Introduction

Thank you for purchasing an Avantes NIR-128 Spectrometer.
You may find an electronic version of this manual as pdf file on your Avantes CDROM that came with the system. The newest version of this manual and the basic version of the operating software can also be downloaded from our website www.avantes.com under the section downloads.
This manual provides users with directions on how to connect your NIR-128 to your computer and how to operate the AvaSoft software.
For abbreviated directions on setting up your system, turn to the instructions beginning in Chapter 0: Installation, in Chapter 1 you may find a Quick start.

Upgrades

Customers sometimes find that they need Avantes to change or upgrade their system. In order for Avantes to make these changes, the customer must first contact us and obtain a Return Merchandise Authorization (RMA) number. Please contact the Avantes Technical Services for specific instructions when returning a product.

If you still have problems with your installation, do not hesitate to contact us:

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0 AvaSoft Installation

AVASOFT version 5.1 is a 32-bit application that can be installed under the following operating systems:

- Windows 95/98/Me
- Windows NT/2000/XP

Installation program

With each new spectrometer system, an AVANTES PRODUCT CD-ROM is included. Also included is a unique configuration diskette with spectrometer serial number. It is necessary to have this diskette inserted in the floppy drive during the installation from CD-ROM.

Installation Dialogs

The setup program will check the system configuration of the computer. If there are no problems detected, the first dialog is the "Welcome" dialog with some general information.

After this, a dialog will be shown, in which you will be asked to insert the spectrometer-specific configuration diskette into drive a:. If the configuration diskette is not inserted, AvaSoft Basic will be installed. AvaSoft Full cannot be installed without the information that is in the files on the diskette. After inserting the diskette into drive a: and clicking the next button, the installation program starts reading spectrometer-specific information from the diskette. Depending on this information, the program proceeds with installing AvaSoft Basic or AvaSoft FULL.
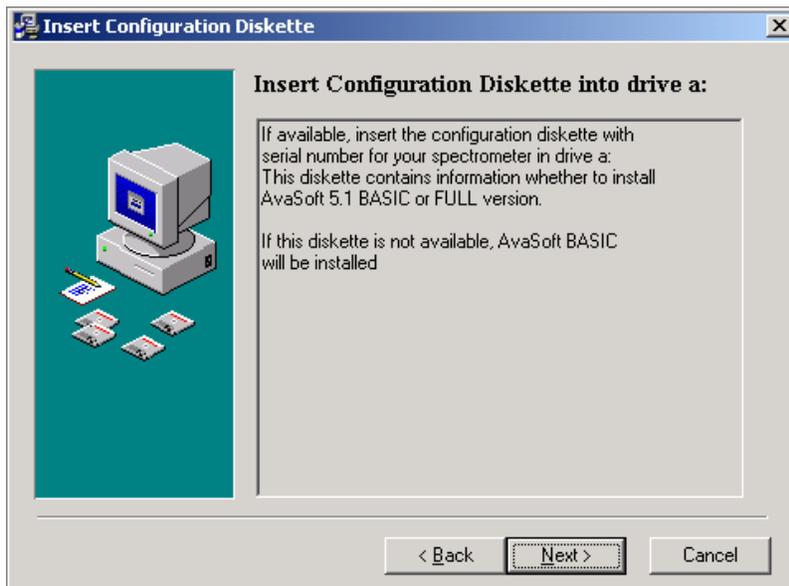
In the next dialog, the destination directory for the AvaSoft software can be changed. The default destination directory is C:\NIR5FULL if AvaSoft FULL will be installed and C:\NIR5BASIC if AvaSoft BASIC will be installed. If you want to install the software to a different directory, click the Browse button, select a new directory and click OK. If the specified directory does not exist, it will be created.

In the next dialog, the name for the program manager group can be changed. The default name for this is "AVANTES Software".
After this, the "Start Installation" dialog is shown. After clicking the "next" button, the installation program starts installing files.

One of the files that will be installed in AvaSoft's main directory is a Microsoft Utility program, called hhupd.exe (hhupd=Html Help UPDate). This file is executed during the installation to check if the computer recognizes HTML Help files. This format is also used in the AvaSoft Help files. On most computers, the program hhupd.exe will return the next dialog:
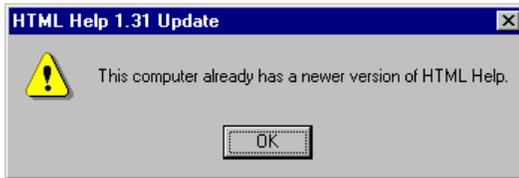
indicating that no update of HTML Help is required. If HTML Help is not recognized, or an older version has been found, the next dialog will be displayed:
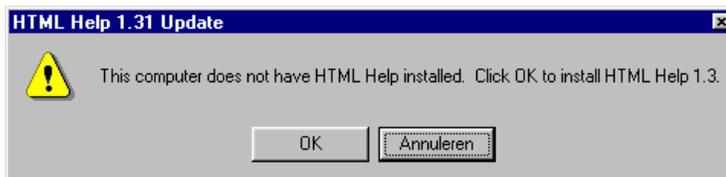
HTML Help can be installed by clicking the "OK" button, or you can run the utility program later on, by executing hhupd.exe from AvaSoft's main directory.

After all files have been installed, the "Installation Complete" dialog shows up. By clicking the "Finish" button, a last dialog may show up which contains the following information:
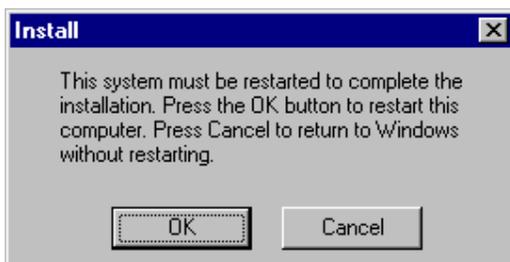
It's strongly recommended to restart the computer before starting AvaSoft.

Connecting the hardware

Connect the NIR-128 to the power supply with the correct cable (supplied cable with 2 male 8-pin mini-DIN connectors).
Connect the RS232 connector on the power supply to a serial port on your computer (supplied cable with male and female DB-9 connectors).
Connect the power supply to a power outlet.
Switch on the power supply.

Launching the software

AvaSoft can be started from Windows Start Menu. Under Start-programs, the group "AVANTES Software" has been added. This group contains two icons. With the red "V" icon, AvaSoft is started. The AvaSoft Help icon can be used to activate the AvaSoft helpfiles (these helpfiles can also be activated from the Help menu after starting AvaSoft).

After AvaSoft is started, you can select 'Setup' 'Hardware' to change the serial port the NIR-128 is connected to from COM1 to another port. After the correct port is entered here, data collection can be activated by clicking the green start button.
If no spectrum is shown after clicking the start button, or if there are other software problems, please refer to APPENDIX A: Troubleshooting.

1 Quick Start: Measuring and saving a spectrum

1. After starting AvaSoft, the green Start button needs to be clicked to start measuring.
2. Connect the spectrometer read fiber to a probe or light source and set up the experiment for taking a reference spectrum.
3. Now turn on the light source. Usually some sort of spectrum may be seen on the screen, but it is possible that too much or too little light reaches the spectrometer at the present data collection settings. Too much light means that, over a certain wavelength range, the signal is overloaded shown as a straight line at any arbitrary height, even near zero. This can usually be solved by a shorter integration time. The integration time can be changed in the main window, in the white box below the start/stop button. If AvaSoft is collecting data, the start/stop button shows a red 'stop' and the integration time box is gray, indicating that it cannot be changed. After clicking the 'stop' button the data acquisition stops and the integration time can be changed. The result of the changed integration time can be viewed after clicking the green 'start' button. Try to adjust the integration time, such that the maximum count over the wavelength range is around 55000 counts. When at minimum integration the signal is still too high, an attenuator (FHSA-TTL), a neutral density filter or fibers with a smaller diameter may be used. When not enough light reaches the spectrometer, likewise a longer integration time should be entered.
4. When a good spectrum is displayed, turn off the light source.
5. Now save the Dark data. This is be done by File-Save-Dark from the menu or by clicking the black square on the left top of the screen with the mouse. Always use Save Dark after the integration time has been changed.
6. Turn on the light source again. Save the present spectrum as a reference by choosing File Save-Reference from the menu or by clicking at the white square (next to the black one). Always use Save Reference after the integration time has been changed. Now the Transmittance/reflectance (T button) or Absorbance (A button) spectra can be obtained online. To have a better look at the amplitude versus wavelength, the cursor button can be clicked. A vertical line is displayed in the graph. If the mouse cursor is placed nearby this line, the shape of the mouse cursor changes from an arrow to a 'drag' shape. If this shape is displayed, the left mouse button can be used to drag (keep left mouse button down) the line with the mouse towards a new position. Moving this line shows the corresponding values of wavelength and amplitude in the main screen. By clicking the red stop button, the data acquisition is stopped and the last acquired spectrum is shown in static mode. The data acquisition can be started again by clicking the same button, which now shows a green 'Start'.
7. To save the spectrum (in the mode chosen before), choose File-Save-Experiment from the menu, or click the Save Experiment button from the button bar.
8. To improve the Signal/Noise ratio, a number of spectra may be averaged. To do this, the value in the white average box in the main window (next to integration time) can be increased. The value can only be changed in static mode. When AvaSoft is acquiring data, the average box becomes gray.

2 Main Window

2.1 Menu bar

The menu's and submenu's are described in section 3.

2.2 Button bar

   Start/Stop button

The Start/Stop button can be used to display data real-time or to take a snapshot

   Cursor button

After clicking the cursor button, a vertical line is displayed in the graph. If the mouse cursor is placed nearby this line, the shape of the mouse cursor changes from an arrow to a 'drag' shape. If this shape is displayed, the left mouse button can be used to drag (keep left mouse button down) the line with the mouse towards a new position. Moving this line shows the corresponding values of wavelength and amplitude in the main screen. As an alternative for dragging the line, the small step and big step arrow buttons may be used, or the left and right arrow keys on the keyboard. The step size for the arrow buttons can be changed by holding down the CTRL-key while clicking at a (single or double) arrow button.
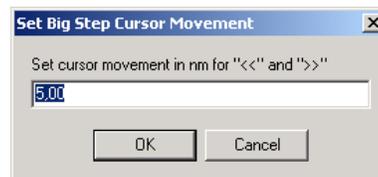
   Save reference and dark buttons

The reference button is the white button at the left top of the screen. It needs to be clicked to save the reference data. The same result can be achieved with the option File-Save Reference. The dark button is the black button at the left top of the screen. It needs to be clicked to save the dark data. The same result can be achieved with the option File-Save Dark.

   Save experiment button

By clicking the Save Experiment button an experiment is saved. The same result can be achieved with the option File-Save Experiment.

Print button

By clicking the Print button a graph that is displayed on the monitor will be printed. The same result can be achieved with the option File-Print.

Scope button

By clicking the S button, the data will be presented in Scope Mode. The same result can be achieved with the option View-Scope Mode.

Absorbance button

By clicking the A button, the data will be presented in Absorbance Mode. The same result can be achieved with the option View-Absorbance Mode.

Transmission button

By clicking the T button, the data will be presented in Transmittance Mode. The same result can be achieved with the option View-Transmittance Mode.

Irradiance button

By clicking the I button, the data will be presented in Irradiance Mode. The same result can be achieved with the option View-Irradiance Mode.

Autoscale Y-axis button

By clicking this button, the graph will be rescaled on-line. A maximum signal will be shown at about 75% of the vertical scale. The same result can be achieved with the option View-Autoscale Y-axis

Change Graph Scale button

By clicking this button, a dialog will be shown in which the range can be changed for both X- and Y-axis. This range can be saved as well and restored any time by clicking the Goto Preset Scale button (see below). The menu option with the same functionality is View-Change Graph Scale.

Goto Preset Scale button

By clicking this button, the scale for X- and Y-axis will be set to a range that has been set before. The same result can be achieved with the menu option View-Goto Preset Scale

Graphic Reset button

By clicking this button, the X- and Y-axis will be reset to their default values. The same result can be achieved with the option View-Graphic Reset

Auto Configure Integration time button

After this button is clicked, AvaSoft starts searching for an optimal integration time. Depending on the maximum counts in the last scan, the integration time will be increased/decreased automatically until a scope signal of about 55000 counts is measured. During the search routine, the changes in integration time can be followed in the integration time edit box in the edit bar. A dialog will display the new integration time if the search is ready. The routine can be aborted by clicking the button again before the search has ended.

H.C.F. button

The History Channel Function button allows you to switch directly to the history channel function screen to start measuring immediately. Of course first the functions need to be defined.

2.3 Edit bar

Integration time [ms]:	1	Average:	1	Wavelength [nm]:	1365.48

When AvaSoft is acquiring data, the edit fields are gray and non-editable. By clicking the red STOP button, data acquisition is stopped and the edit fields become white and editable. The edit bar shows the following parameters:

Integration time[ms]
This option changes the detector readout frequency and therefore the exposure- or integration time of the detector. The longer the integration time, the more light is exposed to the detector during a single scan, so the higher the signal. If the integration time is set too long, too much light reaches the detector. The result is that, over some wavelength range, the signal extends the maximum counts (65536) or in extreme case shows as a straight line at any arbitrary height, even near zero. Entering a shorter integration time can usually solve this.

Try to adjust the integration time, such that the maximum count over the wavelength range is around 55000 counts. When at minimum integration the signal is still too high, an attenuator (FHSA-TTL), a neutral density filter or fibers with a smaller diameter may be used. When not enough light reaches the spectrometer, likewise a longer integration time should be entered. It's also possible to let AvaSoft search for a good integration time by clicking the '∫AC' button, or by using the menu option Setup-Options-Auto Configure Integration time.

