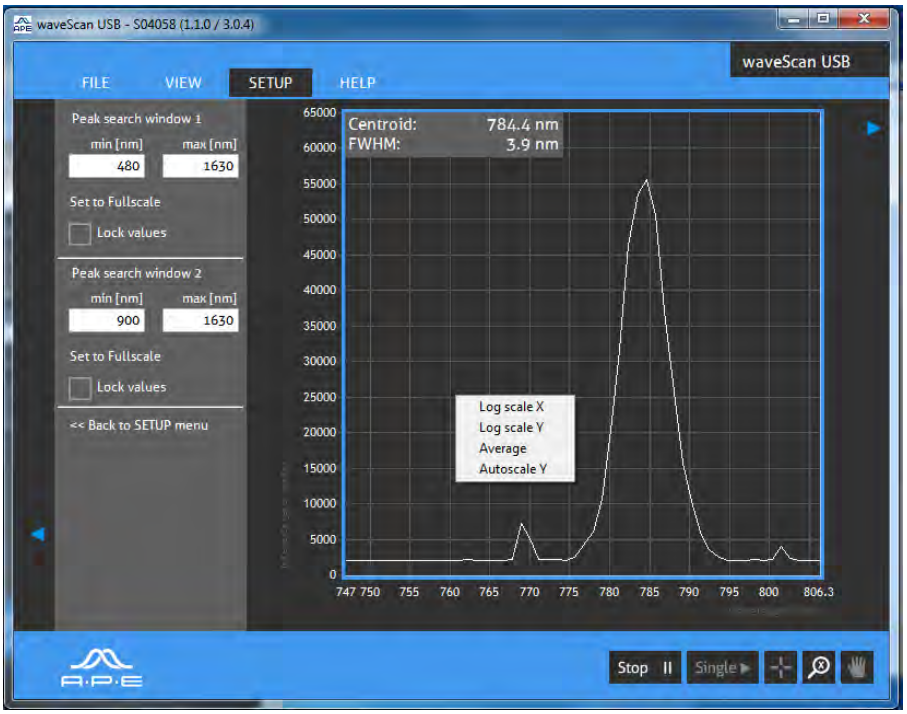


Figure 5.51: Context menu of the measurement graph

Available function	Explained in paragraph
"Log Scale X"	5.7.2.1
"Log Scale Y"	5.7.2.3
"Average"	5.7.3.7
"Autoscale Y"	5.7.2.4

6 TCP/IP Command Set

This section provides a complete overview of the remote control commands of the ***wave*Scan USB** . The command structure of the ***wave*Scan USB** is mostly in agreement with the SCPI-standard. However, A·P·E does not state compliance nor conformance to the standard, since some standard commands are not yet implemented in the present version. Detailed information about the SCPI is found at: www.ivifoundation.org

The spectrometer will execute the following commands:

***IDN?**

Get Device Identification
<idn> Device Information (APE GmbH, Devicename, Serialnumber, Software Version, Firmware Version) as string,
Example:

```
*IDN?
```

***RST**

Perform Device Reset
Example:

```
*RST
```

***STB?**

Get Status Byte
<stb> SCPI Status Byte (8 Bit unsigned as decimal) Bit0: reserved Bit1: reserved Bit2: Error Bit3: reserved Bit4: MAV Bit5: ESB Bit6: RSQ/MSS Bit7: OPE as integer,
Example:

```
*STB?
```

***CLS**

Clear Status Byte (STB)
Example:

```
*CLS
```

***ESE<value>**

Set Event Status Enable Register
<value> ESE Register Value as integer, range: 0 ... 255,
Example:

```
*ESE=127
```

***ESE?**

Get Event Status Enable Register
<value> ESE Register Value as integer, range: 0 ... 255,
Example:

```
*ESE?
```

***SRE<value>**

Set Service Request Enable Register
<value> SRE Register Value as integer, range: 0 ... 255,
Example:

```
*SRE=127
```