If measurements are done in a mode in which reference and dark data are required (all modes except Scope mode), then new reference and dark spectra need to be saved after the integration time has been changed.

Average

With this option, the number of scans to average can be set. A spectrum will be displayed after every # scans. This spectrum is the average of the # scans.

Wavelength[nm]
The wavelength shows the position of the cursor, which becomes visible if the cursor button is down. The amplitude of the signal, which is given in the statusbar at the bottom of the main window, is the amplitude at the wavelength shown in this field.

2.4 Graphical region

The graphical region displays the data in an XY-diagram, with at the X-axis the wavelength in nanometers, and at the Y-axis the detector counts. After loading or saving a reference and dark spectrum, other units can be selected at the Y-axis: Absorbance Units, Percentage Transmittance, or Relative Irradiance.
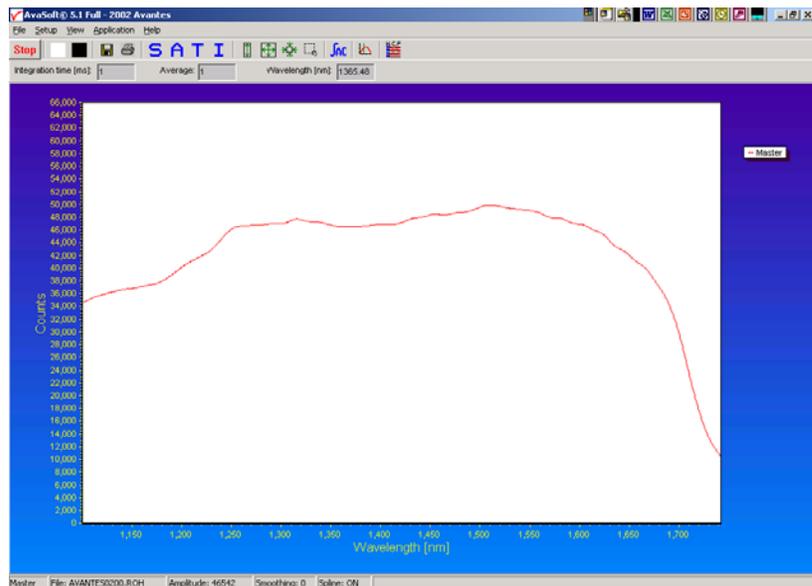
Zoom features
Zoom in: select a region to be expanded to the full graph. To select this region, click the left mouse button in the white graphical region and drag it downwards and to the right. After releasing the left mouse button within the graphic display, both the X- and Y-axis will be rescaled to the new values of the selected region.
Zoom out: drag with the left mouse button within the white rectangle, but in stead of dragging the mouse downwards and to the right, drag it into another direction. After releasing the mouse button, both the X- and Y-axis will be reset to their default values.

Move X-Y: dragging with the right mouse button results in moving the complete spectrum up or down and to the left or right.

Move-Y: if a mouse-wheel is available on the mouse being used, then the spectrum can be moved up or down by moving the mouse wheel.

2.5 Status bar

| Master | File: AVANTES0200.ROH | Amplitude: 46542 | Smoothing: 0 | Spline: ON |
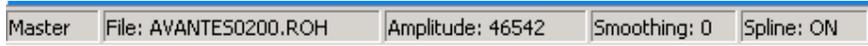
A statusbar at the bottom of the main window shows information about the file to which the data will be saved, amplitude at current wavelength, and the current settings for the smoothing and spline parameters.

2.6 Find peaks or valleys by CTRL or SHIFT + left mouse button click

This option can be used in all modes (Scope, Absorbance, Transmittance or Irradiance) and for all displayed graphics. When the left mouse button is clicked in the graphical region, while the CTRL key is down, AvaSoft will follow the following procedure to run to the closest peak:

1. The wavelength is determined from the position the mouse click occurred.
2. The data from closest pixel is retrieved
3. The direction to search for the peak is determined from the neighbor pixels. If both neighbor pixels have a lower value at the Y-axis than the current pixel, the current pixel is already a peak. If only one of the neighbor pixel values is higher then the current pixel value, the peak will be searched in the direction of this higher pixel. If both neighbor pixels have a higher value at the Y-axis than the current pixel, the current pixel is in a valley. The peak will in this case be searched in the direction of this neighbor pixel with the highest value.
4. The cursor starts moving in the direction, as determined under 3), until it reaches a pixel of which the value is not higher than the last one evaluated. At this pixel the cursor stops.

By holding down the SHIFT key in stead of the CTRL key, the same procedure will be used to move to the closest valley.

If more than one spectrum is being displayed, a dialog, as shown at the right, pops up in which the spectrum for which the peakfinder needs to be activated can be selected out of all displayed spectra.
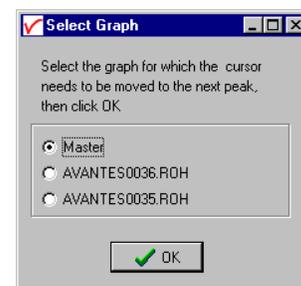
3 Menu Options

In sections 3.1 to 3.4 the four main menu options (File, Setup, View and Application) and their submenu's are described in detail.

3.1 File Menu
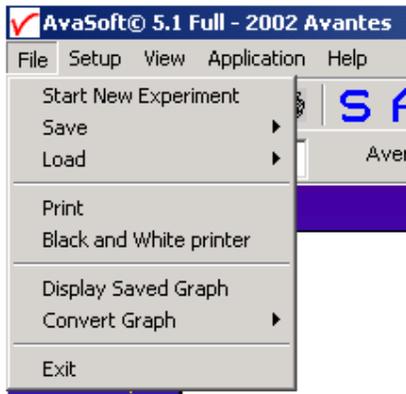

3.1.1 File Menu: Start New Experiment

After selecting this option, a dialog box appears in which a new experiment name can be entered. The experiment name will be saved as a filename with the extension *.kon. This extension does not need to be entered.

After clicking the save button, the current filename will be built up from the experiment name that has been entered, and a sequence number, starting at 0001.
Example: if the experiment name is TOP, the first graphic file that will be saved in scope mode, will be called TOP0001.ROH, the sequence number will be automatically incremented, so the next file that will be saved in scope mode will be called TOP0002.ROH etc. For detailed information on graphic filenames, see

File-Save Experiment. Note that the dialog allows you to select different folders or drives to save the experiments to, as well as creating a new folder name for the new experiment.
After closing the dialog box by clicking the save button, the new experiment name, followed by its sequence number, is displayed in the lower left of the status bar. By clicking the cancel button, the old experiment name will be restored.
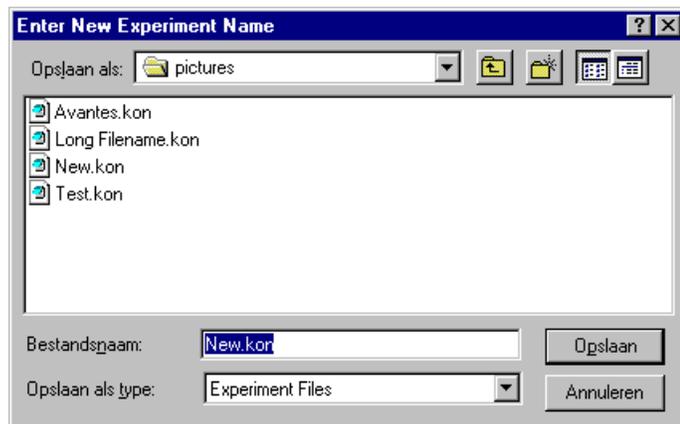
3.1.2 File Menu: Load Dark

With this option, dark data can be loaded, that have been saved before. If AvaSoft is in static mode, the dark data that will be loaded are shown on the screen first.

### 3.1.3 File Menu: Load Reference

With this option, reference data can be loaded, that have been saved before. If AvaSoft is in static mode, the reference data that will be loaded are shown on the screen first.

3.1.4 File Menu: Load Experiment

With this option, an experiment can be loaded, that has been used before. This way more spectra can be saved to an existing experiment. An experiment name has the file extension "*.kon". After choosing this option, a dialog box shows all experiments that were saved earlier in the current experiment directory. If the experiment name that needs to be loaded is in this directory, select it and click the save button. If the experiment name that needs to be loaded is in another drive and/or directory, move to this directory by clicking the
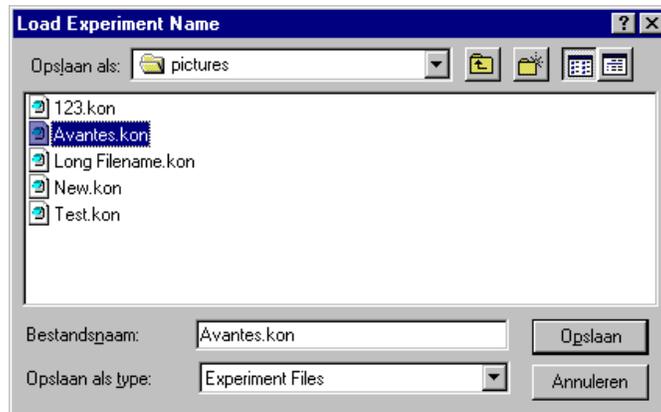
behind the current foldername. For detailed information on graphic filenames, see File-Save Experiment.

3.1.5 File Menu: Save Dark

With this option, dark data are saved. The name of the dark data file is "dark*.dat", where * represents the number of the slave channel for which the dark data has been saved (*=0 represents the master channel).

The dark data files will be saved in the experiment directory that has been picked by the option File-Load-Experiment or File-Start New-Experiment.

3.1.6 File Menu: Save Reference

With this option, reference data are saved. The name of the reference data file is "ref*.dat", where * represents the number of the slave channel for which the reference data has been saved (*=0 represents the master channel).

The reference data files will be saved in the experiment directory that has been picked by the option File-Load-Experiment or File-Start New-Experiment.

3.1.7 File Menu: Save Experiment

With this option, spectral data is saved. All graphic files will be saved in the experiment directory that has been picked by the option File-Load-Experiment or File-Start New-Experiment.

First, a window appears in which a line of comments can be entered to the saved graph. Next two files will be saved: the first file contains the saved spectrum data. The name of this first file starts with the experiment name, directly followed by the sequence number of the saved spectrum. The extension of this first file depends on the current measuring mode, as shown below:

Extension	Mode
ROH	Scope Mode
ABS	Absorbance
TRM	Transmittance/Reflectance
IRR	Irradiance

The second file contains the line of comments, which may have been added to this graph. The name of this second file is, except for the extension, the same as the name of the first file (experiment name and sequence number). The extension of this second file also depends on the measuring mode, as shown below:

Extension	Mode
RCM	Scope Mode
ACM	Absorbance
TCM	Transmittance/Reflectance
ICM	Irradiance

Example: suppose the name of our experiment is "top". Then, saving one spectrum in scope mode, one in absorbance mode and two in transmittance mode results in the following files:

top0001.roh: spectrum data in scope mode

top0001.rcm: comments for the spectrum saved in top0001.roh

top0001.abs: spectrum data in absorbance mode

top0001.acm: comments for the spectrum saved in top0001.abs

top0001.trm: spectrum transmittance mode

top0001.tcm: comments for the spectrum saved in top0001.trm

top0002.trm: spectrum data in transmittance mode

top0002.tcm: comments for the spectrum saved in top0002.trm

After leaving the application and opening AvaSoft the next time, saving graphics in scope, absorbance and transmittance mode, will then result in respectively the data-files top0002.roh, top0002.abs and top0003.trm, as well as the comment files top0002.rcm, top0002.acm and top0003.tcm.

Before saving, the name of the graphic file is displayed in the statusbar at the bottom of the screen. After saving, the sequence number is automatically incremented by one.

3.1.8 File Menu: Print

After selecting the print menu option, the background colors in the graphical region will become white. If the menu option "Black and White printer" (see next section) has been marked, the line style for the spectra will also change from colored to black. A dialog will be shown in which the title for the printout can be entered. In the next window, the printer settings can be changed (e.g. portrait or landscape printing, printing quality etc.). After clicking OK in the printer settings dialog, the graph will be printed, and the original graph colors will be restored on the monitor.
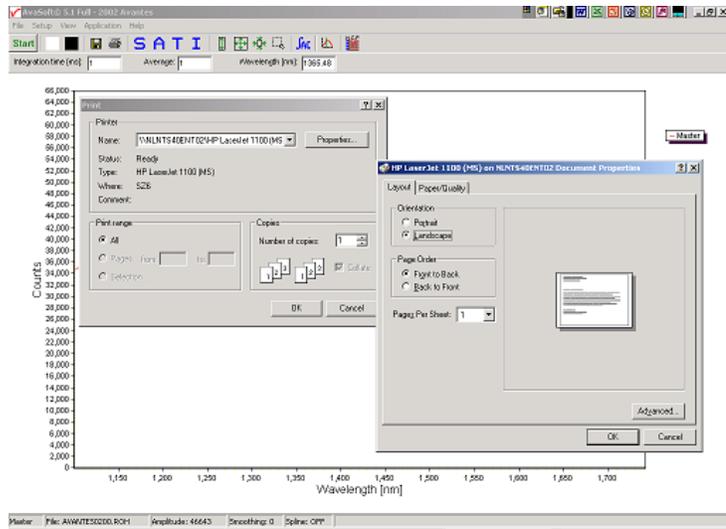
3.1.9 File Menu: Black and White printer

The default setting in AvaSoft is to print the spectra in the same color as they appear on the monitor. However, if a color printer is not available, the menu option "Black and White printer" can be enabled. If this option is enabled, different line styles will be printed if more than one spectrum is displayed, e.g. dash-dash, dot-dot, dash-dot. To enable this option, click the menu option and a checkmark appears in front of it.

3.1.10 File Menu: Display Saved Graph

This option requires that graphic files were saved earlier by using the option File-Save Experiment. After choosing this option, a window shows all files in the current measure mode. In the example at the right, the measure mode is "scope", so the extension of the earlier saved spectra is *.roh.

To select graphic files that were saved in another measure mode, e.g. absorbance, click behind the Graph - …Mode, and pick the desired measure mode.

To select graphic files from another folder or drive, click ⬛ behind the current foldername.

If a graphic file is marked by a (single) mouse click on the filename, the comment line for this file appears at the top of the graphical region in the main window. Selecting multiple filenames can be realized by using the CTRL or SHIFT key in combination with the mouse. If the CTRL key is pressed, all the files that are clicked by the mouse will be selected for displaying. If the SHIFT key is pressed, all the files in between two clicked files will be selected for displaying.

Select the name of the file(s) to be displayed and click the Open button. To leave this dialog without displaying graphic files, click the CANCEL button.

In the figure at the right, two graphic files were selected in scope mode. The comments that were saved with these graphs are displayed at the top of the graphical region, together with information about amplitude at current wavelength (amp), integration time (it) and smoothing (s) settings at the moment that the file was saved and the name of the graphic file. The actual data for the activated channel(s) will be displayed in the same graph as the selected graphic files. By clicking the green start button, the online measurements can be compared directly to the graphics that were saved before.
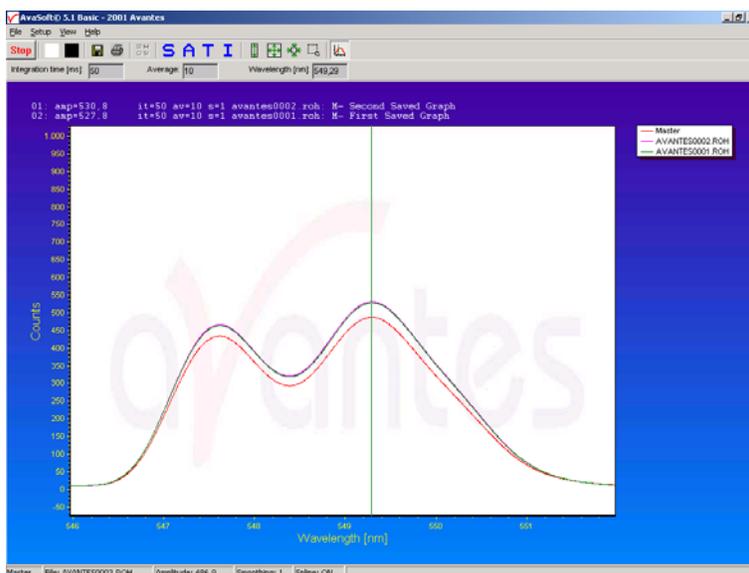

The menu option File-Display Saved Graph is preceded by a checkmark as long as the earlier saved graphics are displayed. To clear these earlier saved graphics, select again the menu option File-Display Saved Graph, after which the checkmark disappears, and only the spectra for the active spectrometer channel(s) will be displayed.

3.1.11 File Menu: Convert Graph - to ASCII

This option requires that graphic files were saved earlier by using the option File-Save Experiment. After choosing this option, a window shows all files in the current measure mode. In the example at the right, the measure mode is "scope", so the extension of the earlier saved spectra is *.roh.

To select graphic files that were saved in another measure mode, e.g. absorbance, click ⬛ behind the Graph - …Mode, and pick the desired measure mode.

To select graphic files from another folder or drive, click ▼ behind the current foldername.

If a graphic file is marked by a (single) mouse click on the filename, the comment line for this file appears at the top of the graphical region in the main window. Selecting multiple filenames can be realized by using the CTRL or SHIFT key in combination with the mouse.If the CTRL key is pressed, all the files that are clicked by the mouse will be selected for conversion. If the SHIFT key is pressed, all the files in between two clicked files will be selected for conversion.

Select the name of the file(s) to be converted to ASCII and click the Open button. To leave this dialog without converting files, click the CANCEL button. The extension of the text files depends on the extension of the binary graphic file as shown below:

Extension binary file	Extension text-file
ROH	TRT
ABS	TAT
TRM	TTT
IRR	TIT

All text files start with a header with information for the graphic file that has been converted. The header shows:

- the comment line

- the integration time

- the number of scans that has been averaged

- the number of pixels used for smoothing

The data in a *.TRT file is given in two columns. The first column gives the wavelength in nanometers, the second one the scope data.

The data in the *.TAT, *.TTT and *.TIT files is presented in five columns. The first column gives the wavelength in nanometers. The second to fourth column give respectively the dark, reference and scope data. The fifth column shows the calculated value for absorbance (in a *.TAT file), transmittance (in a *.TTT file) or irradiance (in a *.TIT file).

3.1.12 File Menu: Convert Graph - to J-CAMP

JCAMP-DX is a standard file format for exchange of spectra between different spectrometer systems and computers. A JCAMP-DX spectrum is a text file, which can be viewed, corrected and annotated with a text editor. A lot of other elaborate spectrometer software programs, like Grams32 and OPUS, are capable of importing files in JCAMP-DX format.

This option requires that graphic files were saved earlier by using the option File-Save Experiment. After choosing this option, a window shows all files in the current measure mode. In the example at the right, the measure mode is "scope", so the extension of the earlier saved spectra is *.roh.
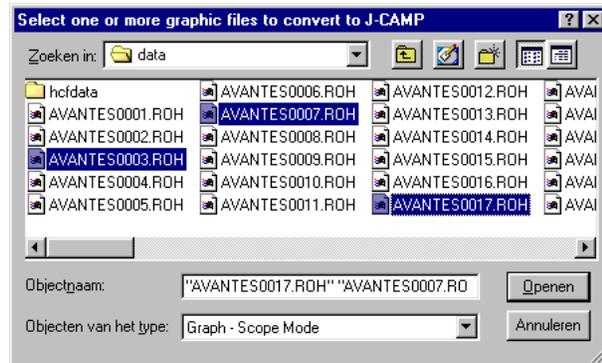
To select graphic files that were saved in another measure mode, e.g. absorbance, click ⬛ behind the Graph - …Mode, and pick the desired measure mode.

To select graphic files from another folder or drive, click ⬛ behind the name of the current folder.

If a graphic file is marked by a (single) mouse click on the filename, the comment line for this file appears at the top of the graphical region in the main window. Selecting multiple filenames can be realized by using the CTRL or SHIFT key in combination with the mouse. If the CTRL key is pressed, all the files that are clicked by the mouse will be selected for conversion. If the SHIFT key is pressed, all the files in between two clicked files will be selected for conversion.

Select the name of the file(s) to be converted to J-CAMP and click the Open button. To leave this dialog without converting files, click the CANCEL button. The text files in J-Camp format require an extension DX. If, for example a file AVANTES0001.trm and another file AVANTES0001.abs are both converted to J-camp, the result will be AVANTES0001.dx in both cases.

3.1.13 File Menu: Exit

Closes AvaSoft.

3.2 Setup Menu
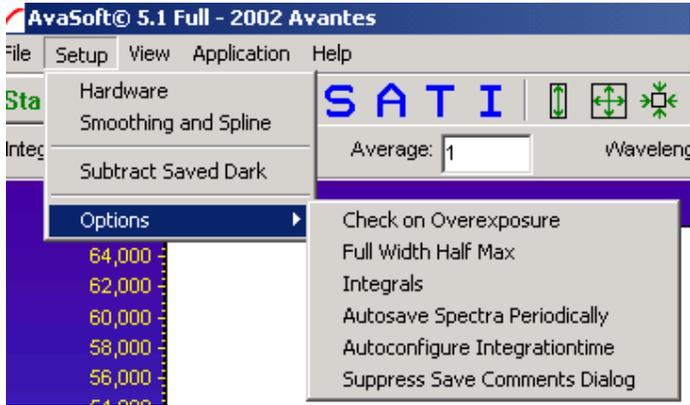
3.2.1   Setup Menu: Hardware

After clicking this option, a dialog is shown in which a number of hardware parameters can be set.

The COM port that the spectrometer is connected to can be selected in the top left.

In the top right part, the gain factor can be selected. Selecting 'On' here will apply a factor of 10, meaning your signal level will be ten times as high.

In the bottom part, you can select whether you want the detector to be temperature controlled or not, and you can enter the setpoint for the detector temperature. You can also read the current detector and system temperatures here. All values are degrees Celcius.

As the NIR-128 does not feature a cooling system, it is important to select a setpoint that is a few degrees over the current system temperature. Please allow 15 minutes for the system to warm up before changing the setpoint value.

In a temperate climate, this will usually result in a value of 28-30 degrees Celsius. Keeping this value comparatively low will improve your signal to noise ratio.

Click the OK button to leave the dialog.
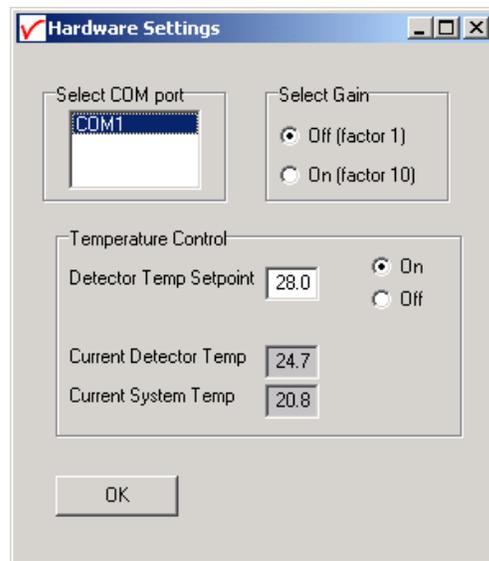
3.2.2   Setup Menu: Smoothing and Spline

The Cubic Spline Interpolation Algorithm can be applied to get a better estimation for the spectral data between the pixels on the detector array.

Smoothing is a procedure that averages the spectral data over a number of pixels on the detector array. For example, if the smoothing parameter is set to 2, the spectral data for all pixels x_n on the detector array will be averaged with their neighbor pixels x_{n-2}, x_{n-1}, x_{n+1} and x_{n+2}.

Cubic Spline Interpolation

In the figure at the right, the effect of spline interpolation is illustrated. The Master data shows the AD counts for 4 pixels, connected by a straight line (linear interpolation). The Slave1 data is for these 4 pixels exactly the same as for the Master data, but this time the cubic spline interpolation algorithm has been applied, resulting in data which is smooth in the first derivative and continuous in the second derivative.

The spline interpolation can be useful for applications in which the output of line sources, like laser diodes is displayed, or for other applications, which require a high resolution.
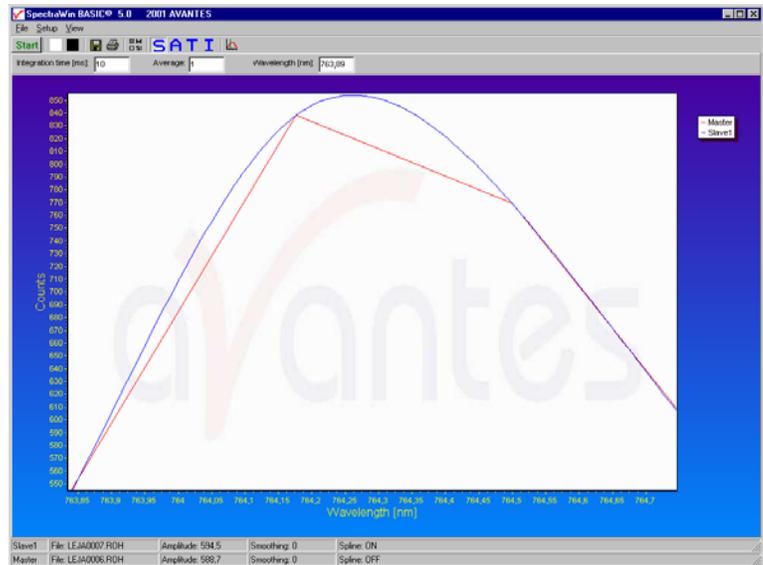
Smoothing

To get a smoother spectrum without losing information it is important to set the right smoothing parameter. The optimal smoothing parameter depends on the distance between the pixels at the detector array and the light beam that enters the spectrometer. For the NIR-128 the distance between the pixels on the InGaAs detector is 50 microns.

Since the slit is also 50 microns wide, it is advised to leave the smoothing at the default setting, which is 0.

3.2.3   Setup Menu: Subtract Saved Dark

This option is used to subtract the dark spectrum that has been saved (File-Save Dark) from the raw scope data. After starting up AvaSoft, this menu option is always unselected, because a dark spectrum needs to be saved or loaded before it can be subtracted.

If this menu option is preceded by a checkmark, the scope data is corrected with the saved dark.