***SRE?**

Get Service Request Enable Register
<value> SRE Register Value as integer, range: 0 ... 255,
Example:

```
*SRE?
```

***ESR?**

Get Event Status Register
<value> ESE Register Value as integer, range: 0 ... 255,
Example:

```
*ESR?
```

***OPC?**

Get Operation Complete Status
<status> OPC Stats Value (always "1", since multi-command interface is not available) as integer, range: 0 ... 255,
Example:

```
*OPC?
```

***OPER?**

Get Operation Status
<oper> SCPI Opertation Status (16 Bit unsigned as decimal) Bit0: Disconnected, Bit1: VISA Connected, Bit2: Device Initialized, Bit3: Device ready, Bit4: Device busy, Bit5: Standby (Motor off), Bit6: Data Error (Spectrum not valid), Bit7: Software Error, Bit8: Firmware Error (see *FRMW?), Bit9: Shutdown, Bit10: Service Mode active, Bit11: unused, Bit12: unused, Bit13: unused, Bit14: unused, Bit15: unused as integer,
Example:

```
*OPER?
```

***INIT?**

Get Device Initialization Status
<init> SCPI INIT Status (8 Bit unsigned as decimal, upper 4 Bits are always "1") Bit0: Power ON, Bit1: Config parsing OK, Bit2: Motor ON, Bit3: unused, forced to "1", Bit4: unused, forced to "1", Bit5: unused, forced to "1", Bit6: unused, forced to "1", Bit7: unused, forced to "1" as integer,
Example:

```
*INIT?
```

***BUSY?**

Get Device Busy Status
<busy> SCPI BUSY Status (8 Bit unsigned as decimal, upper 4 Bits are always "0") Bit0: IDLE, Bit1: Measurement running, Bit2: New Data available, Bit3: Aquiring Data, Bit4: Curvefitting, Bit5: unused, Bit6: unused, Bit7: unused as integer,
Example:

```
*BUSY?
```

***ERR?**

Get Data Error Status
<errs> SCPI DATA ERROR Status (8 Bit unsigned as decimal, Bit 7 is always "0") Bit0: Signal too low, Bit1: Signal too high, Bit2: No Peak found, Bit3: unused, Bit4: unused, Bit5: unused, Bit6: unused, Bit7: unused as integer,
Example:

```
*ERR?
```

***FRMW?**

Get Firmware Status
<frmw> SCPI Firmware Error Status (16 Bit unsigned as decimal) Bit0: unused, Bit1: unused, Bit2: unused, Bit3: unused, Bit4: unused, Bit5: unused, Bit6: unused, Bit7: unused, Bit8: unused, Bit9: unused, Bit10: unused, Bit11: unused, Bit12: unused, Bit13: unused, Bit14: unused, Bit15: unused as integer,
Example:

```
*OPER?
```

SYSTEM:HELP?
SYS:HELP?

Return list of all available commands
<cmdlist> Commandlist as string,
Example:

```
:system:help?
```

SYSTEM:SNUMBER?
SYS:SNUMBER?

Return devices serialnumber
<snr> Serialnumber as string,
Example:

```
:system:snumber?
```

SYSTEM:DEVICE?
SYS:DEVICE?

Return Devicename
<name> Devicename as string,
Example:

```
:system:device?
```

SYSTEM:SOFTWARE?
SYS:SOFTWARE?

Return Software Version
<v> Software Version as string,
Example:

```
:system:software?
```

SYSTEM:FIRMWARE?
SYS:FIRMWARE?

Return Firmware Version
<v> Firmware Version as string,
Example:

```
:system:firmware?
```

SYSTEM:HARDWARE?
SYS:HARDWARE?

Return Hardware Version
<v> Hardware Version as string,
Example:

```
:system:hardware?
```

SYSTEM:ERROR?
SYS:ERR?