3.2.4 Setup Menu: Options
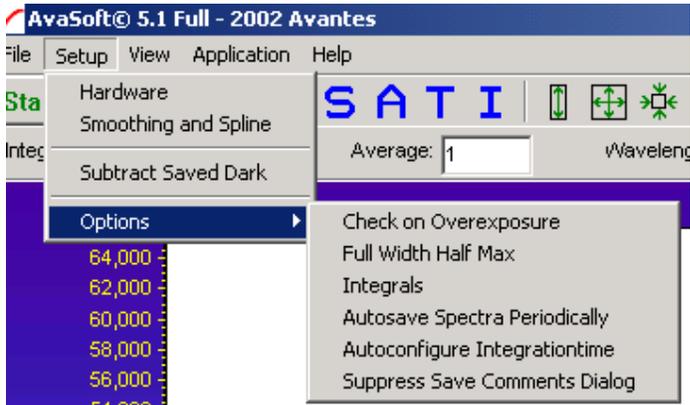
3.2.5.1 Setup Menu: Options - Check on Overexposure.

This option, if preceded by a checkmark, checks if there is too much light exposed to the detector in the spectrometer. This is useful for measurements in transmittance, absorbance and irradiance mode, or if the history channel functions are used. In all these modes data may be misinterpreted, if the spectrometer is overexposed.

By default this option is OFF. After clicking the menu option it will be enabled. First, the saturation level can be changed. The check on overexposure routine compares the maximum value over all pixels of the scope data in each scan with the saturation level entered in the dialog at the right. If this maximum exceeds the saturation level, a warning will be given. If the warning appears during measurements, the ignore button in the message dialog can be chosen to continue measuring without further warnings. By choosing the ignore button the check on overexposure option will be disabled.
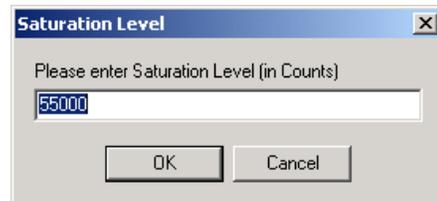
3.2.5.2 Setup Menu: Options – Full Width Half Max

The Full Width Half Maximum of a peak is the bandwidth (in nanometers) for which the intensity is higher than half of the maximum intensity of that peak. The FWHM can be calculated in Scope or Irradiance Mode. This utility is used mostly measuring the output of laser diodes. During FWHM calculations, the intensity needs to be corrected for the dark data. Therefore it is recommended to enable the option Subtract Saved Dark, as shown in the dialog at the right which appears after clicking the FWHM option.
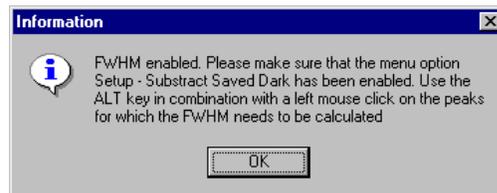
After clicking the OK button, the Full Width Half Max calculated for a number of peaks. To mark a peak for which the FWHM values needs to be calculated, press the ALT key, and click with the left mouse button on this peak. If there are no earlier saved graphs being displayed, then the FWHM value of the marked peak will be shown directly on top of the peak. Afterwards, this peak will be marked yellow over the width of the FWHM value (it may be necessary to zoom in on the peak to be able to view that the peak is marked).

If more than one spectrum is being displayed, a dialog, as shown at the right, pops up in which the spectrum for which the FWHM needs to be activated can be selected out of all displayed spectra.
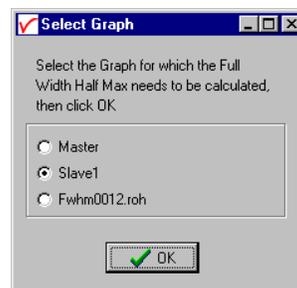
To disable the FWHM calculation, the menu option (which is marked as long as the FWHM is enabled), needs to be reselected.

3.2.5.3 Setup Menu: Options - Integrals

This utility can be used for measuring the total amount of energy coming into the spectrometer. Up to 10 integrals can be displayed simultaneously. The integral calculations are enabled after they have been defined in the dialog that is shown at the right. This dialog is displayed after activating the menu option Setup-Options-Integrals. In the example at the right, three integrals have been defined (the first 3 are marked by the "Enable" checkbox in the first column). In the second column, a spectrum can be chosen out of all spectra that are at that moment displayed in the main window in AvaSoft. A full list of the spectra to choose from (this includes earlier saved spectra like integral 3 in the example) is displayed after clicking on the arrow button at the right side of the second column. In the third and fourth column, the wavelength range can be entered over which the integral should be calculated. Finally, a multiplication factor can be entered for scaling purposes. After clicking the OK button, the integral values are given as shown in the figure at the next page.
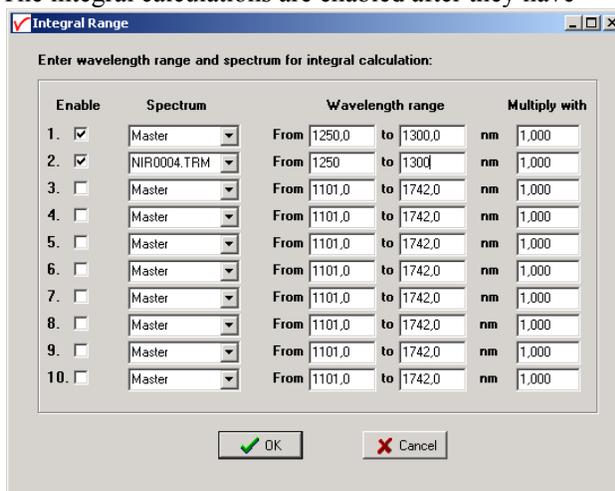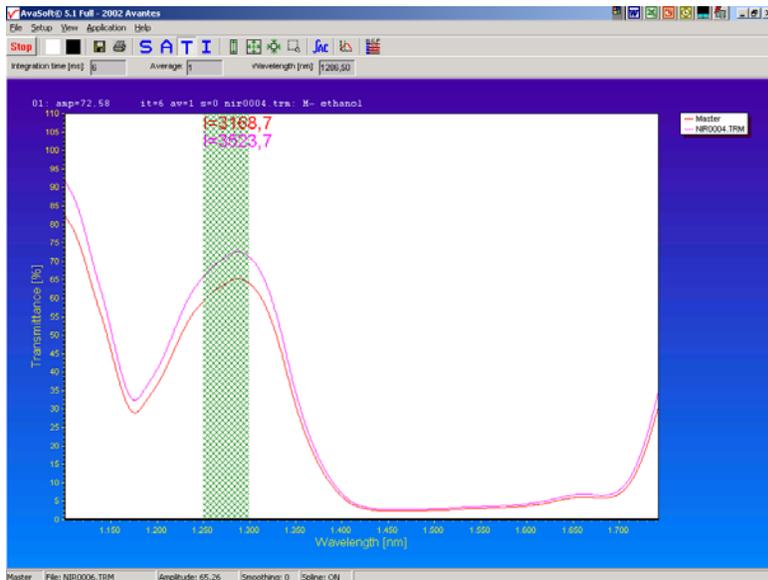
To disable the integral calculation, the menu option (which is marked as long as the Integrals are enabled), needs to be reselected.

To measure the integral versus time, up to 8 different functions can be entered in the History application.

3.2.5.4 Setup Menu: Options – Autosave Spectra Periodically

With this option complete spectra will be saved automatically in time. The following parameters can be set:

- **Time delay before first scan** needs to be entered in seconds. After clicking the OK button, AvaSoft waits for this number of seconds, before the first scan is saved.

- **Time delay between scans** needs to be entered in seconds. This defines the time between saving two subsequent spectra. If this number is set to zero, AvaSoft will save the spectra as fast as possible.

- **Number of scans to save**: the number of spectra that needs to be saved can be entered.
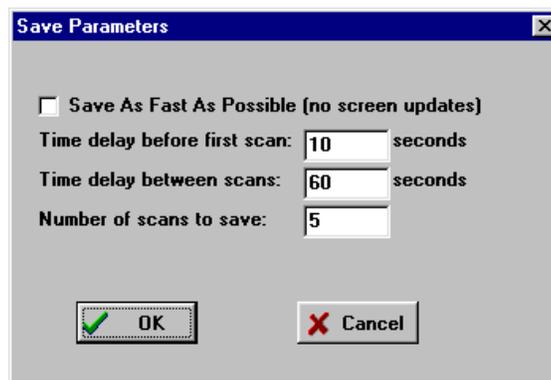
On top of the parameters that appear at the right, a checkbox shows: Save As Fast As Possible (no screen updates).

If the white checkbox in front of this text line is marked, the Automatic Save option will always save the number of scans that have been entered as fast as possible. To do so, the time delay between scans is automatically changed to 0 milliseconds at the moment the checkbox is clicked. With this option selected, the spectra will be saved much times faster, compared to if this option is not selected. This speed increase is achieved by mainly two factors:

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1) During the saving of the number of scans that has been entered, the screen update, which is very time-consuming, is not activated.

2) No comment files will be generated.

Other factors that have a positive effect on the speed of the data acquisition, and which can be set in AvaSoft are:
- Smoothing parameters. Set smoothing to 0 pixels
- Integration time.
- Averaging.

Furthermore, it is recommended to keep the number of files in your experiment directory small (a few hundred maximum), because a large number of files in the same experiment directory has a negative effect on the system speed.

After pressing the OK button, the remaining number of spectra to be saved, is counted down in the edit bar at the top right of the screen. If the automatic saving needs to be aborted before all spectra have been saved, the Autosave Spectra Periodically menu option can be selected again and the value 0 can be entered for the number of spectra to be saved.

3.2.5.5 Setup Menu: Options - Auto configure Integration time

After this menu option is clicked, AvaSoft starts searching for an optimal integration time. Depending on the maximum counts in the last scan, the integration time will be increased/decreased automatically until an optimal signal is measured.
The changing values of the actual integration time during the search can be followed in the integration time field at the edit bar. If the autoconfigure integration time routine needs to be aborted before an optimal integration time has been found, click the '∫AC' button (which is in the down position during the search), or reselect the menu option Setup-Options-Auto Configure Integration time.

When the maximum peak is around 55000 counts, a dialog is shown in which the new integration time is given. Since the integration time has changed, new reference and dark spectra need to be saved, before switching to transmittance or absorbance mode is possible. For this reason this option is only available in scope mode.

3.2.5.6 Setup Menu: Options - Suppress Save Comments

This option, if preceded by a checkmark, disables the appearance of the comments dialog box if an experiment is saved as described in section 3.1.7.

By default this option is OFF. After clicking the menu option it will be enabled (preceded by a checkmark).

3.3 View Menu
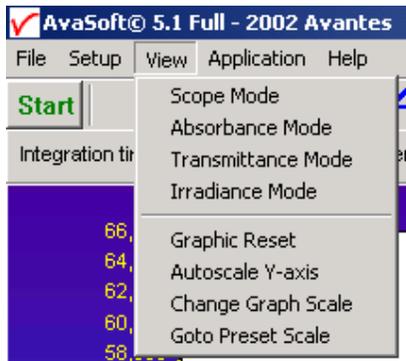
3.3.1 View Menu: Scope Mode

The display is set to Scope Mode, showing a real time raw data signal, with on the Y-axes the read out of the AD-converter and on the X-axes the calculated wavelength.

3.3.2 View Menu: Absorbance Mode

In Absorbance Mode, the absorbance at pixel n is calculated using the current sample, reference and dark data sets in the following equation:

$$A_n = -\log\left(\frac{sample_n - dark_n}{ref_n - dark_n}\right)$$

3.3.3 View Menu: Transmittance Mode

In Transmittance Mode, the transmittance at pixel n is calculated using the current sample, reference and dark data sets in the following equation:

$$T_n = 100 * \left(\frac{sample_n - dark_n}{ref_n - dark_n}\right)$$

The percentage of transmittance is mathematically equivalent to the percentage of reflectance and can also be used for reflectance experiments.

3.3.4 View Menu: Irradiance Mode

A light source of known color temperature is needed as a reference, for example the HL2000 or HL-2000-LL with color temperatures of respectively 2960K and 2800K. The **relative** radiance energy at wavelength λ is then calculated using the current sample, the reference and the dark data sets:

$$S_\lambda = B_\lambda * \left(sample_\lambda - dark_\lambda\right)$$

Where B_λ is the computed component of the spectral distribution of the blackbody radiant emittance (at user selected temperature in degrees Kelvin), divided by the current reference data at wavelength λ

How to take relative irradiance measurements with AvaSoft

1. Start the AvaSoft software, and click the Start button in the main window.

2. Connect the input fiber of the Spectrometer.

3. Adjust the Smoothing Parameters in the Setup menu to optimize smoothing for the Fiber/Slit diameter that is used. (Leave this setting at 0 for the NIR-128)

4. Set up the experiment such that the other end of the fiber points at the sample of light to be determined (use a fixture for the best results). Usually some sort of spectrum may be seen on the screen, but it is possible that too much or too little light reaches the spectrometer at the present data collection settings. Too much light means that, over a certain wavelength range, the signal is overloaded shown as a straight line at any arbitrary height, even near zero. This can usually be solved by a shorter integration time. The integration time can be changed in the main window, in the white box below the start/stop button. If AvaSoft is collecting data, the start/stop button shows a red 'stop' and the integration time box is gray, indicating that it cannot be changed. After clicking the 'stop' button the data acquisition stops and the integration time can be changed. The result of the changed integration time can be viewed after clicking the green 'start' button. Try to adjust the integration time, such that the maximum count over the wavelength range is around 55000 counts. When at minimum integration the signal is still too high, fibers with a smaller diameter can be used. When not enough light reaches the spectrometer, likewise a longer integration time should be entered.

5. When a good spectrum is displayed, turn off the light source.

6. Now save the Dark data. This is done by File-Save Dark from the menu or by clicking the black square on the left top of the screen with the mouse.

7. Turn on the **reference light source of known color temperature** (2960K for HL2000) and set up the fiber end that is not connected to the spectrometer, so that a good spectrum is displayed on the screen. Note that the integration time or fiber type may not be changed while measuring the reference data. If there is too much light, adjust the focusing of the light source, so less light is coupled into the fiber. As long as only light from the reference light source and no ambient light is coupled into the fiber, this will not influence the spectral distribution, only its height. Try to set up the fiber such that the maximum count over the wavelength range is around 55000 counts.

8. Save the Reference data. This is done by File-Save Reference from the menu or by clicking the white square on the left top of the screen with the mouse.

9. Note that the whole operation of saving a reference file does not need to be carried out each time a new experiment is started. The reference data are saved in a file called ref*.dat and can be loaded next time by choosing the option File-Load Reference. After saving or loading reference and dark the irradiance mode can be chosen by clicking the 'I' button or by the menu option View-Irradiance mode. First a message box appears in which the value of the color temperature in Kelvin of the light source that has been used as a reference can be entered. If light from the reference light source is viewed, the Planck-curve for the color temperature of the reference light source is displayed, as shown in the figure at the start of section 3.3. The maximum of the reference Planck-curve has been set to 100.

3.3.5   View Menu: Change Graph Scale

After selecting this option, a dialog is shown in which the range
for both X- and Y-axis can be changed. To switch to the full
scale, the View-Graphic Reset option, or the mouse zoom-out
feature can be used. By clicking the Save button in this dialog,
the settings for X-axis and Y-Axis will be saved to a file and can
be restored in the future by selecting the menu option "View-
Goto Preset Scale" or by clicking the corresponding button in the
button bar.
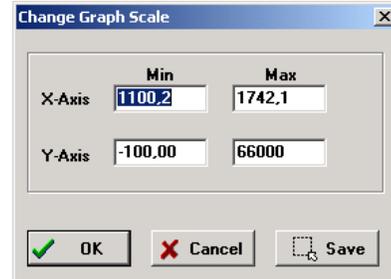
3.3.6   View Menu: Graphic Reset

When selecting this option, the graph will be reset to the default X- and Y-axes.

3.3.7   View Menu: Autoscale Y-axis

By using this option, the graph will be rescaled on-line. A maximum signal will be shown at about
75% of the vertical scale.

3.3.8   View Menu: Goto Preset Scale

By clicking this menu option, the scale for X- and Y-axis will be set to a range that has been set
before . The same result can be achieved by clicking the Goto Preset Scale Button in the button bar.

4 Applications

## 4.1 Applications: History Channel Functions

4.1.1 History Application: Function Entry

With the History Application, the output of self defined functions or integrals can be followed in a graph against time. Up to 8 functions can be followed simultaneously.

The functions are defined in the dialog at the right, which is shown after the History-Function Entry option has been chosen.
The functions F1 to F8 can be selected by clicking the corresponding TAB sheet at the top of this dialog. Furtheron, a number of general (function independent) parameters can be entered, below of the function TAB sheets.
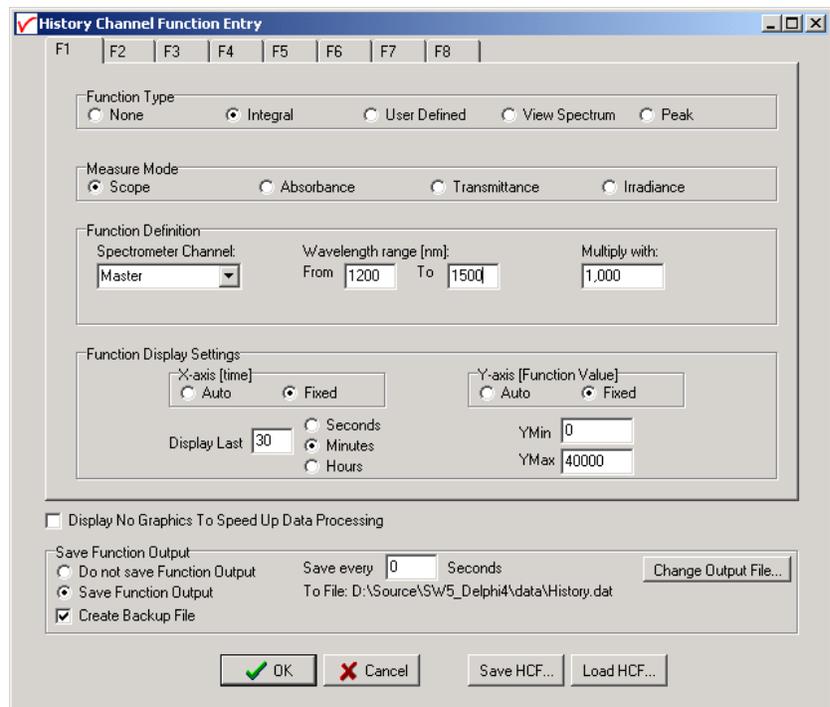
Function Type

The first time that the Function Entry dialog is activated, all 8 functions are not activated (Function Type = None). To define a function, the Function Type radio button needs to be changed from None to: Integral, User Defined , View Spectrum or Peak. After defining the function type, the Measure Mode, Function Definition and Function Display Settings can be set.

Measure Mode

The four possible modes (Scope, Absorbance, Transmittance or Irradiance) are described in section 3.3.1 to 3.3.4. Note that if the selected measure mode is Absorbance, Transmittance or Irradiance a reference and dark spectrum needs to be saved or loaded before the History Channel Measurements can be started.

Function Definition

The parameters that need to be entered in the Function Definition Box depend on the Function Type that has been chosen: Integral, User Defined, View Spectrum or Peak.

Function Definition-Integral

In case a function is defined to display the integral versus time, the following parameters can be set: Spectrometer Channel. The default is Master. Since the NIR128 does not support Slave channels, the Spectrometer channel should always be set to Master.
The "from" and "to" edit boxes may be changed to specify the wavelength range in nanometer over which the integral needs to be calculated.
Finally, a multiplication factor can be entered. The value entered here is multiplied with the calculated integral.

Function Definition-User Defined

In case a function is entered to display the output of a self defined function against time, a function needs to be defined first. In the dialog box, a comprehensive example is given, but it illustrates some of the functions AvaSoft can handle. A list of allowed operators and functions is given below:

Operators: *, /, +,-
Functions:
log(x)   = natural log

log10(x)   = log base 10

exp(x)   = e to the power of x

sqrt(x)   = square root

Additionally, the wavelength signal for the master channel is given in by:

m(wavelength in nm)   = master

For example: the function that needs to be entered to follow the intensity of the signal at 1550 nm against time is: m(1550).

Function Definition-View Spectrum
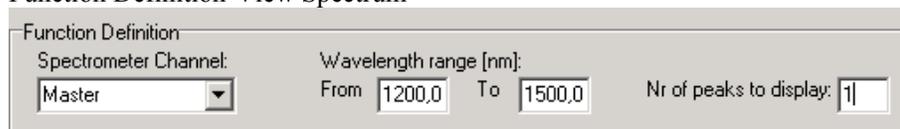
The View Spectrum function does not display function output against time. Instead, the wavelength range that has been entered in the Function Definition Box will be displayed at the X-axis. The spectrum for the selected spectrometer channel will be displayed in the selected measure mode. If the History Channel Functions are used to track the intensity or wavelength of a peak (see below for the Function Definition – Peak), a graphical feature can be used to visualize the peak changes in a spectrum. The number of peaks to display in the spectrum can be entered. This number (between 0 and 100) is the number of vertical lines that will be drawn in the spectrum, each vertical line representing one of the detected peaks in the past.

- The height of the vertical line is equal to the peak intensity.
- The wavelength at which the vertical line is drawn in the spectrum corresponds to the wavelength of the detected peak.
- The color of a vertical line represents the oldness of the peak: Most recent peak is red, going back in time followed by orange, green and blue. All older peaks are gray colored, from light gray (oldest peak) to dark gray (one peak older than blue).

The time interval at which the vertical lines are updated is the same as the time interval at which the function output is saved (to be entered under Save every x Seconds under Save Function Output). For example, suppose the function output will be saved every 3 seconds, and the Nr of peaks to display has been set to 10 in function F1. After starting the History Channel Measurements, the peak in the spectrum drawn for F1, will be marked by a red vertical line immediately. In the next 3 seconds, the spectral peak may vary in height or position but the red vertical line remains at the same place and height. After 3 seconds, the red vertical line becomes orange, and a new red line will be drawn at the position and with the height of the peak detected at that moment (t=3). After 6 seconds another line is drawn and the colors are shifted again, so that red is most recent, then orange, then green. At t=27 seconds, the 10th vertical line is drawn, again red for the most recent, the oldest is now represented by a light gray color. At t=30 seconds, the oldest peak is removed from the list (since in this example the Nr of peaks to display is 10), a new one is added and the colors are shifted according to the definition etc….

Function Definition-Peak
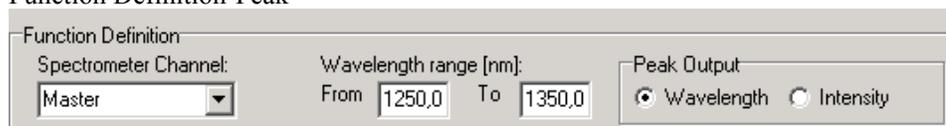
In case a function is defined to display a peak versus time, the following parameters can be set: Spectrometer Channel. The default is Master. Since the NIR128 does not support Slave channels, the Spectrometer channel should always be set to Master.
The "from" and "to" edit boxes may be changed to specify the wavelength range in nanometer, which will be evaluated in the peak search. Finally, a selection can be made to define the Peak Output: Wavelength or Intensity.

If both wavelength and intensity need to be followed against time, one of the functions (F1..F8) can be used to follow the peak wavelength, and another function to follow the peak intensity. To visualize the peak changes, a third function can be set to "View Spectrum" with e.g. the wavelength range set to 1250- 1350 as well and the nr of peaks to display set to 10. In the figure above, the resulting output will be the wavelength of the highest peak between 1250 and 1350 in nanometer. If the intensity button had been selected, the function output would have been the intensity of the highest peak between 1250 and 1350 nanometer.

Function Display Setting

For Integral , User Defined and Peak functions, the output can be displayed graphically against time. The amount of time that will be displayed at the X-axis can be set manually by clicking the Fixed radiobutton. If set to Auto, the time axis will be set to 1 minute. This option is not available if the View Spectrum Function Type has been selected, because the X-axis range is in that case in nanometers, and determined by the wavelength range as described above.
The Y-Axis can also be set to Fixed or to Auto. The Auto option will set the Y-axis range to the minimum and maximum function values that are in the list of measured datapoints.

Function Independent Parameters
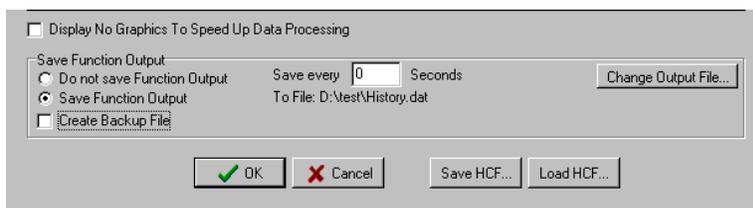
Function Independent Parameters - Display no graphics to speed up data processing
Below the TAB sheets for function definition an option can be enabled or disabled to speed up data processing by not displaying the graphics during the measurements. If an application requires fast data processing (e.g. more than 10 scans per second), this option should be enabled. If saved to an output file, the data can be displayed graphically after the time series experiment has been ended, as described in section 4.1.3: History-Display Saved History Graph.

Function Independent Parameters - Save Function Output
The results of a time series experiment will be saved to an ASCII-file if the radio button "Save Function Output" has been selected. A number of seconds between saving can be entered for data reduction, in case measurements are carried out over long periods. Entering a value of zero results in saving every scan. The name of the file to which the data will be saved, can be changed after clicking

the "Change Output File…" button. Last option in the "Save Function Output" box is to enable or disable the possibility to create a backup file during the measurements. If this option is enabled, AvaSoft will create a backup file with the same filename, but with the extension *.bak (also in ASCII). This backup file is updated every scan and can be used in case the filename that has been selected has failed to save the data, for instance because of a power failure during the measurements.

Save HCF…/Load HCF buttons
AvaSoft automatically saves all parameters (function definition, save options) to the file hcf.ini, and restores these parameters, the next time AvaSoft is started. With the Save HCF… and Load HCF… buttons, it's also possible to save these parameter settings to (and load from) a file with the extension *.hcf. With this feature it is possible to save for each experiment a different HCF file, so it can be loaded a next time the same settings are required. The left figure below shows the dialog in which the name of the hcf file can be entered after clicking the save HCF… button. The right figure below, which is displayed after clicking the Load HCF… button, illustrates how to select an earlier saved HCF file.
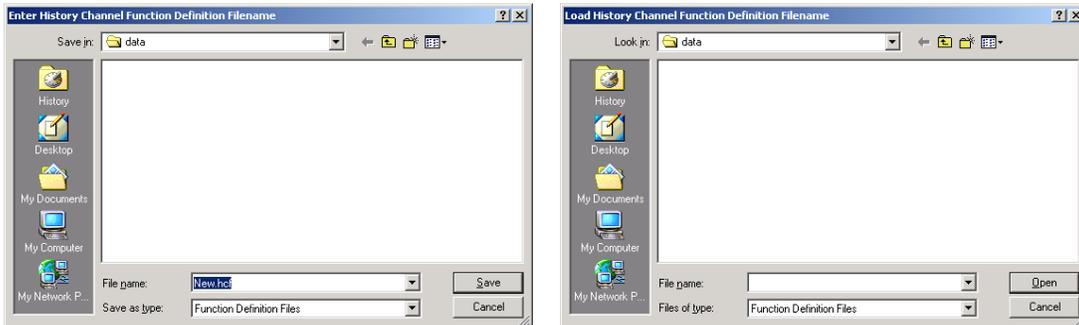
After the definition of one or more functions, the OK button is clicked to confirm, the CANCEL button to leave the dialog without changes. If the OK button is clicked, AvaSoft performs a number of checks on the data that has been entered. If no warnings show up, the parameters that have been entered are accepted, and the measurement can be started by the History – Start Measuring menu option.