Return next error in Log
<v> Logged error Message in format: ERRORCODE @ COMMAND (Caller: CALLER: ERROR DESCRIPTION as string,
Example:

```
:system:error?
```

STATUS:CONNECT?
STA:CON?

Return USB Connection status
<status> Connection status (Connected = T/1) as boolean,
Example:

```
:status:connect?
```

STATUS:RUN<status>
STA:RUN<status>

Set Measurement status
<status> Measurement status (Running = 1, Stopped = 0) as integer,
Example:

```
:status:run=1
```

STATUS:RUN?
STA:RUN?

Return Measurement status
<status> Measurement status (Running = 1, Stopped = 0) as integer,
Example:

```
:status:run?
```

STATUS:SMOOTH?
STA:SMOOTH?

Return Smoothing Function status
<status> Smoothing Function status (Active = 1, Inactive = 0) as integer,
Example:

```
:status:smooth?
```

STATUS:MAXHOLD?
STA:MAXHOLD?

Return Maxhold Function status
<status> Maxhold Function status (Active = 1, Inactive = 0) as integer,
Example:

```
:status:maxhold?
```

STATUS:AVERAGE?
STA:AVG?

Get Number of Mesurements used for averaging
<status> Number of Measurements (0 = Averaging inactive) as integer,
Example:

```
:status:avg?
```

SPECTRUM:DATA?
SPE:DATA?

Return Measured Data
<data> Spectrum Data (Binary Double-Value-Array [x0,y0,x1,y1,...,xN,yN]) as array of s in block data format,
Example:

```
:spectrum:data?
```

SPECTRUM:PEAK?
SPE:PEAK?

Return calculated peak wavelength
<wl> Peak Wavelength as double,
Example:

```
:spectrum:peak?
```

SPECTRUM:FWHM?
SPE:FWHM?

Return calculated fwhm value
<fwhm> FWHM as double,
Example:

```
:spectrum:fwhm?
```

SPECTRUM:CENTER?
SPE:CENTER?

Return calculated center wavelength
<wl> Center wavelength as double,
Example:

```
:spectrum:center?
```

SPECTRUM:PEAK_MAX?
SPE:PEAK_MAX?

Return maximum intensity value
<intensity> Intensity (maximum) as double,
Example:

```
:spectrum:peak_max?
```

SPECTRUM:1PEAK?
SPE:1PEAK?

Return calculated peak wavelength for peak window 1
<wl> Peak 1 wavelength as double,
Example:

```
:spectrum:1peak?
```

SPECTRUM:1FWHM?
SPE:1FWHM?

Return calculated FWHM for peak window 1
<fwhm> Peak 1 FWHM as double,
Example:

```
:spectrum:1fwhm?
```

SPECTRUM:1CENTER?
SPE:1CENTER?

Return calculated center wavelength for peak window 1
<wl> Peak 1 center wavelength as double,
Example:

```
:spectrum:1center?
```

SPECTRUM:2PEAK?
SPE:2PEAK?

Return calculated peak wavelength for peak window 2
<wl> Peak 2 wavelength as double,
Example:

```
:spectrum:2peak?
```

SPECTRUM:2FWHM?
SPE:2FWHM?

Return calculated FWHM for peak window 2
<fwhm> Peak 2 FWHM as double,
Example:

```
:spectrum:2fwhm?
```

SPECTRUM:2CENTER?
SPE:2CENTER?

Return calculated center wavelength for peak window 2
<wl> Peak 2 center wavelength as double,
Example:

```
:spectrum:2center?
```

DATA:SAVE<path>
DAT:SAVE<path>

<path> as string,

DATA:QSAVE
DAT:QSAVE

Quicksave the current waveform into the pre-defined output directory
Example:

```
:data:qsave
```

MEASUREMENT:FOURIER_LIMIT?
MEAS:FLIM?