4.1.2   History Application: Start Measuring

This option displays the output against time for the history functions that have been defined in the History Channel Function Entry dialog box. If the option "Display no graphics to speed up data processing" has been marked in the function entry dialog, the function output will be shown by numbers only, which are updated each time a new scan is saved to the output file.
There are six buttons at the top of this window: an Exit button, a Pause/Start button, a Save Reference button, a Save Dark button, an Info button and a Print button.
If the red Exit button is clicked, the time measurements are ended and the main window and menu is activated again. The yellow Pause button can be used to stop the time measurements temporarily. After clicking the Pause button, data acquisition stops and the text on the button changes to a green Start. If the Start button is clicked, data acquisition is activated again and the text changes back to the yellow Pause again.

The Save Reference and Save Dark buttons have the same functionality as in the main window.
The Info button shows the Function Entry dialog, in which all parameters can be viewed (not edited) while the measurement is running.

By clicking the Print button, the graphics that are displayed can be printed during the run. First the printer specific dialog shows up in which the print options can be set. For example, if only one graph of the four in the figure above need to be printed, this graph can be selected by the page(s) radiobutton. All graphics are printed full size on a different page.
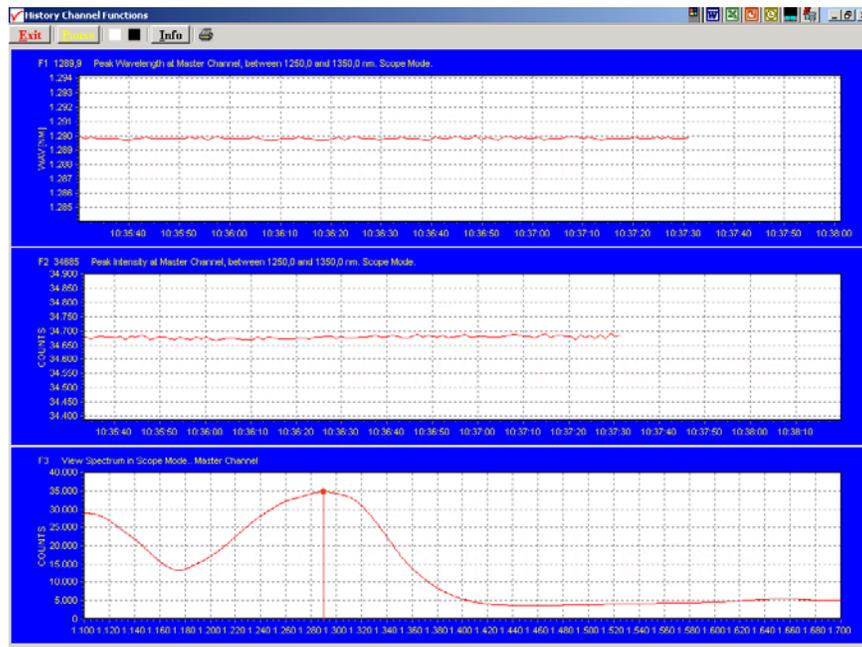
Zoom features

In each graph the same zoom features apply as in the main window (except for scaling the Y-axis with the mouse wheel). However, zooming in over the X-axis while the measurement is running and the X-axis is already scrolling will not be possible, because in that case the X-axis is updated with each new scan. Clicking the pause button to take a snapshot will solve this problem.
**Zoom in:** select a region to be expanded to the full graph. To select this region, click the left mouse button in the white graphics region and drag it downwards and to the right. After releasing the left mouse button, both the X- and Y-axis will be rescaled to the new values of the selected region.
Zoom out: drag with the left mouse button within the white graphics region, but in stead of dragging the mouse downwards and to the right, drag it into another direction. After releasing the mouse button, both the X- and Y-axis will be reset to their default values.
Move X-Y: dragging with the right mouse button results in moving the complete spectrum up or down and to the left or right.

4.1.3   History Application: Display Saved History Graph

If time measurement data have been saved, the resulting ASCII file can be displayed graphically by selecting this file in the dialog that is shown after clicking the "Display Saved History Graph" menu option.
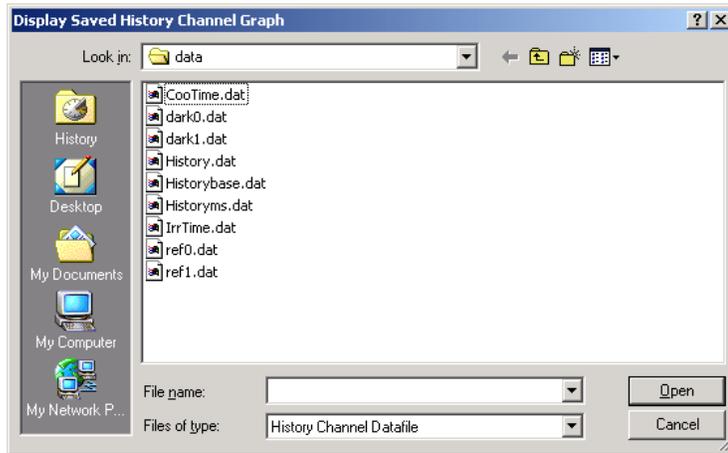
After clicking the "Open" button, the function output of the functions with function type "Integral" or "User Defined" is displayed against time. Both X- and Y-axis are set to their full scale, which is determined by the minimum and maximum values in the list.

The zoom features, as described in section 4.1.2, can be applied, to zoom in on an interesting time interval. A description for the print button can also be found in section 4.1.2.

Since the History Channels Output file is in ASCII, this file can be easily imported in a spreadsheet program like Microsoft EXCEL. The data in the file can also be viewed with a text editor, like Microsoft Word, or with Notepad. An example of the file format is given below:

History Channel Functions Measurement Report

Measurements started at 5-4-2002   Time: 10:46:53

Integration time: 4 ms

Average   : 1 scans

Description of the Functions:

FUNCTION 1:User Defined Function: m(1300). Scope Mode.

FUNCTION 2:User Defined Function: m(1300). Absorbance Mode.

FUNCTION 3:User Defined Function: m(1300). Transmittance Mode.

FUNCTION 4:Not Activated

FUNCTION 5:Not Activated

FUNCTION 6:Not Activated

FUNCTION 7:Not Activated

FUNCTION 8:Not Activated

Time	Seconds	F1	F2	F3
10:46:53	0,35	24588	0,139	72,56
10:46:53	0,67	24587	0,139	72,55
10:46:54	1,00	24586	0,139	72,55
10:46:54	1,33	24587	0,139	72,55
10:46:54	1,65	24587	0,139	72,55
10:46:55	1,98	24590	0,139	72,56
10:46:55	2,31	24586	0,139	72,55
10:46:55	2,64	24589	0,139	72,56
10:46:56	2,96	24584	0,139	72,54
10:46:56	3,29	24589	0,139	72,56
10:46:56	3,63	24586	0,139	72,55
10:46:56	3,95	24587	0,139	72,55

4.2 Applications: Process Control Application

Avasoft Process Control allows you to operate digital outputs corresponding with preset levels of your history channels. You can use all eight history channels.

AvaSoft supports the PCI-6503 card from National Instruments, and uses 17 of the maximum of 24 digital output channels this card offers.
The driver- and testsoftware that comes with this card is called NI-DAQ. National Instruments advises you to install this software prior to installing the hardware.
The card's user manual is also available on the NI-DAQ CD-ROM, in pdf format.

4.2.1 Installation of the NI-DAQ software

Installation of the NI-DAQ software is done by inserting the CD-ROM and running the installation software by choosing "Install NI-DAQ" from the menu. AvaSoft 5.1 has been tested with NI-DAQ version 6.9.1.
National Instruments offers the latest version on their web-site via:

ftp://ftp.ni.com/support/daq/pc/ni-daq/

4.2.2 Installation of the PCI-6503 hardware

Please install the PCI-6503 card in an available PCI slot inside your computer.

4.2.3 Configure and test the PCI-6503 card

After NI-DAQ has been installed, you can run the Measurement and Automation Explorer by clicking it's icon on the desktop to verify correct installation.
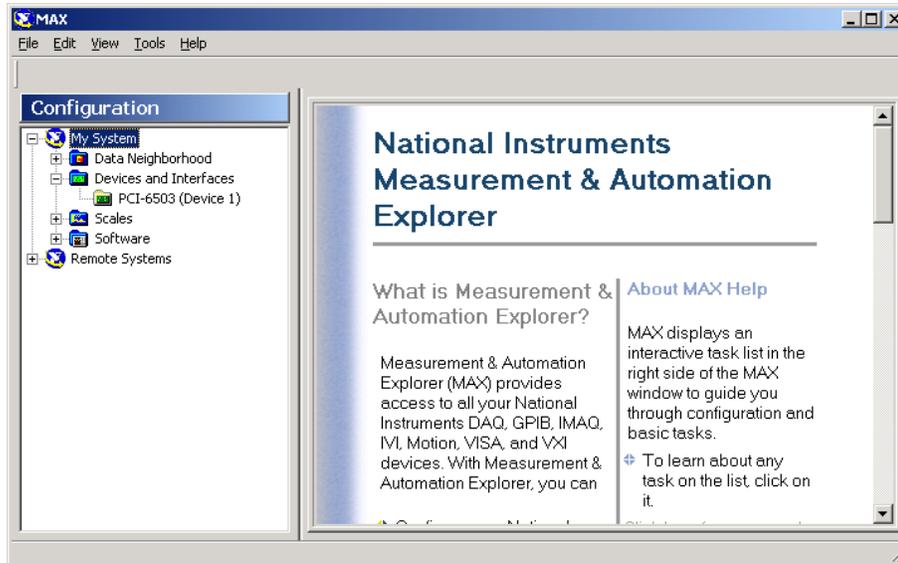
You can also test the different outputs channels with this program by running the Test Panel application. Right click the PCI-6503 in the Devices and Interfaces tree and select Test Panel.

The Output Port and Line Numbers for the different channels are listed in the table below. Go to the Digital Output section, select the correct Output Port and Line Number and click the Write Output button. This will set the corresponding digital output high. Deselect the Line Number box and click the Write Output button to set the output low.
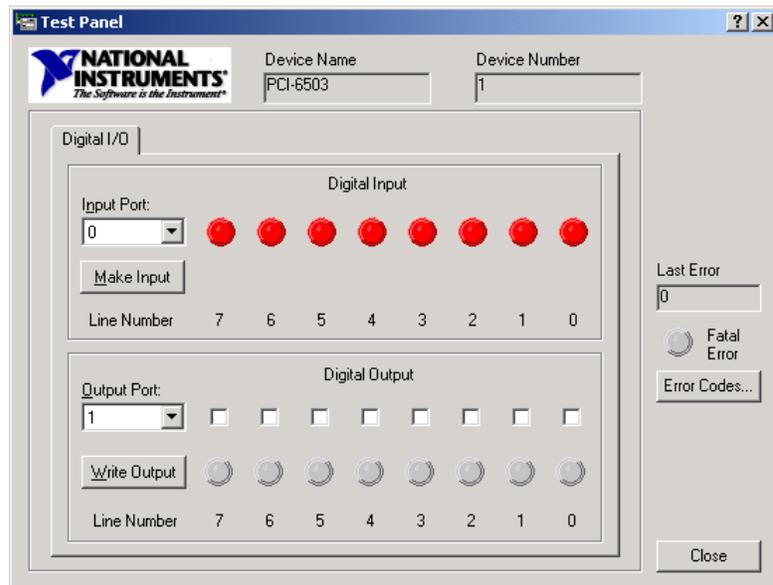
Pin assignments of the PCI-6503 card:			
PC7	1	2	GND
PC6	3	4	GND
PC5	5	6	GND
PC4	7	8	GND
PC3	9	10	GND
PC2	11	12	GND
PC1	13	14	GND
PC0	15	16	GND
PB7	17	18	GND
PB6	19	20	GND
PB5	21	22	GND
PB4	23	24	GND
PB3	25	26	GND
PB2	27	28	GND
PB1	29	30	GND
PB0	31	32	GND
PA7	33	34	GND
PA6	35	36	GND
PA5	37	38	GND
PA4	39	40	GND
PA3	41	42	GND
PA2	43	44	GND
PA1	45	46	GND
PA0	47	48	GND
+5V	49	50	GND

PCI-6503 signals used by AvaSoft Process Control			
F#	connector pin	NI-DAQ port	NI-DAQ line
1 max	1	2	7
min	3	2	6
2 max	5	2	5
min	7	2	4
3 max	9	2	3
min	11	2	2
4 max	13	2	1
min	15	2	0
5 max	17	1	7
min	19	1	6
6 max	21	1	5
min	23	1	4
7 max	25	1	3
min	27	1	2
8 max	29	1	1
min	31	1	0
scan	47	0	0

4.2.4 Using the Process Control Application in AvaSoft

The Process Control application needs to be activated by selecting 'Application', 'Process Control', 'Enable'. A checkmark will appear before the menu entry to show that the option is enabled.

To set minimum and maximum threshold values for each of the History functions, select 'Application', 'Process Control', 'Digital Output Settings'.


The box shows 16 values, corresponding with a minimum and maximum threshold value for the 8 history channels. All 16 values can be edited by clicking them with the mouse. After selecting OK, the settings are written to a binary file called 'digital.ini'.
The minimum and maximum threshold values are indicated in the history graphs with horizontal lines. If the history function output value exceeds the maximum value or is smaller than the minimum value, the corresponding output pin will be set high.

Pin 47 (PA0, port 0, line 0) can be used to test system integrity. For each two consecutively arriving scans, one will result in a high signal to pin 47, and the other will result in a low signal to pin 47. This way, your application can test for e.g. a hardware malfunction, power failure or software crash, which would cause the state of the digital outputs to be erratic.

An example of running the History Channel functions together with the Process Control application is shown below.
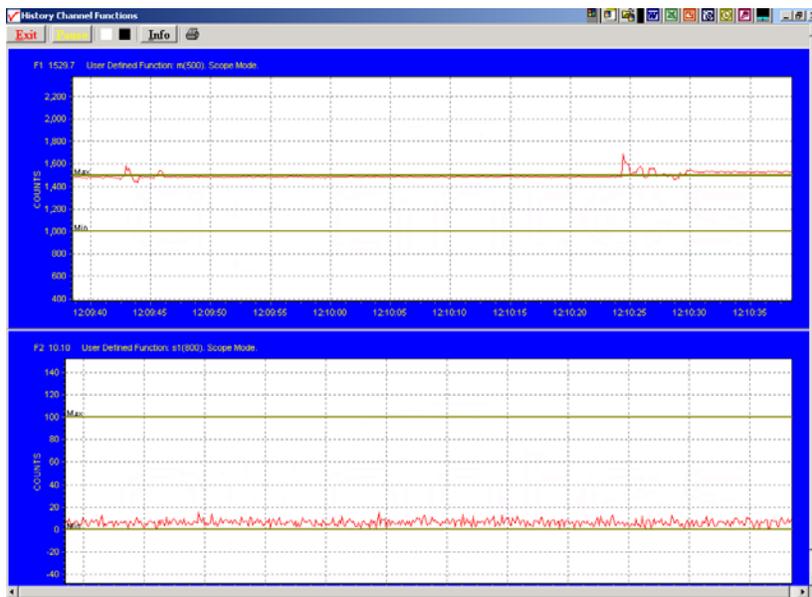
In this example, two History Channel functions were defined. The threshold values for function F1 were set at 1000 and 1500, for function F2 at 0 and 100. These values are represented by the horizontal lines in the graphs.

4.3 Applications: Excel Output

AvaSoft XLS is an add-on application that enables Avasoft Full to output history channel data and/or complete spectra to Microsoft Excel.
It uses OLE-Automation, which is a technology that enables AvaSoft to remotely control Excel, opening sheets and copying data into cells.
On modern hardware, we have been able to copy complete 2048 pixel spectra to Excel with as little as 50 msec. overhead per scan.

4.3.1   Select Source Data

Besides enabling Excel output, you will have to select your source data. This is done in the same way it would be done without the Excel output option, with the input screens you use to define History Channel Functions.

The only difference is the 'Save Function Output' box, which is not used by the Excel Output option. This part is replaced by a separate dialog, which will be described under 'Settings'.
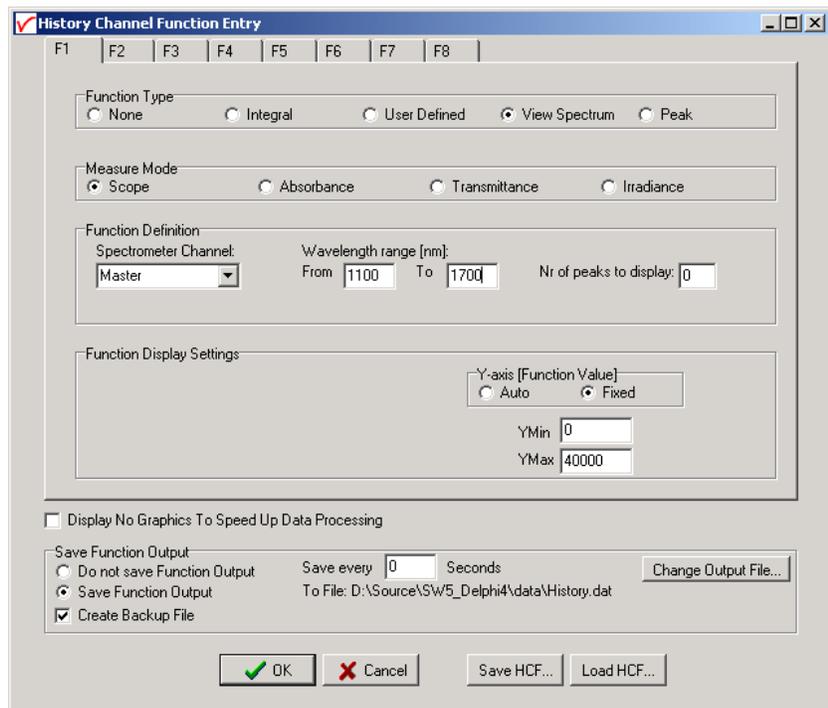
4.3.2   Enable Excel Output

Enable the option by selecting 'Application', 'Excel Output', 'Enable'.
A checkmark will appear before the menu entry 'Enable' to show the status of the option.

4.3.3 Settings

AvaSoft will write the data to three differently formatted sheets, depending on user input in History Channel Function Entry and the Settings dialog .
You can enter the Settings dialog by selecting 'Application', 'Excel Output', 'Settings'.
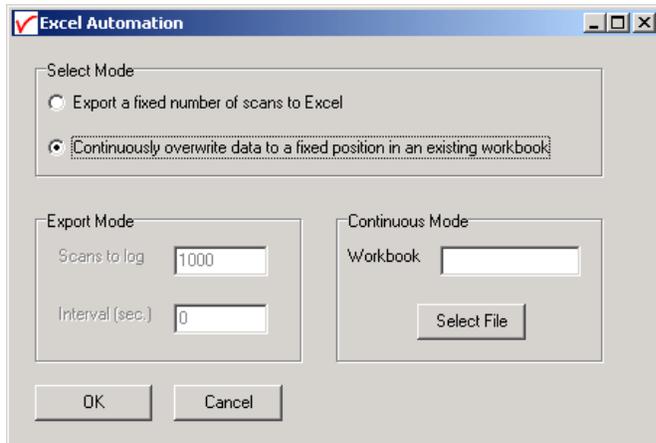
First, select the mode you want.

Export mode

You can select Export Mode by selecting the top radio button. In this mode, a predefined number of scans will be logged to new worksheets that Excel will open.
Depending on your choice of history channel, one of two formats of sheet (or both) will be opened by Excel.

If you select regular history channels, without selecting 'View Spectrum', the sheet will be formatted horizontally, with the program adding a new row for each measurement written.

The sheet will be called 'AvaSoft Data', the columns contain the following data:

Column A contains a data/time value, formatted as 'dd:mm:yyyy hh:mm:ss'.
This is a floating point value, in which the integer part is the day number, starting at January 1, 1900 with day 1. The fractional part represents a decimal time value, where 0.5 is 12:00 h. noon and 0.75 is 18:00 h.
This way, differences in date/time can be readily calculated by subtracting values, which would be much more difficult if this was a text representation.

Column B contains a time value, representing the elapsed milliseconds since midnight. This value does not have a one millisecond resolution. Remember that Windows is not a real-time operating system. It can, however, be used as a reasonably accurate indicator of the time that passes between scans.

Columns C through J contain the 8 different History Channel values. For unselected History Channels, a value of 0 will be entered in the sheet.

If you select 'View Spectrum' in your choice of History Channels, the sheet will be formatted vertically. As Excel only offers 256 columns per sheet, we need to write a spectrum (which can hold more than 2000 pixels) in a column instead of a row, and add more columns as time passes.

	A	B	C	D	E	F	G
1	Time	05/04/2002 13:56:54	05/04/2002 13:56:55	05/04/2002 13:56:56	05/04/2002 13:56:56	05/04/2002 13:56:57	05/04/2002 13:56:57
2	Elapsed msec.	50214389	50214980	50215541	50216112	50216682	50217253
3	Wavelength (nm)						
4	1100,23	91,00583591	91,03526065	91,04016478	91,0646854	91,0450689	91,0646854
5	1110,93	84,54782815	84,56206978	84,52883931	84,55732257	84,59055305	84,56206978
6	1121,63	75,28199415	75,24021724	75,249501	75,24485912	75,28199415	75,28199415
7	1132,33	65,36195478	65,34825303	65,3893583	65,34368577	65,34825303	65,35738753
8	1143,02	55,72721949	55,76775821	55,7362281	55,77226251	55,80379262	55,78127111
9	1153,72	45,7068904	45,65780079	45,71581578	45,68903963	45,65780079	45,66672617
10	1164,42	37,0373611	37,02423659	37,02423659	37,0373611	37,05048561	37,04173593
11	1175,12	32,81471612	32,81041819	32,78463059	32,83190785	32,79752439	32,84480165
12	1185,81	33,20130087	33,20130087	33,20130087	33,20963976	33,22631755	33,21380921
13	1196,51	34,29805441	34,28190845	34,28998143	34,31823686	34,31016388	34,28998143
14	1207,21	34,1182443	34,10262418	34,09871915	34,09090909	34,10652921	34,08309903
15	1217,91	31,83256725	31,85517293	31,84763771	31,85894055	31,87024339	31,85140532
16	1228,60	29,22087361	29,22814158	29,20270368	29,20633767	29,1990697	29,21723962
17	1239,30	30,39966432	30,39267107	30,37169132	30,3961677	30,4101542	30,39267107
18	1250,00	36,07460216	36,07460216	36,05432983	36,07798088	36,05770855	36,06784471
19	1260,70	42,36807388	42,35488127	42,38456464	42,39116095	42,39775726	42,37796834
20	1271,40	45,72732776	45,69787798	45,72732776	45,73059996	45,73714435	45,73223606
21	1282,09	49,03412227	48,9886692	49,01788903	49,01788903	49,02438233	49,03412227
22	1292,79	47,1459793	47,16526323	47,15562126	47,14919329	47,17811917	47,15883525
23	1303,49	41,04829962	41,01001723	41,01639763	41,00682703	41,00682703	41,01001723
24	1314,19	32,51589464	32,52842244	32,53155439	32,52215854	32,55974193	32,53155439
25	1324,88	22,89111034	22,91949166	22,87218946	22,91003122	22,88795686	22,91949166
26	1335,58	14,41701265	14,39799702	14,39165848	14,40116629	14,4106741	14,40433556
27	1346,28	8,746122606	8,752518308	8,762111861	8,762111861	8,746122606	8,771705414
28	1356,98	5,760151086	5,77968806	5,786200384	5,77968806	5,766663411	5,77968806
29	1367,67	4,537787333	4,544402183	4,514635356	4,534479907	4,551017033	4,537787333
30	1378,37	4,154746856	4,148093939	4,161399774	4,141441022	4,138114563	4,148093939
31	1389,07	4,099810073	4,093260855	4,099810073	4,103084681	4,083437029	4,10635929
32	1399,77	4,077403724	4,093343535	4,064651875	4,061463912	4,071027799	4,067839837
33	1410,47	4,105580976	4,114918916	4,102468329	4,096243035	4,130482149	4,111806269
34	1421,16	4,175864606	4,194260486	4,181996566	4,203458425	4,185062546	4,194260486

Since there is a maximum of 256 columns per sheet, new sheets will be added after column 256 ('IV') is filled.

The first sheet will be called 'F1' for history channel 1, 'F2' for history channel 2, etc.If extra sheets are added, a suffix will be added to this name, e.g. F1_01, F1_02 etc.

If the function type "View Spectrum" has been selected for more than one History Channel Function (e.g. Master channel for F1, Slave1 channel for F2), then the different history channel sheets (named F1 and F2) are located in separate workbooks, and must be saved under separate filenames. This is also the case for the sheet with 8 History Channel values, described before.
Rows 1 and 2 contain the date/time stamp and the elapsed millisecond value, as described in the previous section.
Column A of the first sheet holds the wavelength scale. The wavelength range matches the wavelength range as specified in the History Channel Functions.

The lower left half of the Settings dialog can be used to enter the number of scans you want to export to Excel, and the time interval (in seconds) between two scans you want to log.
Default values are 1000 scans and no interval, meaning as fast as possible.

Continuous Mode

You can select Continuous Mode by selecting the bottom radio button. In this mode, data will be written to a single sheet, each scan overwriting the previous one.
In the lower right part of the Settings dialog, you can select the workbook the sheet will be added to, thereby enabling you to use your own calculations and graphs in Excel on live data from AvaSoft.