Get calculated fourier limit value for peak 1
<status> Value as integer,
Example:

```
:measurement:fourier_limit?
```

MEASUREMENT:GAIN<value>
MEAS:GAIN<value>

Set Detector Gain (only available for FW-version 3.0.0 and newer)
<value> Gain as integer,
Example:

```
:measurement:gain=10
```

MEASUREMENT:GAIN?
MEAS:GAIN?

Get Detector Gain Setting (only available for FW-version 3.0.0 and newer)
<value> Gain as integer,
Example:

```
:measurement:gain?
```

MEASUREMENT:SPECTRUM_TYPE<value>
MEAS:STYPE<value>

Set spectrum type (only available for FW-version 3.0.0 and newer)
<value> spectrum type as string,
Example:

```
:measurement:spectrum_type=1
```

MEASUREMENT:SPECTRUM_TYPE?
MEAS:STYPE?

Get the selected spectrum type (only available for FW-version 3.0.0 and newer)
<value> spectrum type as string,
Example:

```
:measurement:spectrum_type?
```

MEASUREMENT:WLRANGE:ABS_MAX?
MEAS:WLRA:ABS_MAX?

Return max. Wavelength that can be measured whith this device
<wl> Wavelength as double,
Example:

```
:measurement:wlrange:abs_max?
```

MEASUREMENT:WLRANGE:ABS_MIN?
MEAS:WLRA:ABS_MIN?

Return min. Wavelength that can be measured whith this device
<wl> Wavelength as double,
Example:

```
:measurement:wlrange:abs_min?
```

MEASUREMENT:WLRANGE:MAX<wl>
MEAS:WLRA:MAX<wl>

Set upper wavelength-border of measurement window
<wl> Wavelength as double,
Example:

```
:measurement:wlrange:max=1550
```

MEASUREMENT:WLRANGE:MAX?
MEAS:WLRA:MAX?

Return upper wavelength-border of measurement window
<wl> Wavelength as double,
Example:

```
:measurement:wlrange:max?
```

MEASUREMENT:WLRANGE:MIN<wl>
MEAS:WLRA:MIN<wl>

Set lower wavelength-border of measurement window
<wl> Wavelength as double,
Example:

```
:measurement:wlrange:min=620
```

MEASUREMENT:WLRANGE:MIN?
MEAS:WLRA:MIN?

Return lower wavelength-border of measurement window
<wl> Wavelength as double,
Example:

```
:measurement:wlrange:min?
```

MEASUREMENT:PEAK1:MAX<wl>
MEAS:PEAK1:MAX<wl>

Set upper wavelength-border of peak window 1
<wl> Wavelength as double,
Example:

```
:measurement:peak1:max=1550
```

MEASUREMENT:PEAK1:MAX?
MEAS:PEAK1:MAX?

Return upper wavelength-border of peak window 1
<wl> Wavelength as double,
Example:

```
:measurement:peak1:max?
```

MEASUREMENT:PEAK1:MIN<wl>
MEAS:PEAK1:MIN<wl>

Set lower wavelength-border of peak window 1
<wl> Wavelength as double,
Example:

```
:measurement:peak1:min=620
```

MEASUREMENT:PEAK1:MIN?
MEAS:PEAK1:MIN?

Return lower wavelength-border of peak window 1
<wl> Wavelength as double,
Example:

```
:measurement:peak1:min?
```

MEASUREMENT:PEAK1:EWIDTH<wl>
MEAS:PEAK1:EWIDTH<wl>

Set expected spectral width for peak1 measurements
<wl> Spectral Width as double,
Example:

```
:measurement:peak1:ewidth=5,0
```

MEASUREMENT:PEAK1:EWIDTH?
MEAS:PEAK1:EWIDTH?

Return set expected spectral width in nm
<wl> Spectral Width as double,
Example:

```
:measurement:peak1:ewidth?
```

MEASUREMENT:PEAK1:LOCK<Status>
MEAS:PEAK1:LOCK<Status>

Set status of peak window 1 wavelength lock
<Status> Status as integer,
Example:

```
:measurement:peak1:lock=1
```

MEASUREMENT:PEAK1:LOCK?
MEAS:PEAK1:LOCK?

Return status of peak window 1 wavelength lock
<Status> Status as integer,
Example:

```
:measurement:peak1:lock?
```

MEASUREMENT:PEAK2:MAX<wl>
MEAS:PEAK2:MAX<wl>

Set upper wavelength-border of peak window 2
<wl> Wavelength as double,
Example:

```
:measurement:peak2:max=1550
```

MEASUREMENT:PEAK2:MAX?
MEAS:PEAK2:MAX?

Return upper wavelength-border of peak window 2
<wl> Wavelength as double,
Example:

```
:measurement:peak2:max?
```

MEASUREMENT:PEAK2:MIN<wl>
MEAS:PEAK2:MIN<wl>

Set lower wavelength-border of peak window 2
<wl> Wavelength as double,
Example:

```
:measurement:peak2:min=620
```

MEASUREMENT:PEAK2:MIN?
MEAS:PEAK2:MIN?

Return lower wavelength-border of peak window 2
<wl> Wavelength as double,
Example:

```
:measurement:peak2:min?
```

MEASUREMENT:PEAK2:LOCK<Status>
MEAS:PEAK2:LOCK<Status>

Set status of peak window 2 wavelength lock
<Status> Status as integer,
Example:

```
:measurement:peak2:lock=1
```

MEASUREMENT:PEAK2:LOCK?
MEAS:PEAK2:LOCK?

Return status of peak window 2 wavelength lock
<Status> Status as integer,
Example:

```
:measurement:peak2:lock?
```

MEASUREMENT:FIT:TYPE<type>
MEAS:FIT:TYPE<type>

Set function type for curvefitting
<type> Function Type (0,GAUSS; 1,LORENTZ; 2,SECH2) as string,
Example:

```
:measurement:fit:type=GAUSS
```

MEASUREMENT:FIT:TYPE?
MEAS:FIT:TYPE?

Return type of function to fit through the measured data
<type> Function Type (0,GAUSS; 1,LORENTZ; 2,SECH2) as string,
Example:

```
:measurement:fit:type?
```

MEASUREMENT:FIT:ENABLED<status>
MEAS:FIT:ENABLED<status>

Set status of curvefitting
<status> Status as integer,
Example:

```
:measurement:fit:enabled=1
```

MEASUREMENT:FIT:ENABLED?
MEAS:FIT:ENABLED?

Return stauts of curvefitting
<status> Status as integer,
Example:

```
:measurement:fit:enabled?
```

MEASUREMENT:FIT:DATA?
MEAS:FIT:DATA?

Return fitted data
<fitdata> FitData as Array of Double Values [x0,y0,x1,y1,...,xN,yN] as array of s in block data format,
Example:

```
:measurement:fit:data?
```

MEASUREMENT:FOURIER_LIMIT:ENABLED<status>
MEAS:FLIM:ENABLED<status>

Set status of fourier limit (peak 1) calculation
<status> Status as integer,
Example:

```
:measurement:fourier_limit:enabled=1
```

MEASUREMENT:FOURIER_LIMIT:ENABLED?
MEAS:FLIM:ENABLED?

Return stauts of fourier limit (peak 1) calculation
<status> Status as integer,

Example:

```
:measurement:fourier_limit:enabled?
```

7 Maintenance and Troubleshooting

7.1 Cleaning

Do not use any aggressive solvents to clean the *wave*Scan USB spectrometer components! Switch the laser OFF or block the input beam, switch the *wave*Scan OFF and unplug the mains power adapter from the wall power socket for cleaning!

Use a soft lint-free dry or only slightly moistened cloth to clean the covers of the ***wave*Scan USB** components.

Use dry methanol and lens cleaning tissue applying common optics cleaning techniques for cleaning the input mirror.

7.2 Troubleshooting

Problem	Possible reason	Action
Message "Not connected" in the info string	***wave*Scan** not properly connected to the PC	check USB cable connection between ***wave*Scan USB** and computer
	power not switched on	make sure the power adapter is plugged into the wall outlet and into the ***wave*Scan USB** , respectively, make sure power is switched on
	software driver not properly installed	re-install ***wave*Scan USB** Control Software on your computer
No noise signal on the graph, message "Connected" in the info string	measurement not started	press "Start" button
	wavelength or intensity ranges not properly set	set wavelength window to "Full scale" (see 5.7.3.1), set X-axis to "Full scale X" (see 5.7.2.2), set Y-axis to "Autoscale Y" (see 5.7.2.4)
No laser peak to be found	wavelength or intensity ranges not properly set	set wavelength window to "Full scale" (see 5.7.3.1), set X-axis to "Full scale X" (see 5.7.2.2), set Y-axis to "Autoscale Y" (see 5.7.2.4)
	alignment of the input beam not correct	use the alignment apertures of the input mirror and the beam entrance, follow the steps in 4.1.1 and 4.1.2
	laser outside the ***wave*Scan USB** specifications	make sure the laser beam to be measured is inside the wavelength and power specifications of your ***wave*Scan USB** model

7.3 Technical Support

For technical questions or problems within Germany, please contact:

A·P·E Angewandte Physik & Elektronik GmbH
Plauener Straße 163 - 165, Haus N
D - 13053 Berlin
tel +49 30 98601130
fax +49 30 986011333
ape@ape-berlin.de
http://www.ape-berlin.com

To contact our international distributors, please have a look at our website:

http://www.ape-berlin.com

A·P·E Angewandte Physik & Elektronik GmbH
Plauener Str. 163 – 165 | Haus N
13053 Berlin
Germany

Declaration of Conformity to EU RoHS

Products listed below that are manufactured by A·P·E Angewandte Physik & Elektronik GmbH are in compliance with Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (also known as “RoHS Recast”). In addition, this declaration of conformity is issued under the sole responsibility of A·P·E Angewandte Physik & Elektronik GmbH. Specifically, products manufactured do not contain the substances listed in the table below in concentrations greater than the listed maximum value.

Substance	Maximum Limit (ppm)
Lead (Pb)	1000
Cadmium (Cd)	100
Mercury (Hg)	1000
Hexavalent Chromium (Cr6+)	1000
Poly Brominated Biphenyls (PBB)	1000
Poly Brominated Diphenyl ethers (PBDE)	1000

Product Identification:
Product

***wave*Scan USB** VIS
A·P·E Id: 133012

***wave*Scan USB** IR
A·P·E Id: 132901

***wave*Scan USB** VIS + IR
A·P·E Id: 133013

***wave*Scan USB** Extended IR
A·P·E Id: 133014

***wave*Scan USB** Blue
A·P·E Id: 133015

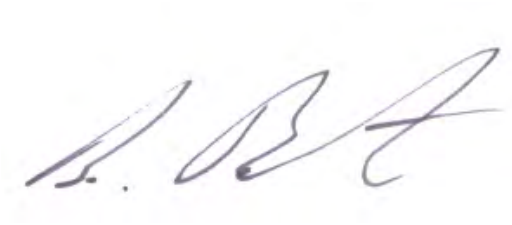
***wave*Scan USB** Blue HR
A·P·E Id: 134968

***wave*Scan USB** UV
A·P·E Id: 133017

***wave*Scan USB** UV2
A·P·E Id: 134965

***wave*Scan USB** MIR
A·P·E Id: 139235

Signature:



Name (printed): Dr. Bodo Richter
Title: CEO

Telephone: +49 30 98601130
Email: ape@ape-berlin.de