Press the 'Select File' button to select the workbook. Please save an empty workbook using Excel if you don't have a previous workbook to open.
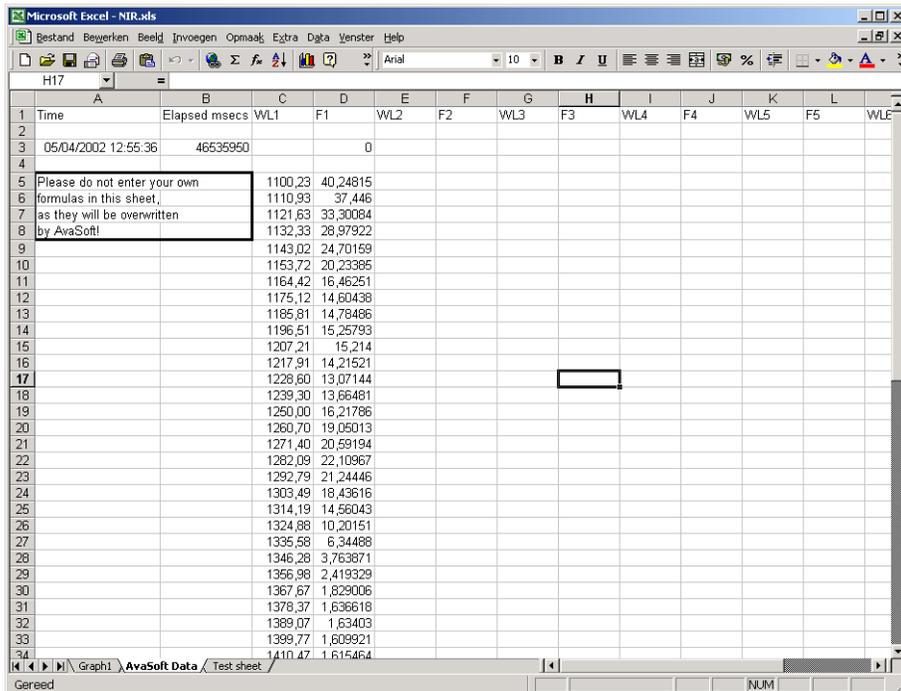
AvaSoft will check if a sheet named 'AvaSoft Data' is present, and will add this sheet if it is not present. This way, links to the sheet can be preserved between sessions.

The sheet contains the following data, at fixed positions:

A3   : Date / Time stamp

This is a floating point value, in which the integer part is the day number, starting at January 1, 1900 with day 1. The fractional part represents a decimal time value, where 0.5 is 12:00 h. noon and 0.75 is 18:00 h. This way, differences in date/time can be readily calculated by subtracting values, which would be much more difficult if this was a text representation.

B3   : Time in milliseconds after midnight

This value does not have a one millisecond resolution. Remember that Windows is not a real-time operating system. It can, however, be used as a reasonably accurate indicator of the time that passes between scans.

C5-C***   : Wavelength scale (in nm) for first History Channel spectrum
D3   : Value for first History Channel (0 if spectrum is selected)
D5-D***   : Spectrum for first History Channel.

E5-E***   : Wavelength scale (in nm) for second History Channel spectrum
                     (empty if spectrum is not selected)
F3   : Value for second History Channel
F5-F***   : Spectrum for second History Channel
  (empty if spectrum is not selected)

etc.

*** : depends on the wavelength range selected.

4.3.4   Start Output

You start the output the usual way, with 'Application',
'History', 'Start measuring'.
You can also use the corresponding button on the Button Bar.
Please do not perform large alterations of the worksheet, while
data is being transmitted. An error 'Call was rejected by callee'
will be issued if Excel is too busy.
Moving around the worksheet should not pose any problems.
Save any alterations to your worksheet before starting the transfer to Excel. You do not have to close
the worksheet or close Excel.

4.3.5   Stop Output

If you want to stop the transfer to Excel give focus to AvaSoft and press 'Exit'. It may take a few
seconds before the buttons appear.
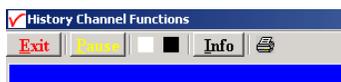
Excel will not be closed by AvaSoft. Save your work and close Excel the same way you would when
working with Excel manually.

We have included a sample worksheet, called 'Continuous.xls', which demonstrates linking to the
'AvaSoft Data' sheet. In this case, one graph is drawn from the columns for History Channel F1. The
graph and data are continuously updated while data is being transferred to Excel.
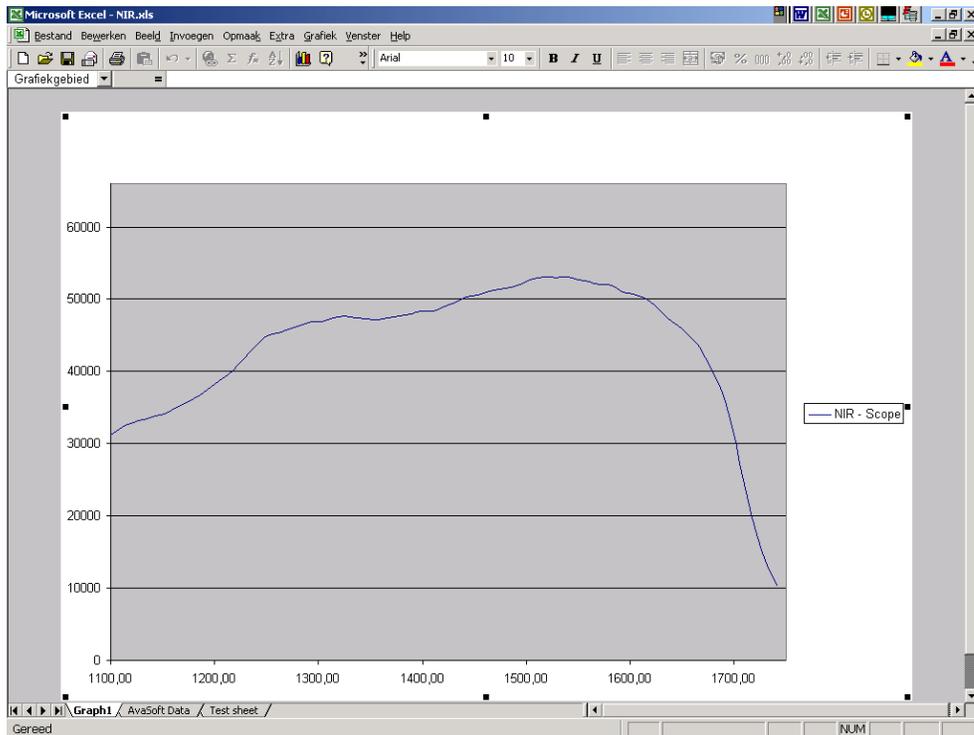
4.3.6 Limitations and Optimization Notes

As all scans are stored in memory, it is very easy to overflow internal memory with scans in Export mode.

Therefore, a limit to the number of scans to store in Excel has been built in. Before a new sheet is added, the amount of memory Excel uses is determined. If this number is larger than half the physical memory installed in the machine, output to Excel will stop.

On a 128 MB machine, this corresponds with 7-8 complete sheets of 256 columns and 2000 rows, roughly 2000 full scans. Limiting the wavelength range will extend your range of scans accordingly. Of course, adding more Ram to your machine will also help raise this limit.

We have, however, seen limitations in the amount of memory that Excel can use. It looks like there is an internal limit that is hit before internal memory runs out.

In a machine with 512 MB, the limit corresponds with about 16 sheets of complete 2000 pixel spectra. After this Excel issues an 'Out of Memory' message and is no longer functional. E.g. saving your data to disk is not possible anymore.

This is only an issue on machines with large amounts of memory (256 MB, 512 MB)

For greatest speed, it is important to give the focus to Excel. If you set the focus to AvaSoft, Windows will dramatically lower Excel's priority. You can verify this by looking at the 'Filling Cells' progress bar in the lower left corner of your worksheet.

5 Help

After clicking the Help-Contents menu option, the AvaSoft FULL manual will be displayed in HTML format. At the left side the Help Contents displays all sections to which the user can browse to a specific topic.
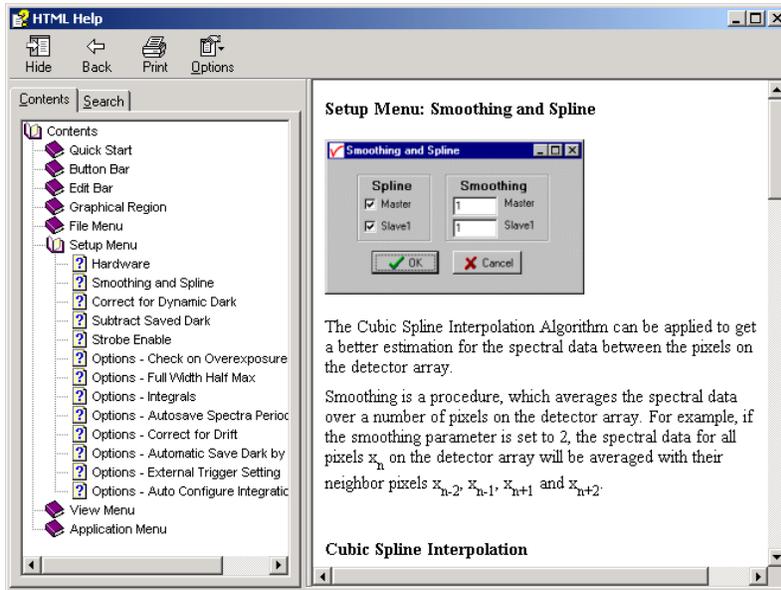
In stead of browsing through the contents to a specific topic, the search TAB can be selected, as illustrated in the figure below. After typing in a keyword (e.g. smoothing), and clicking the List Topics button, a list of all topics containing this keyword is shown. By selecting a topic at the left (double click), the information is displayed at the right, in which the keyword is marked in the text.
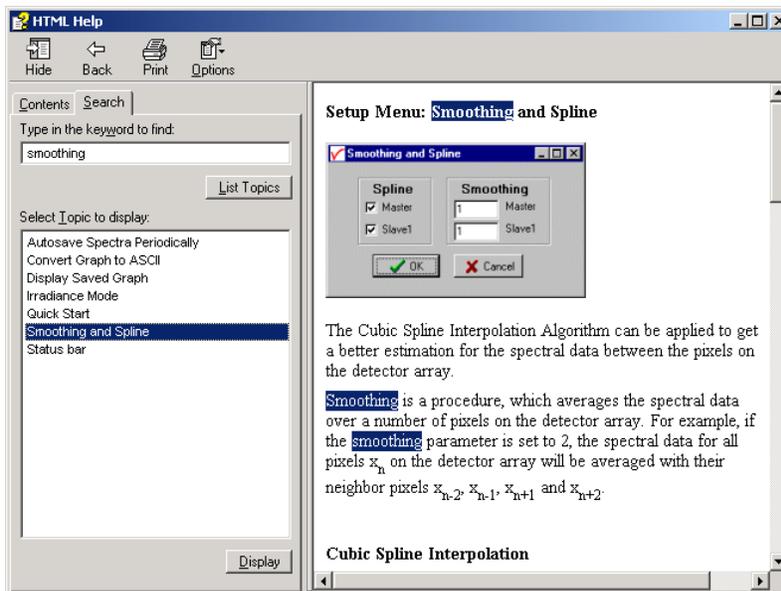
Appendix A   **Troubleshooting**

In this Appendix, some potential software installation problems will be described, together with the action that should be taken to solve the problem. Most of these failures are due to an incorrect installation. If an installation was not successful, it can be helpful to read the recommendations below. There are also other failures that were encountered during the test procedures for AvaSoft 5.1. Some showed up only under Operating System Windows 95. We categorized the potential problems into three sections:

- Spectrometer does not acquire data
- Known problems under Windows 95
- Other potential problems

If there are any failures not listed in this Appendix, or if the described solutions don't solve the problem, please don't hesitate to contact us:

Avantes Technical Support
Soerense Zand 4a
NL-6961 LL Eerbeek
The Netherlands

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E-mail: info@avantes.com
Web: www.avantes.com

A.1 Spectrometer does not acquire data

If the installation program did not report any problems, and all hardware has been installed as described in the Avantes Fiberoptic Spectroscopy Operating Manual, then AvaSoft can be started and should display a spectrum in Scope Mode, after the green Start button has been clicked. If no spectrum is displayed, please check if the NIR-128 is connected to COM1. If not, select the correct COM port in the Hardware settings dialog and click the OK button in the Hardware settings dialog. If necessary, close AvaSoft, restart the program and click the green Start button. Refer to section A.3.1 if a range check error is displayed the next time AvaSoft is started.

A.2 Known problem under Windows 95

On some computers which run under Windows 95 the glyphs on the buttons in the toolbar are not visible. This is a known Windows 95 problem for which a utility program (401comupd.exe) can be found on the internet at:

http://www.microsoft.com/msdownload/ieplatform/ie/comctrl.asp

Of course we can also send this utility program on request per attached e-mail. After executing 401comupd.exe, the problem is solved.

A.3 Other potential problems

A.3.1 Range check error and no wavelength range at the x-axis

If a first installation failed, this situation shows up immediately after starting AvaSoft, because the wavelength range at the x-axis shows only a '0' instead of the expected range (e.g. 1100-1750 nm). A "range check error" will be given. The same error can happen if at the end of the installation program which installs AvaSoft 5.1, the computer was not restarted (as recommended).

If this situation occurs, the problem can be solved by closing AvaSoft and deleting the file **nir.ini** in AvaSoft's main directory (default C:\NIR5FULL or C:\NIR5BASIC). AvaSoft will create a default nir.ini the next time it is started. Execute the Hardware settings dialog by selecting 'Setup' 'Hardware' Make sure to fill in the right parameters in this dialog. After clicking the OK button in the Hardware dialog, the right wavelength range should appear at the x-axis.

A.3.2 AvaSoft 5.1 Basic has been installed although the FULL version was ordered
During the installation, the configuration diskette needs to be inserted in floppy drive a:. Depending on the information on this diskette, the installation program proceeds with installing AvaSoft Basic or AvaSoft FULL. Apparently the configuration diskette could not be read during the installation. The installation program needs to be executed again, this time with the configuration diskette in drive a: