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Introduction

Thank you for purchasing an AvaSpec Avantes Fiber Optic Spectrometer System.
You may find an electronic version of this manual as pdf file on your Avantes CD-rom that came with the system, the newest version of this manual can also be downloaded from our website www.avantes.com under the section downloads.
This manual provides users with directions on configuring your AvaSpec with your computer and operating the AvaSpec-128, AvaSpec-256, AvaSpec-1024, AvaSpec-2048 (FT and TEC), AvaSpec-2048L, AvaSpec-2048x14, AvaSpec-3648, AvaSpec-ULS2048 and AvaSpec-NIR256 Miniature Fiber Optic Spectrometer. For abbreviated directions on setting up your system, turn to the instructions beginning in Chapter 1: Quick Start. In addition, this manual covers instructions for using some of our most popular spectroscopic components including light sources, sampling chambers, sampling optics, fiber optic probes, and optical fiber assemblies.
This manual describes the installation and operation for both USB1 platform (USB1) and USB2 platform (USB2) spectrometers, the reference to the platform is designated between brackets.

There is a separate manual for AvaSoft full version Spectrometer Software and there is a separate manual available for OEM customers on the AvaBench and AS-161 or AS-5216 electronics board.

Contents of shipment

In your shipment box you will find following, please check carefully that all items are present:

- AvaSpec spectrometer
- PS-12V/1.0A power supply (not included for –USB2 or SPU1 self powered USB version)
- USB or RS-232 interface cable
- AvaSpec Product CD-rom
- Wavelength Calibration Data Sheet.

AvaSpec Spectrometer



The AvaSpec spectrometer comes in a black enclosure for 1 and 2 channels. All electrical connectors are located on the backside; on the front side is the optical entrance connector. On the bottom a sticker is located with spectrometer type, serial nr, installed options date and customer name.
Please follow instructions in chapter 1 or 2 for installation.

PS-12VDC/1.0A power supply (not included for –USB2 or –SPU self powered USB version)



The PS-12V/1.0A power supply is standard equipped with EUR connection and is suitable for 100-240 VAC. If you need different socket connection, please contact us for US, UK or Australian power supply. Please follow instructions in chapter 1 or 2 before connecting the power supply.

USB or RS-232 interface cable

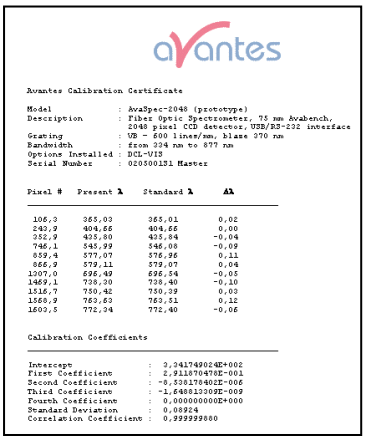
Standard a USB interface cable is included in the shipment. For connection under RS-232 a 9- pole IC-DB9-2 interface cable (for USB1 platform) or an IC-DB26/DB9-2 (for USB2 platform) should be separately ordered with the instrument.

AvaSpec Product CD-rom



The AvaSpec CD-ROM includes the installation software for the AvaSpec products, such as AvaSpec-128, AvaSpec-256, AvaSpec-1024, AvaSpec-2048(L), AvaSpec-2048x14, AvaSpec-3648, AvaSpec-ULS2048 and AvaSpec-NIR256. It also includes a PDF version of this manual, a PDF version of the Avantes catalog and a PDF version of the AvaSoft-full manual.

Wavelength Calibration Data Sheet



Avantes Calibration Certificate

Model : AvaSpec-2048 (prototype)
Description : Fiber Optic Spectrometer, 75 mm Avabench, 2048 pixel CCD detector, USB/RS-232 interface
Grating : UV - 600 lines/mm, blaze 370 nm
Bandwidth : from 294 nm to 877 nm
Options Installed : DCL-UV1
Serial Number : 0205001B1 Master

Pixel #	Present λ	Standard λ	Δλ
108,3	365,03	365,01	0,02
240,9	404,65	404,66	0,00
252,9	435,80	435,84	-0,04
746,1	545,99	546,08	-0,09
859,4	577,07	576,96	0,11
868,9	579,11	579,07	0,04
1207,0	696,49	696,54	-0,05
1469,1	738,30	738,40	-0,10
1516,7	750,42	750,39	0,03
1568,9	763,63	763,51	0,12
1603,5	772,94	772,40	-0,06

Calibration Coefficients

Intercept	:	2,941749024E+002
First Coefficient	:	2,911870470E-001
Second Coefficient	:	-8,539178402E-006
Third Coefficient	:	-1,648813209E-009
Fourth Coefficient	:	0,000000000E+000
Standard Deviation	:	0,08924
Correlation Coefficient	:	0,999999880

This calibration sheet is unique to your spectrometer; it includes the wavelength calibration coefficients, installed grating, wavelength range and options as well as the spectrometer serial nr.
Please make sure to save this document in a secure place.

Upgrades

Customers sometimes find that they need Avantes to make a change to or to upgrade their system. In order for Avantes to make these changes, the customer must first contact us and obtain a Return For Upgrade (RFU) 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:

Avantes Technical Support

Soerense Zand Noord 26

NL-6961 RB Eerbeek

The Netherlands

Tel. +31-(0) 313-670170, Fax. +31-(0) 313-670179

www.avantes.com, info@avantes.com

1 Quick Start

The AvaSpec spectrometers are easy to set up, allowing the user to start collecting data within minutes. The pages in this section provide instructions on setting up your system, installing and configuring the software and connecting sampling optics.

1.1 Installing the AvaSpec

First install the AvaSoft software from the CD-rom, before you connect your AvaSpec spectrometer to your computer. If you connect the AvaSpec first, you will not be able to use your spectrometer. One of the options in the main menu which is shown after the CD-rom is inserted in the CD-rom drive, is to install AvaSoft software. After selecting this option, a submenu is displayed in which the spectrometer configuration can be selected. The AvaSpec-USB1 group of spectrometers should be selected to install AvaSoft for one of the following spectrometer types:

- AvaSpec-128 or AvaSpec128-y
- AvaSpec-256 or AvaSpec256-y
- AvaSpec-1024 or AvaSpec1024-y
- AvaSpec-2048 or AvaSpec2048-y
- AvaSpec-2048FT or AvaSpec2048FT-y

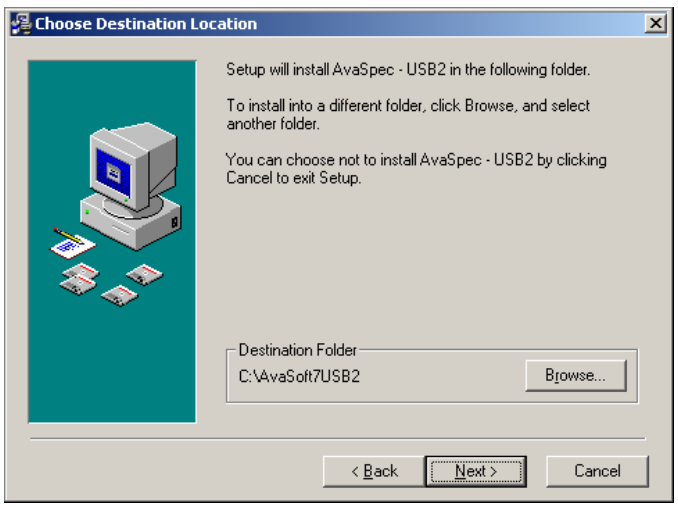
In which y represents the number of spectrometer channels.
The AvaSpec-USB2 group of spectrometers should be selected to install AvaSoft7 for one of the following spectrometer types:
AvaSpec-128/256/1024/2048/2048L/2048x14/3648/ULS2048/NIR256-USB2.
Other Avantes Products for which AvaSoft can be installed are AvaMouse for which a separate manual is available.
Instructions below are for the AvaSpec-USB1 and -USB2 spectrometers, -Bluetooth® instructions are found in section 1.1.1.

New since AvaSoft 7.3.1 Windows-Vista 64 bit support for AvaSpec-USB2 platform only

New AS5216.DLL with support for Windows Vista x64. The AS5216.DLL now detects whether it is running on a 64 bit version of Windows, and will then use the WinUSB device driver, instead of the 32 bit Avsusb2.sys kernel mode device driver. WinUSB is Microsoft's own USB driver, that is distributed with Vista. The install package for the as5216.dll will configure WinUSB to support the AS5216 hardware. The DLL and AvaSoft are all still 32 bit programs, but they will now work on Vista x64 (in the so-called WoW64 mode).

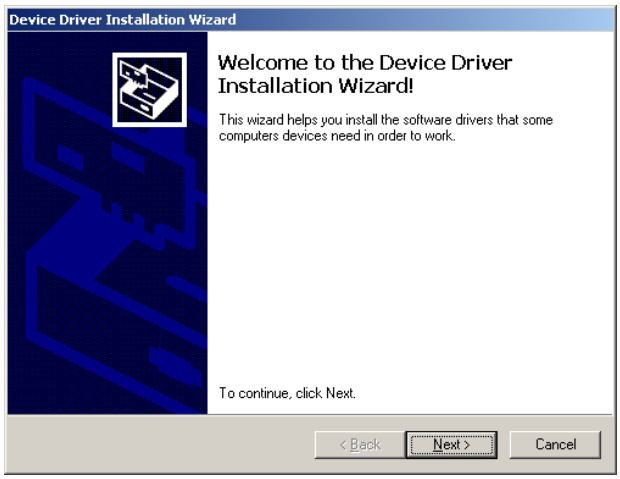
Installation Dialogs

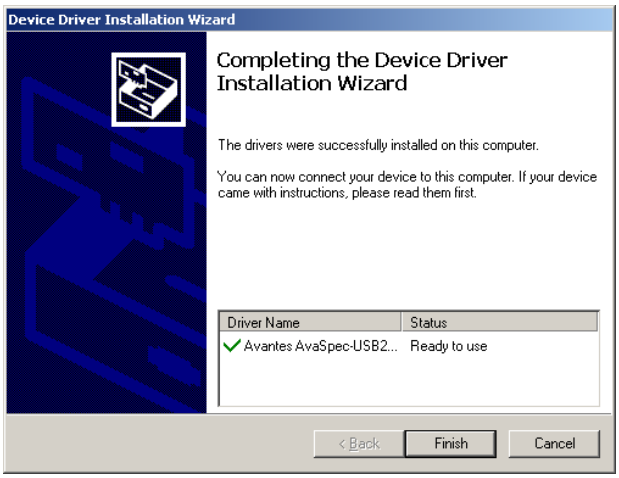
The setup program will check the system configuration of the computer. If no problems are detected, the first dialog is the "Welcome" dialog with some general information.
In the next dialog, the destination directory for the AvaSoft software can be changed. The default destination directory is C:\AVASOFT7USB2. 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.

During this installation, the installation program will check if the most recent USB driver has been installed already at the PC. If no driver is found, or if the driver needs to be upgraded, the Device Driver Installation Wizard is launched automatically, click Next

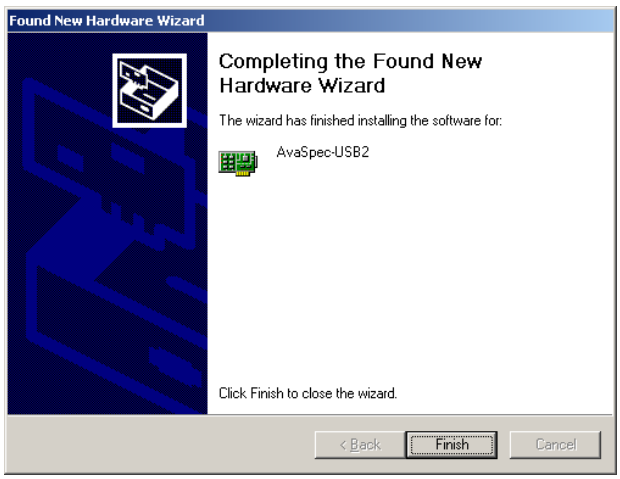




After the drivers have been installed successfully, the dialog at the right is displayed, click Finish.
After all files have been installed, the “Installation Complete” dialog shows up. Click Finish.

Connecting the hardware

Connect the USB connector to a USB port on your computer with the supplied USB cable. Windows will display the “Found New Hardware” dialog. Select the (default) option to install the software automatically, and click next. After the Hardware Wizard has completed, the following dialog is displayed:



Click Finish to complete the installation.

Please note that if the spectrometer is Connected to another USB port to which it has not been connected before, the “Found New Hardware Wizard” will need to install the software for this port as well. For this reason, this Wizard will run “NrOfChannel” times for a multichannel AvaSpec-USB2 spectrometer system. This, because inside the housing, the USB ports for each spectrometer channel is connected to a USB-Hub.
Windows Vista will install the driver automatically, without displaying the “Found New Hardware Wizard” dialogs

1.1.1 Bluetooth installation

The AvaSpec spectrometers with Bluetooth® wireless data transfer support are shipped with a Bluesoleil BS001 USB dongle. The Bluetooth® drivers can be installed from the Avantes product CD-ROM. This section describes how to setup Bluetooth® data communication with the AvaSpec-BT spectrometer.

Install AvaSoft for USB2 spectrometers from the Avantes Product CD-ROM

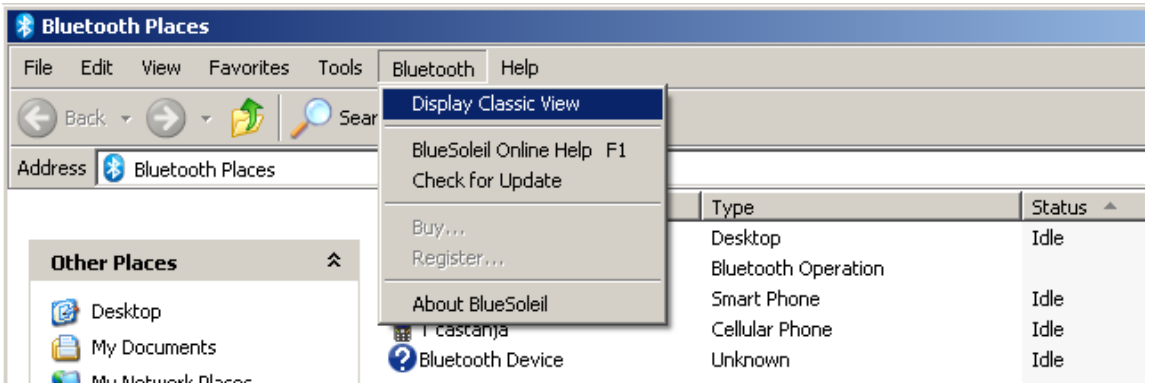
Insert the Avantes Product CD-ROM in the CD drive of your PC, select "Software Installation" and install AvaSoft.

Install Bluetooth® drivers

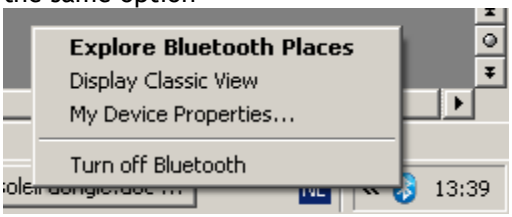
The option to install the Bluesoleil Bluetooth Drivers can also be found in the "Software Installation" section of the Avantes Product CD-ROM. Click this option to install the Bluetooth drivers for the BS001 USB dongle. After the installation has been completed you will be asked to restart the computer. After the restart, insert the BS001 USB dongle.



The "Bluetooth Places" Window in the figure below can be opened by double clicking the bluetooth icon at the desktop. In this window, go to the Bluetooth menu and select "Display Classic View"



A shortcut to setup the Classic View is to right click the Bluetooth icon in the taskbar which shows the same option



Connect the 12 VDC external power supply or batterypack to the AvaSpecSpec

First make sure that the Batterypack is completely charged, if not connect the batterypack to the charger and let it charge until the LED on the charger starts to flicker (trickle-charge mode). Now connect the batterypack to the AvaSpec and switch on the batterypack (switch on the frontside) and switch on the AvaSpec to external power. In the Classic View, the AvaSpec will initially be displayed as a Bluetooth Device. The icon is a question mark.



By double clicking the question mark icon, the serial port icon will be high lighted:



By double clicking the Serial Port icon, the connection will be established and a virtual serial port number will be assigned:

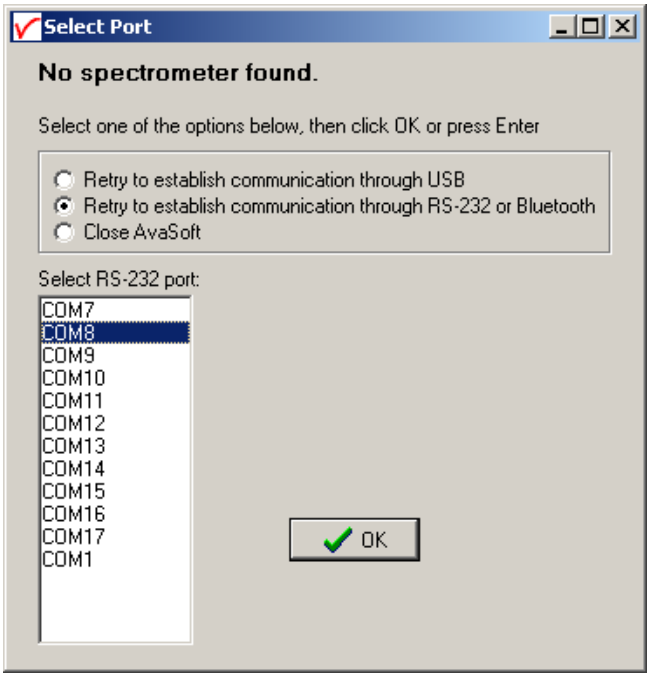


This serial port number (COM21 in this example) will be needed later on in AvaSoft. The color of the Bluetooth Device icon changes to green, and a dotted line with moving red dot between the PC (yellow bowl in the center) and the Bluetooth Device (AvaSpec) illustrates that the connection has been established successfully



Starting AvaSoft

AvaSoft can be started after data communication has been established. The first time that AvaSoft is started for the Bluetooth spectrometer, it will show the dialog at the right.
Click the option: “Retry to establish communication through RS-232 or Bluetooth”. A list with available comports will be displayed. In our example, COM8 has been selected for the Bluetooth® data communication. Select the right COM port from the list and click OK. AvaSoft will now read the configuration data from the spectrometer (this can take about 15 seconds), after which measurements can be started.

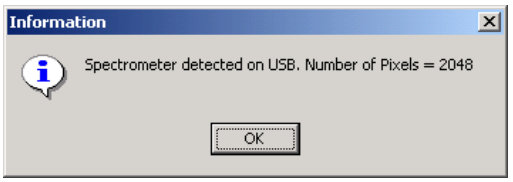


1.2 Launching the software

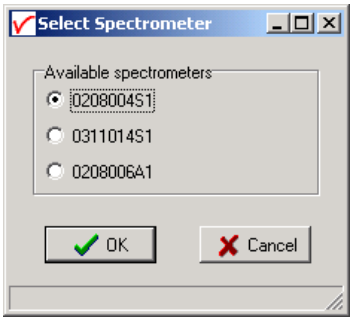
AvaSoft can be started from Windows Start Menu. Under Start-programs, the group “AVANTES Software” has been added. This group contains two icons. With the red “V” icon, AvaSoft is started. The AvaSoft Help icon can be used to activate the AvaSoft help files (these help files can also be activated from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

1.2.1 USB1 platform

After starting AvaSoft, the dialog at the right will be shown to indicate that the USB connection has been detected (a similar dialog will be shown if the serial RS-232 interface is used):



If more than one AvaSpec spectrometer is connected to your PC, the dialog at the right will be shown which allows you to select the spectrometer serial number for which you want to use AvaSoft. With USB1 platform spectrometers you can run multiple spectrometers simultaneously, just by restarting AvaSoft multiple times. After clicking the OK button, the main window is displayed.



1.2.2 USB2 platform

After starting the AvaSoft 7 software, all connected spectrometers will be recognized automatically and the serialnrs will appear as labels on the right hand of the screen. After clicking the start button all connected spectrometers will be displayed in the main window.

Refer to section 3 for a description about the main window components. A “Quick Start” can be found in section 1.3, if you want to start measuring immediately. Detailed information about the menu options are found in section 3. Depending on the AvaSoft version (Basic or Full) and the extra add-on modules that were ordered for your spectrometer, up to six applications are available in AvaSoft-full, which are described in the separate AvaSoft-full manual:

- History (standard in AvaSoft FULL)
- Wavelength Calibration (standard in AvaSoft FULL)
- Color Measurement (add-on module)
- Irradiance Measurement(add-on module)
- Process Control (add-on module)
- Excel Output (add-on module)
- Oxygen (add-on module)
- Chemometry (add-on module)

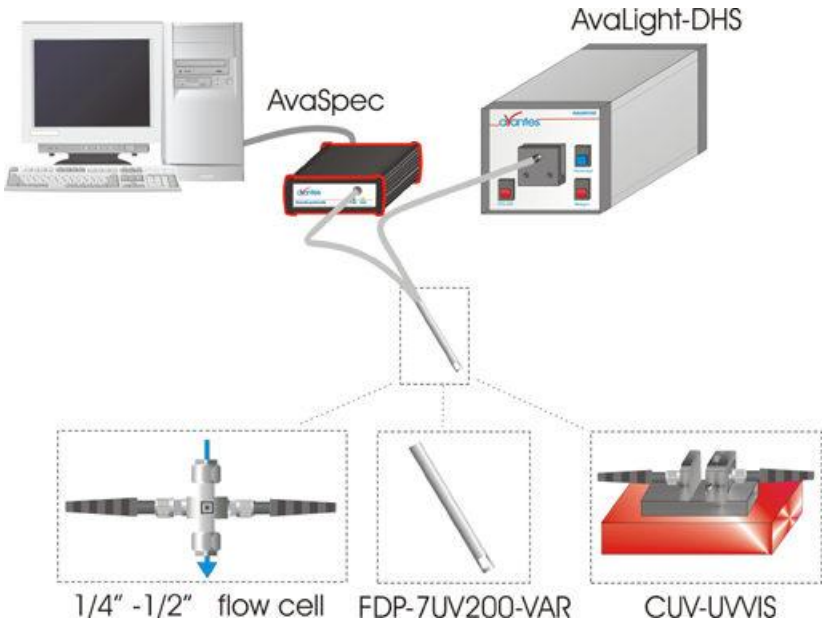
1.3 Measuring and saving a spectrum

1. After starting AvaSoft, the green Start button needs to be clicked to start measuring.
2. Connect a fiber or probe to the light source and to the spectrometer input port(s) and set up the experiment for taking a reference spectrum.
3. Adjust the Smoothing Parameters in the Setup menu (section 3.2.2) to optimize smoothing for the Fiber/Slit diameter that is used (for –USB2 platform AvaSpecs optimal smoothing is preset and stored on board in the EEPROM).
4. 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 saturated shown as a straight line at the maximum counts and the appearance of the label “saturated” in the statusbar of the spectrometer channel. 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 (USB1). 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 90% of the full ADC scale (14750 counts for the 14bit ADC, 59000 counts for the 16bit ADC). When at minimum integration the signal is still too high, an attenuator, 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.
5. When a good spectrum is displayed, turn off the light source.
6. 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.
7. 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/R 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’.
8. 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.
9. 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 (USB1 platform).

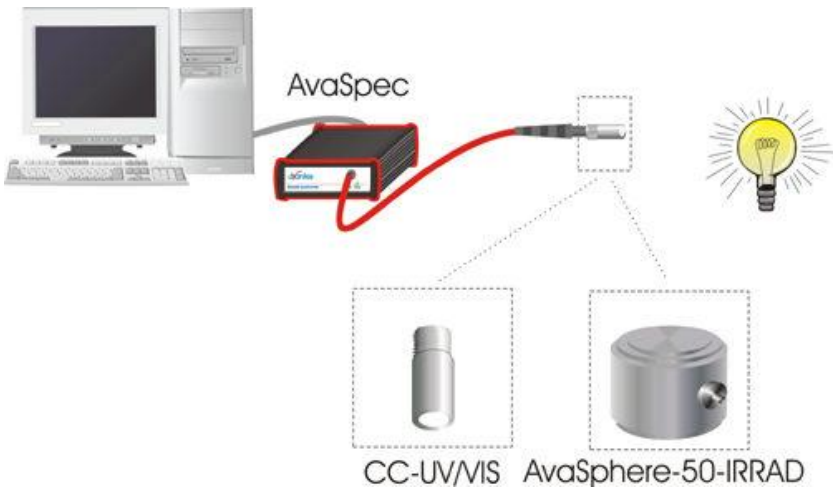
The following are typical configurations for absorbance, transmission, irradiance, and reflection experiments.

1.4 Measurement Setup

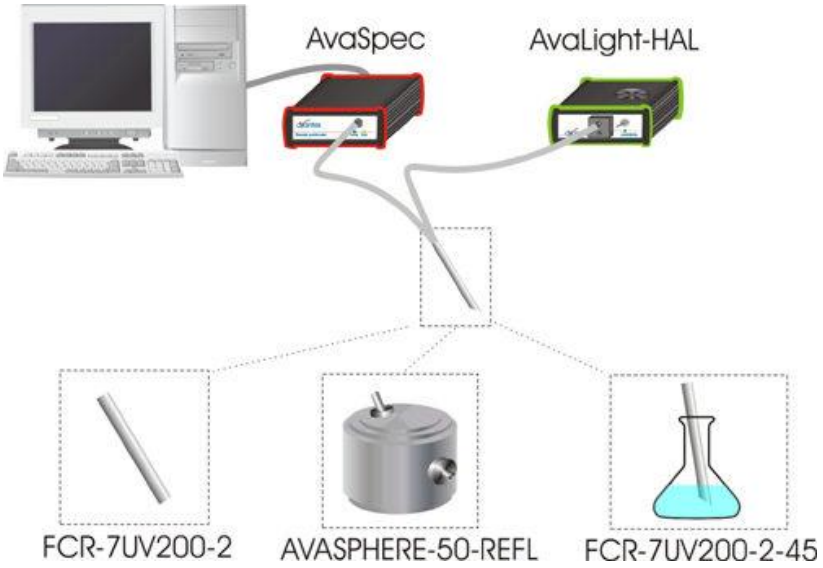
UV/VIS Absorbance/Transmission Setup



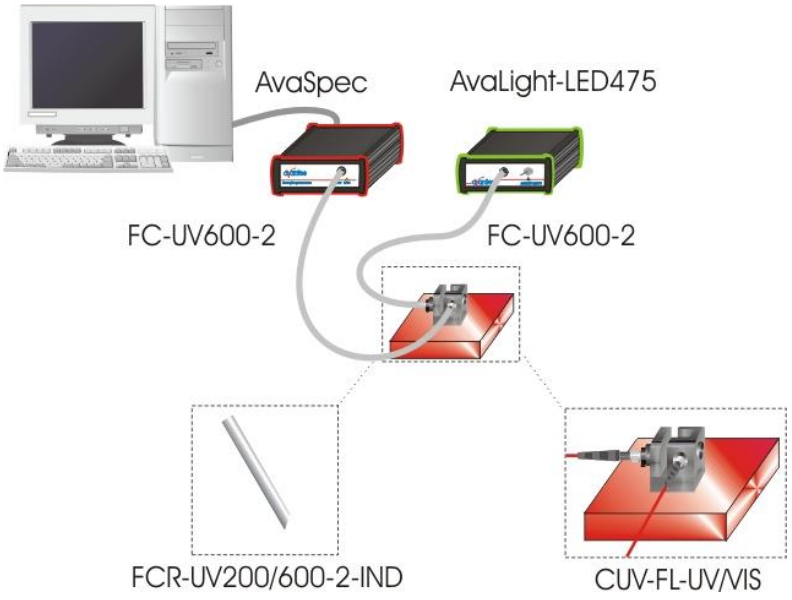
Irradiance Setup



Reflection Setup



Fluorescence Setup



2 Miniature Fiber Optic Spectrometers

With the introduction of the USB2 platform spectrometers the setup of this chapter has slightly changed, first you will find all spectrometers by ordering code and then you will find last paragraphs of this chapter the connections for both USB1 platform and USB2 platform.

2.1 AvaSpec-128 Fiber Optic Spectrometer



The AvaSpec-128 Fiber Optic Spectrometer is based on the AvaBench-45 symmetrical Czerny-Turner design with 128 pixel Photo Diode Array. The spectrometer has a fiber optic entrance connector (standard SMA, others possible), collimating and focusing mirror and diffractional grating. A choice of 11 different gratings with different dispersion and blaze angles enable applications in the 360-1100nm range. The AvaSpec-128 can be delivered with 2 platforms of electronics; either with USB1.1 with 14 bit AD converter or the new USB2.0 with 16 bit AD converter. Applications for this instrument are low cost color measurements. Digital IO ports enable external triggering and control of shutter and pulsed light sources from the Avantes line of instruments.

The AvaSpec-128 is also available as dual channel or multiple channel instrument (up to 8 channels), where all spectra are taken simultaneously.
The AvaSpec-128 comes with AvaSoft-basic, a complete manual, USB interface cable and a PS-12V/1.0A power supply. AvaSoft-full and application software can be ordered separately.
Alternatively the AvaSpec-128-SPU has a switch to run on USB power or external power.
The new AvaSpec-USB2 has a USB2 interface with ultrafast datasampling of 8000 spectra per second (with on board averaging) and datatransfer in 1.1msec and supports analog in-and outputs as well.
Optional Bluetooth® (-BT) communication and an SD card for on-board saving of spectra can be added. Multiple (up to 127) USB2 spectrometers with different detector types can be externally coupled.
AvaSoft-full and application software can be ordered separately.

Technical Data

Spectrometer platform	**AvaSpec-128**	**AvaSpec-128-USB2**
Optical Bench	Symmetrical Czerny-Turner, 45 mm focal length	
Wavelength range	360-1100 nm	
Resolution	1.4 –64 nm, depending on configuration (see table)	
Stray light	< 0.3%	
Sensitivity (AvaLight-HAL, 8 µm fiber) counts/µW per ms integration time	1000 (14-bit AD)	4000 (16-bit AD)
Detector	Photo diode array, 128 pixels	
Signal/Noise	500:1	

AD converter	14 bit, 1.33 MHz	16 bit, 2 MHz
Integration time	1 msec – 60 sec	0.06 msec – 10 minutes
Interface	USB 1.1, 12 Mbps RS-232, 115.200 bps	USB 2.0 high speed, 480 Mbps RS-232, 115.200 bps
Sample speed with on-board averaging	3 msec	0.12 msec
Data transfer speed	6-7 ms / scan (depending on # pixels transferred)	1.1 msec / scan
Digital IO	DB-15 connector, 2 Digital in, 12 Digital out	HD-26 connector, 2 Analog in, 2 Analog out, 3 Digital in, 12 Digital out, trigger, sync.
Power supply	12 VDC, reverse polarity protection ,160 mA (PS-12V/1.0A) or 5VDC USB power	Default USB power, 350 mA Or with SPU2 external 12VDC, 350 mA
Dimensions, weight	175 x 110 x 44 mm(1 channel), 716 grams 175 x 165 x 85 mm (2 channel), 1.700 grams	175 x 110 x 44 mm(1 channel), 716 grams

Grating selection table for AvaSpec-128

Use	Useable range	Spectral range (nm)	Lines/mm	Blaze (nm)	Order code
VIS/NIR	360-1100	400	300	300	UA
VIS	360-750	100	1200	250	UC
VIS	360-850	200	600	400	BB
VIS/NIR	360-1100*	740*	150	500	VZ
VIS/NIR	360-1100	400	300	500	VA
VIS	360-850	200	600	500	VB
VIS	400-980	100	1200	500	VC
NIR	500-935	200	600	750	NB
NIR	500-1000	100	1200	750	NC
NIR	600-1100	400	300	1000	IA
NIR	600-1100	200	600	1000	IB

** please note that not all 128 pixels will be used for the useable range*

Resolution table (FWHM) for AvaSpec-128

Slit size (µm)				
Grating (lines/mm)	**50**	**100**	**200**	**500**
150	13.0	13.0	26.0	64.0
300	6.4	6.4	13.0	32.0
600	3.0	3.0	6.0	16.0
1200	1.5	1.5	3.0	8.0

Ordering Information

AvaSpec-128	Fiber Optic Spectrometer, 45 mm Avabench, 128 pixel PDA detector, USB1.1/RS-232 interface, incl AvaSoft-Basic, USB interface cable and a PS-12V/1.0A power supply, specify grating, wavelength range and options
AvaSpec-128-USB2	Fiber Optic Spectrometer, 45 mm Avabench, 128 pixel PDA detector, USB powered high speed USB2 interface, incl AvaSoft-Basic, USB interface cable, specify grating, wavelength range and options
AvaSpec-128-2	Dual Channel Fiber Optic Spectrometer, 2 * 45 mm Avabench, 128 pixel PDA detector, USB1.1/RS-232 interface, incl AvaSoft-Basic, USB interface cable and a PS-12V/1.0A power supply, for both channels specify grating, wavelength range and options

Options

-SPU	incl. switch for USB powered USB1 or external power for RS232
-SPU2	incl. switch for USB powered USB2 or external power for RS232
-SPU2-BT	Bluetooth® interface for USB2 platform only, including antenna and switch
SDXXX	Internal XXX MB SD card for on board data saving, for USB2 platform only
DCL-VIS	Detector collection lens to enhance sensitivity, PMMA, 360-1100nm
SLIT-XX	Slit size, please specify XX = 50, 100, 200, 500 µm
OSF-YYY	Order sorting filter for 2nd order effects filtering, please specify YY= 385, 475, 515, 550, 600 nm

N.B. In order to change a grating, wavelength range or any of the options, the unit needs to be returned to Avantes manufacturing, please ask for an RFU number (see page 4 of this manual). The cost for the so-called AvaSpec-Upgrade depends on the modification that needs to be done.

2.2 AvaSpec-256 Fiber Optic Spectrometer

AvaSpec-256



The AvaSpec-256 Fiber Optic Spectrometer is based on the AvaBench-45 symmetrical Czerny-Turner design with 256 pixel CMOS Detector Array. The spectrometer has a fiber optic entrance connector (standard SMA, others possible), collimating and focusing mirror and diffractional grating. A choice of 13 different gratings with different dispersion and blaze angles enable applications in the 200-1100nm range. The AvaSpec-256 can be delivered with 2 platforms of electronics; either with USB1.1 with 14 bit AD converter or the new USB2.0 interface with 16 bit AD converter.
The AvaSpec-256 is specially suitable for low noise applications. Digital IO ports enable external triggering and control of shutter and pulsed light sources from the Avantes line of instruments.

The AvaSpec-256 is also available as dual channel or multiple channel instrument (up to 8 channels), where all spectra are taken simultaneously.
The AvaSpec-256 comes with AvaSoft-basic, a complete manual, USB interface cable and a PS-12V/1.0A power supply. AvaSoft-full and application software can be ordered separately.
Alternatively the AvaSpec-256-SPU has a switch to run on USB power or external power.
The new AvaSpec-USB2 has a USB2 interface with ultrafast datasampling of 1500 spectra per second (with on board averaging) and datatransfer in 1.5msec and supports analog in-and outputs as well. Optional Bluetooth® (-BT) communication and an SD card for on-board saving of spectra can be added. The AvaSpec-256-USB2 runs on USB power and comes with AvaSoft-basic, a complete manual and USB interface cable. Multiple (up to 127) USB2 spectrometers with different detector types can be externally coupled. AvaSoft-full and application software can be ordered separately.

Technical Data

Spectrometer platform	**AvaSpec-256**	**AvaSpec-256-USB2**
Optical Bench	Symmetrical Czerny-Turner, 45 mm focal length	
Wavelength range	200-1100 nm	
Resolution	0.4 -64 nm, depending on configuration (see table)	
Stray light	< 0.2%	
Sensitivity (AvaLight-HAL, 8 µm fiber) counts/µW per ms integration time	30 (14-bit AD)	120 (16-bit AD)
Detector	CMOS linear array, 256 pixels	
Signal/Noise	2000:1	
AD converter	14 bit, 330 kHz	16 bit, 500 kHz
Integration time	2 msec – 60 seconds	0.6 msec – 10 minutes

Interface	USB 1.1, 12 Mbps RS-232, 115.200 bps	USB 2.0 high speed, 480 Mbps RS-232, 115.200 bps
Sample speed with on-board averaging	4 msec / scan	0.6 msec /scan
Data transfer speed	7-9 ms / scan (depending on # pixels transferred)	1.5 ms / scan
Digital IO	DB-15 connector, 2 Digital in, 12 Digital out	HD-26 connector, 2 Analog in, 2 Analog out, 3 Digital in, 12 Digital out, trigger, sync.
Power supply	12 VDC, reverse polarity protection, 160 mA (PS-12V/1.0A) or 5VDC USB power	Default USB power, 350 mA Or with SPU2 external 12VDC, 350 mA
Dimensions, weight	175 x 110 x 44 mm (1 channel), 716 grams 175 x 165 x 85 mm (2 channel), 1.700 grams	175 x 110 x 44 mm(1 channel), 716 grams

Grating selection table for AvaSpec-256

Use	Useable range	Spectral range (nm)	Lines/mm	Blaze (nm)	Order code
UV/VIS/NIR	200-1100*	900*	122	250	UZ
UV/VIS/NIR	200-1100	400	300	300	UA
UV/VIS	200-850	200	600	300	UB
UV	200-750	100	1200	250	UC
UV/VIS	250-850	200	600	400	BB
VIS/NIR	300-1100*	800*	150	500	VZ
VIS/NIR	300-1100	400	300	500	VA
VIS	360-1000	200	600	500	VB
VIS	300-800	100	1200	500	VC
NIR	500-1050	200	600	750	NB
NIR	500-1050	100	1200	750	NC
NIR	600-1100	400	300	1000	IA
NIR	600-1100	200	600	1000	IB

** please note that not all 256 pixels will be used for the useable range*

Resolution table (FWHM) for AvaSpec-256

Slit size (µm)					
Grating (lines/mm)	**25**	**50**	**100**	**200**	**500**
122	5.5	7.9	15.7	32.0	79.0
150	4.5	6.4	12.8	26.0	64.0
300	2.5	3.2	6.4	13.0	32.0
600	1.0	1.5	3.0	6.0	16.0
1200	0.5	0.8	1.5	3.0	8.0

Ordering Information

AvaSpec-256	Fiber Optic Spectrometer, 45 mm Avabench, 256 pixel CMOS detector, USB1.1/RS-232 interface, incl AvaSoft-Basic, USB cable and PS-12V/1.0A power supply ,specify grating, wavelength range and options
AvaSpec-256-USB2	Fiber Optic Spectrometer, 45 mm Avabench, 256 pixel CMOS detector, USB powered high speed USB2 interface, incl. AvaSoft-Basic, USB interface cable, specify grating, wavelength range and options
AvaSpec-256-2	Dual channel Fiber Optic Spectrometer, 2 * 45 mm Avabench, 256 pixel CMOS detector, USB1.1/RS-232 interface, incl AvaSoft-Basic, USB cable and PS-12V/1.0A power supply ,for both channels specify grating, wavelength range and options

Options

-SPU	incl. switch for USB powered USB1 or external power for RS232
-SPU2	incl. switch for USB powered USB2 or external power for RS232
-SPU2-BT	Bluetooth® interface for USB2 platform only, including antenna and switch
SDXXX	Internal XXX MB SD card for on board data saving, for USB2 platform only
SLIT-XX	Slit size, please specify XX = 25, 50, 100, 200, 500 µm
OSF-YYY	Order sorting filter for 2nd order effects filtering, please specify YY= 385, 475, 515, 550, 600nm

N.B. In order to change a grating, wavelength range or any of the options, the unit needs to be returned to Avantes manufacturing, please ask for an RFU number (see page 4 of this manual). The cost for the socalled AvaSpec-Upgrade depends on the modification that needs to be done.

2.3 AvaSpec-1024 Fiber Optic Spectrometer

AvaSpec-1024



The AvaSpec-1024 Fiber Optic Spectrometer is based on the AvaBench-75 symmetrical Czerny-Turner design with 1024 pixel CMOS Detector Array. The spectrometer has a fiber optic entrance connector (Standard SMA, others possible), collimating and focusing mirror and diffractional grating. A choice of 16 different gratings with different dispersion and blaze angles enable applications in the 200-1100nm range. The AvaSpec-1024 can be delivered with 2 platforms of electronics; either with USB1.1 with 14 bit AD converter or the new USB2.0 interface with 16 bit AD converter.
The AvaSpec-1024 is specially suitable for low noise applications with good resolution. Digital IO ports enable external triggering and control of shutter and pulsed light sources from the Avantes line of instruments.

The AvaSpec-1024 is also available as dual channel or multiple channel instrument (up to 8 channels), where all spectra are taken simultaneously.
The AvaSpec-1024 comes with AvaSoft-basic, a complete manual, USB interface cable and a PS-12V/1.0A power supply. AvaSoft-full and application software can be ordered separately.
Alternatively the AvaSpec-1024-SPU has a switch to run on USB power or external power.
The new AvaSpec1024-USB2 has a USB2 interface with ultrafast datasampling of 450 spectra per second and datatransfer in 2.2msec and supports analog in-and outputs as well. Optional Bluetooth® (-BT) communication and an SD card for on-board saving of spectra can be added. The AvaSpec-1024-USB2 runs on USB power and comes with AvaSoft-basic, a complete manual and USB interface cable. Multiple (up to 127) USB2 spectrometers with different detector types can be externally coupled

Technical Data

Spectrometer platform	**AvaSpec-1024**	**AvaSpec-1024-USB2**
Optical Bench	Symmetrical Czerny-Turner, 75 mm focal length	
Wavelength range	200-1100 nm	
Resolution	0.07 –20 nm, depending on configuration (see table)	
Stray light	< 0.1%	
Sensitivity (AvaLight-HAL, 8 µm fiber) counts/µW per ms integration time	30	120
Detector	CMOS linear array, 1024 pixels	
Signal/Noise	2.000:1	
AD converter	14 bit, 330 kHz	16 bit, 500 kHz
Integration time	4 msec – 60 seconds	2.2 msec – 10 min.

Interface	USB 1.1, 12 Mbps RS-232, 115.200 bps	USB 2.0 high speed, 480 Mbps RS-232, 115.200 bps
Sample speed with on-board averaging	12 msec / scan	2.2 msec /scan
Data transfer speed	12-20 ms / scan (depending on # pixels transferred)	2.2 msec /scan
Digital IO	DB-15 connector, 2 Digital in, 12 Digital out	HD-26 connector, 2 Analog in, 2 Analog out, 3 Digital in, 12 Digital out, trigger, sync.
Power supply	12 VDC, reverse polarity protection, 160 mA (PS-12V/1.0A) or 5VDC USB power	Default USB power, 350 mA Or with SPU2 external 12VDC, 350 mA
Dimensions, weight	175 x 110 x 44 mm (1 channel), 716 grams 175 x 165 x 85 mm (2 channel), 1.700 grams	175 x 110 x 44 mm(1 channel), 716 grams

Grating selection table for AvaSpec-1024

Use	Useable range	Spectral range (nm)	Lines/mm	Blaze (nm)	Order code
UV/VIS/NIR	200-1100*	900*	300	300	UA
UV/VIS	200-850	450	600	300	UB
UV	200-750	220	1200	250	UC
UV	200-650	160	1800	UV	UD
UV	200-580	100	2400	UV	UE
UV	220-400	50	3600	UV	UF
UV/VIS	250-850	450	600	400	BB
VIS/NIR	300-1100*	800*	300	500	VA
VIS	360-1000	450	600	500	VB
VIS	300-800	220	1200	500	VC
VIS	350-750	160	1800	500	VD
VIS	350-640	75	2400	VIS	VE
NIR	500-1050	450	600	750	NB
NIR	500-1000	200	1200	750	NC
NIR	600-1100*	500*	300	1000	IA
NIR	600-1100	450	600	1000	IB

** please note that not all 1024 pixels will be used for the useable range*

Resolution table (FWHM) for AvaSpec-1024

Slit size (µm)					
Grating (lines/mm)	**25**	**50**	**100**	**200**	**500**
300	1.2	2.4	4.3	8.0	20.0
600	0.8	1.2	2.1	4.1	10.0
1200	0.4	0.5	1.0	2.0	5.0
1800	0.3	0.4	0.8	1.4	3.5
2400	0.2	0.25	0.5	1.0	2.5
3600	0.15	0.20	0.4	0.6	1.5

Ordering Information

AvaSpec-1024	Fiber Optic Spectrometer, 75 mm Avabench, 1024 pixel CMOS detector, USB1.1/RS-232 interface, incl AvaSoft-Basic, USB cable and PS-12V/1.0A power supply ,specify grating, wavelength range and options
AvaSpec-1024-USB2	Fiber Optic Spectrometer, 75 mm Avabench, 1024 CMOS detector, USB powered high speed USB2 interface, incl AvaSoft-Basic, USB interface cable, specify grating, wavelength range and options
AvaSpec-1024-2	Dual channel Fiber Optic Spectrometer, 2 * 75 mm Avabench, 1024 pixel CMOS detector, USB1.1/RS-232 interface, incl AvaSoft-Basic, USB cable and PS-12V/1.0A power supply ,for both channels specify grating, wavelength range and options

Options

-SPU	incl. switch for self powered USB1 or external power for RS232
-SPU2	incl. switch for self powered USB2 or external power for RS232
-SPU2-BT	Bluetooth® interface for USB2 platform only, including antenna and switch
SDXXX	Internal XXX MB SD card for on board data saving, for USB2 platform only
SLIT-XX	Slit size, please specify XX = 25, 50, 100, 200, 500 µm
OSF-YYY	Order sorting filter for 2nd order effects filtering, please specify YY= 375, 475, 515, 550, 600 nm
OSC	Order sorting coating with 590nm long pass filter for VA, BB (>350nm) and VB gratings in AvaSpec-1024
OSC-UA	Order sorting coating with 350 and 590nm longpass filter for UA gratings in AvaSpec-1024
OSC-UB	Order sorting coating with 350 and 590nm longpass filter for UB or BB (<350nm) gratings in AvaSpec-1024

N.B. In order to change a grating, wavelength range or any of the options, the unit needs to be returned to Avantes manufacturing, please ask for an RFU number (see page 4 of this manual). The cost for the socalled AvaSpec-Upgrade depends on the modification that needs to be done.

2.4 AvaSpec-2048 Fiber Optic Spectrometer

AvaSpec-2048



The AvaSpec-2048 Fiber Optic Spectrometer is based on the AvaBench-75 symmetrical Czerny-Turner design with 2048 pixel CCD Detector Array. The spectrometer has a fiber optic entrance connector (standard SMA, others possible), collimating and focusing mirror and diffractional grating. A choice of 16 different gratings with different dispersion and blaze angles enable applications in the 200-1100nm range. The AvaSpec-2048 can be delivered with 2 platforms of electronics; either with USB1.1 with 14 bit AD converter or the new USB2.0 interface with 16 bit AD converter.The AvaSpec-2048 is especially suitable for low light level and high resolution applications. An optional detector coating enhances the CCD performance for the UV range and a detector collection lens offers high sensitivity. Digital IO ports enable external triggering and control of shutter and pulsed light sources from the Avantes line of instruments.

The AvaSpec-2048 is also available as dual channel or multiple channel instrument (up to 8 channels), where all spectra are taken simultaneously.
The AvaSpec-2048 comes with AvaSoft-basic, a complete manual, USB interface cable and a PS-12V/1.0A power supply. AvaSoft-full and application software can be ordered separately. Alternatively the AvaSpec-2048-SPU has a switch to run on USB power or external power.

The new AvaSpec2048-USB2 has a USB2 interface with ultrafast datasampling of 500 spectra per second and datatransfer in 2msec and supports analog in-and outputs as well. Optional Bluetooth® (-BT) communication and an SD card for on-board saving of spectra can be added. The AvaSpec-2048-USB2 runs on USB power and comes with AvaSoft-basic, a complete manual and USB interface cable. Multiple (up to 127) USB2 spectrometers with different detector types can be externally coupled.

Technical Data

Spectrometer platform	**AvaSpec-2048**	**AvaSpec-2048-USB2**
Optical Bench	Symmetrical Czerny-Turner, 75 mm focal length	
Wavelength range	200-1100 nm	
Resolution	0.04 –20 nm, depending on configuration (see table)	
Stray light	< 0.1%	
Sensitivity (AvaLight-HAL, 8 µm fiber) counts/µW per ms integration time	5000 (14-bit AD converter)	20,000 (16-bit AD converter)
Detector	CCD linear array, 2048 pixels	
Signal/Noise	200:1	

AD converter	14 bit, 1.33 MHz	16 bit, 2 MHz
Integration time	2 msec – 60 seconds	1.1 ms – 10 min.
Interface	USB 1.1, 12 Mbps RS-232, 115.200 bps	USB 2.0 high speed, 480 Mbps RS-232, 115.200 bps
Sample speed with on-board averaging	17 msec / scan	1.11 msec /scan
Data transfer speed	14-31 ms / scan (depending on # pixels transferred)	1.8 msec /scan
Digital IO	DB-15 connector, 2 Digital in, 12 Digital out	HD-26 connector, 2 Analog in, 2 Analog out, 3 Digital in, 12 Digital out, trigger, sync.
Power supply	12 VDC, reverse polarity protection, 160 mA (PS-12V/1.0A) or 5VDC USB power	Default USB power, 350 mA Or with SPU2 external 12VDC, 350 mA
Dimensions, weight	175 x 110 x 44 mm (1 channel), 716 grams 175 x 165 x 85 mm (2 channel), 1.700 grams	175 x 110 x 44 mm(1 channel), 716 grams

Grating selection table for AvaSpec-2048

Use	**Useable range**	**Spectral range (nm)**	**Lines/mm**	**Blaze (nm)**	**Order code**
UV/VIS/NIR	200-1100**	900**	300	300	UA
UV/VIS	200-850	520	600	300	UB
UV	200-750	250-220*	1200	250	UC
UV	200-650	165-145*	1800	UV	UD
UV	200-580	115-70*	2400	UV	UE
UV	220-400	70-45*	3600	UV	UF
UV/VIS	250-850	520	600	400	BB
VIS/NIR	300-1100**	800**	300	500	VA
VIS	360-1000	500	600	500	VB
VIS	300-800	250-200*	1200	500	VC
VIS	350-750	145-100*	1800	500	VD
VIS	350-640	75-50*	2400	VIS	VE
NIR	500-1050	500	600	750	NB
NIR	500-1050	220-150*	1200	630	NC
NIR	600-1100**	500**	300	1000	IA
NIR	600-1100	500	600	1000	IB

** depends on the starting wavelength of the grating; the higher the wavelength, the bigger the dispersion and the smaller the range to select.*

*** please note that not all 2048 pixels will be used for the useable range*

Resolution table (FWHM) for AvaSpec-2048

Slit size (µm)						
Grating (lines/mm)	**10**	**25**	**50**	**100**	**200**	**500**
300	0.8	1.4	2.4	4.3	8.0	20.0
600	0.4	0.7	1.2	2.1	4.1	10.0
1200	0.1-0.2*	0.2-0.3*	0.4-0.6*	0.7-1.0*	1.4-2.0*	3.3-4.8*
1800	0.07-0.12*	0.12-0.21*	0.2-0.36*	0.4-0.7*	0.7-1.4*	1.7-3.3*
2400	0.05-0.09*	0.08-0.15*	0.14-0.25*	0.3-0.5*	0.5-0.9*	1.2-2.2*
3600	0.04-0.06*	0.07-0.10*	0.11-0.16*	0.2-0.3*	0.4-0.6*	0.9-1.4*

**depends on the starting wavelength of the grating; the higher the wavelength, the bigger the dispersion and the higher the resolution*

Ordering Information

AvaSpec-2048	Fiber Optic Spectrometer, 75 mm Avabench, 2048 pixel CCD detector, USB1.1/RS-232 interface, incl AvaSoft-Basic, USB cable and PS-12V/1.0A power supply ,specify grating, wavelength range and options
AvaSpec-2048-USB2	Fiber Optic Spectrometer, 75 mm Avabench, 2048 pixel CCD detector, USB powered high speed USB2 interface, incl. AvaSoft-Basic, USB interface cable, specify grating, wavelength range and options
AvaSpec-2048-2	Dual channel Fiber Optic Spectrometer, 2 * 75 mm Avabench, 2048 pixel CCD detector, USB1.1/RS-232 interface, incl AvaSoft-Basic, USB cable and PS-12V/1.0A power supply ,for both channels specify grating, wavelength range and options
Options	
-SPU	incl. switch for self powered USB1 or external power for RS232
-SPU2	incl. switch for self powered USB2 or external power for RS232
-SPU2-BT	Bluetooth® interface for USB2 platform only, including antenna and switch
SDXXX	Internal XXX MB SD card for on board data saving, for USB2 platform only
DUV	Deep UV detector coating >150 nm
DCL-UV/VIS	Detector Collection lens to enhance sensitivity, Quartz, 200-1100 nm
SLIT-XX	Slit size, please specify XX = 10, 25, 50, 100, 200, 500 µm
OSF-YYY	Order sorting filter for 2nd order effects filtering, please specify YY= 375, 475, 515, 550, 600 nm
OSC	Order sorting coating with 590nm long pass filter for VA, BB (>350nm) and VB gratings in AvaSpec-2048
OSC-UA	Order sorting coating with 350 and 590nm longpass filter for UA gratings in AvaSpec-2048
OSC-UB	Order sorting coating with 350 and 590nm longpass filter for UB or BB (<350nm) gratings in AvaSpec-2048
Purge	set of 4 mm Gasfittings for AvaSpec purging in DUV (<200nm) applications

N.B. In order to change a grating, wavelength range or any of the options, the unit needs to be returned to Avantes manufacturing, please ask for an RFU number (see page 4 of this manual). The cost for the socalled AvaSpec-Upgrade depends on the modification that needs to be done.

2.5 AvaSpec-2048L Fiber Optic Spectrometer with larger pixels

AvaSpec-2048L



The AvaSpec-2048L Fiber Optic Spectrometer has been added to the Avantes product line since January 2009 and has many technical specifications comparable to the standard AvaSpec-2048. The difference is the CCD detector, the AvaSpec-2048L uses the Sony ILX511 detector whereas the AvaSpec-2048 uses the ILX554B detector.

The AvaSpec-2048L is very useful for applications where larger fiber entrance diameter needs to be projected on the larger CCD detector pixels of 14x200µm height.

The AvaSpec-2048L also has a better signal to noise performance and shows no peak inversion and dark increase at the end of the detector array at longer integration times. The FWHM resolution of the 2048L is ca 20% less good than for the standard 2048 and also non-linearity is a little less, so a NL-calibration per channel is recommended.
All options for the AvaSpec-2048 are also available on the AvaSpec-2048L.

Technical Data

Spectrometer	**AvaSpec-2048-USB2**	**AvaSpec-2048L-USB2**
Detector	Sony ILX-554B	Sony ILX-511
Pixel size	14 X 56 µm	14 x 200µm
Sensitivity (V/lx.s)	240	200
Sensitivity (AvaLight-HAL, 8 µm fiber) counts/µW per ms integration time	20,000	20,000
Peak Wavelength	550 nm	450 nm
Signal/Noise	160:1	300:1
Dark Noise	40	24
Ext trigger delay	1.3µsec	3.0µsec

Ordering Information

AvaSpec-2048L-USB2 Fiber Optic Spectrometer, 75 mm Avabench, 2048 pixel 14x200µm CCD detector, USB powered high speed USB2 interface, incl. AvaSoft-Basic, USB interface cable, specify grating, wavelength range and options

2.6 AvaSpec-ULS2048 Ultra Low Straylight Fiber Optic Spectrometer

AvaSpec-ULS2048



The AvaSpec-ULS2048 consists of a revolutionary new optical bench optimized to reduce straylight and increase both mechanical and temperature stability. The new optical bench has a dual internal modestripper along with multiple CPC's (Compound Parabolic Concentrators) to further reduce straylight levels down to 0.04%, an improvement of a factor of 2.5 over the standard AvaSpec-2048. Along with the straylight improvement the new optical bench design features a much higher rigidity resulting in a factor of 10 decrease in strain sensitivity caused by microbending and temperature flutuations.

The new optical bench is integrated into the new AvaSpec-ULS2048, and is available for all A, B, and C gratings and for all other options that the standard AvaSpec-2048 has

The low straylight performance of the AvaSpec-ULS2048 is extremely useful in applications where high absorbance parameters need to be measured, such as those associated with high chemical concentrations, high optical density optics or long optical path lengths. The new optical bench and spectrometer are available for OEM integration in other systems as well as for purchase as individual instruments.

Technical Data

Spectrometer	AvaSpec-2048-USB2	AvaSpec-ULS2048-USB2
Typ. Straylight for UA, VA, IA gratings	0.5%	0.1%
Typ. Straylight for UB, VB, IB gratings	0.1%	0.04%
Typ. Straylight for UC, VC, IC gratings	0.1%	0.04%
Typ. Temp wavelength shift	0.15 Pixel/°C	0.1 Pixel/°C
Typ. Temp intensity change (CDD on)	1 %/°C	0.5 %/°C
Typ. Microbending* Sensitivity	3 %/N	0.3 %/N

*Microbending is defined as the signal change due to the average external force in vertical direction applied to the SMA connector.

Ordering Information

AvaSpec-ULS2048-USB2	Ultra Low Straylight Fiber Optic Spectrometer, 75 mm Avabench, 2048 pixel 14x56µm CCD detector, USB powered high speed USB2 interface, incl. AvaSoft-Basic, USB interface cable, specify grating (A-C), wavelength range and options

2.7 AvaSpec-3648 Fiber Optic Spectrometer



The AvaSpec-3648 Fiber Optic Spectrometers is based on the AvaBench-75 symmetrical Czerny-Turner design with 3648 pixel CCD Detector Array. The spectrometer has a fiber optic entrance connector (standard SMA, others possible), collimating and focusing mirror and diffractional grating. A choice of 16 different gratings with different dispersion and blaze angles enable applications in the 200-1100nm range. The AvaSpec-3648 comes with a 16 bit AD converter, and USB2.0 high speed interface. The AvaSpec- 3648 is especially suitable for measuring high speed and high resolution applications, such as LIBS and pulsed light sources. An optional detector coating can enhance the CCD performance for the UV range and a detector collection lens offers high sensitivity.
Digital IO ports enable external triggering and control of shutter and pulsed light sources from the Avantes line of instruments.
The new AvaSpec-3648 has a USB2 interface with fast data sampling of 270 spectra per second and data transfer in 3.7 msec and supports analog in-and outputs as well. Optional Bluetooth® (-BT) communication and an SD card for on-board saving of spectra can be added. The AvaSpec-3648-USB2 runs on USB power and comes with AvaSoft-basic, a complete manual and USB interface cable. Multiple (up to 127) USB2 spectrometers with different detector types can be externally coupled.

Technical Data

Optical Bench	Symmetrical Czerny-Turner, 75 mm focal length
Wavelength range	200 - 1100nm
Resolution	0.025 –20 nm, depending on configuration (see table)
Stray light	< 0.1%
Sensitivity (AvaLight-HAL, 8 µm fiber)	14,000 counts (16-bit AD)/µW per ms integration time
Detector	CCD linear array, 3648 pixels
Signal/Noise	350:1
AD converter	16 bit, 1 MHz
Integration time	10 µsec – 10 min.
Interface	USB 2.0 high speed, 480 Mbps RS-232, 115.200 bps
Sample speed with on-board averaging	3.7 msec /scan
Data transfer speed	3.7 msec /scan
Digital IO	HD-26 connector, 2 Analog in, 2 Analog out, 3 Digital in, 12 Digital out, trigger, synchronization
Power supply	Default USB power, 350 mA Or with SPU2 external 12VDC, 350 mA
Dimensions, weight	175 x 110 x 44 mm(1 channel), 716 grams

Grating selection table for AvaSpec-3648

Use	Useable range	Spectral range (nm)	Lines/mm	Blaze (nm)	Order code
UV/VIS/NIR	200-1100**	900**	300	300	UA
UV/VIS	200-850	520	600	300	UB
UV	200-750	250-220*	1200	250	UC
UV	200-650	165-145*	1800	UV	UD
UV	200-580	115-70*	2400	UV	UE
UV	220-400	70-45*	3600	UV	UF
UV/VIS	250-850	520	600	400	BB
VIS/NIR	300-1100**	800**	300	500	VA
VIS	360-1000	500	600	500	VB
VIS	300-800	250-200*	1200	500	VC
VIS	350-750	145-100*	1800	500	VD
VIS	350-640	75-50*	2400	VIS	VE
NIR	500-1050	500	600	750	NB
NIR	500-1050	220-150*	1200	750	NC
NIR	600-1100**	500**	300	1000	IA
NIR	600-1100	500	600	1000	IB

** depends on the starting wavelength of the grating; the higher the wavelength, the bigger the dispersion and the smaller the range to select.*
*** please note that not all 3648 pixels will be used for the useable range*

Resolution table (FWHM) for AvaSpec-3648

	Slit size (µm)					
Grating (lines/mm)	**10**	**25**	**50**	**100**	**200**	**500**
300	0.5	1.4	2.4	4.3	8.0	20.0
600	0.27	0.7	1.2	2.1	4.1	10.0
1200	0.07-0.13*	0.2-0.3*	0.4-0.6*	0.7-1.0*	1.4-2.0*	3.3-4.8*
1800	0.05-0.08*	0.12-0.21*	0.2-0.36*	0.4-0.7*	0.7-1.4*	1.7-3.3*
2400	0.04-0.07*	0.08-0.15*	0.14-0.25*	0.3-0.5*	0.5-0.9*	1.2-2.2*
3600	0.025-0.04*	0.07-0.10*	0.11-0.16*	0.2-0.3*	0.4-0.6*	0.9-1.4*

depends on the starting wavelength of the grating; the higher the wavelength, the bigger the dispersion and the better the resolution

Ordering Information

AvaSpec-3648-USB2	Fiber Optic Spectrometer, 75 mm Avabench, 3648 pixel CCD detector, USB powered high speed USB2 interface, incl AvaSoft-Basic, USB interface cable, specify grating, wavelength range and options
AvaSpec-3648-SPU2	Fiber Optic Spectrometer, 75 mm Avabench, 3648 pixel CCD detector, high speed USB2 interface, incl. switch for USB powered USB2 or external power for RS232, AvaSoft-Basic, USB interface cable, specify grating, wavelength range and options

Options

-SPU2-BT	Bluetooth® interface for USB2 platform only, including antenna
SDXXX	Internal XXX MB SD card for on board data saving, for USB2 platform only
DUV	Deep UV detector coating >150 nm
DCL-UV/VIS	Detector Collection lens to enhance sensitivity, Quartz, 200-1100 nm
SLIT-XX	Slit size, please specify XX = 10, 25, 50, 100, 200, 500 µm
OSF-YYY	Order sorting filter for 2nd order effects filtering, please specify YY= 375, 475, 515, 550, 600 nm
OSC	Order sorting coating with 590nm long pass filter for VA, BB (>350nm) and VB gratings in AvaSpec-3648
OSC-UA	Order sorting coating with 350 and 590nm longpass filter for UA gratings in AvaSpec-3648
OSC-UB	Order sorting coating with 350 and 590nm longpass filter for UB or BB (<350nm) gratings in AvaSpec-3648
Purge	set of 4 mm Gasfittings for AvaSpec purging in DUV (<200nm) applications

N.B. In order to change a grating, wavelength range or any of the options, the unit needs to be returned to Avantes manufacturing, please ask for an RFU number (see page 4 of this manual). The cost for the socalled AvaSpec-Upgrade depends on the modification that needs to be done.

2.8 AvaSpec-2048x14 High UV-sensitivity back-thinned CCD Spectrometer

AvaSpec-2048x14



The AvaSpec-2048x14 Fiber Optic Spectrometers is a back-thinned type CCD spectrometer with high quantum efficiency and high UV sensitivity. The optical design is based on the AvaBench-75 symmetrical Czerny-Turner design with a 2048x14 pixels high UV sensitive CCD image sensor. The image sensor is used as a linear array of 2048 pixels binning the vertical 14 pixels to optimize efficiency. The spectrometer has a fiber optic entrance connector (standard SMA, others possible), collimating and focusing mirror and a diffractional grating. A choice of 16 different gratings with different dispersion and blaze angles enable applications in the 200-1160nm range. The AvaSpec-2048x14 comes with a 16 bit AD converter, and USB2.0 high speed interface. The AvaSpec- 2048x14 is especially suitable for measuring low light, fluorescence and UV-applications. Digital IO ports enable external triggering and control of shutter and pulsed light sources from the Avantes line of instruments.
The new AvaSpec-2048x14 has a USB2 interface with fast data sampling of 450 spectra per second and data transfer in 2.24 msec and supports analog in-and outputs as well. Optional Bluetooth® (-BT) communication and an SD card for on-board saving of spectra can be added. The AvaSpec-2048x14-USB2 runs on USB power and comes with AvaSoft-basic, a complete manual and USB interface cable. Multiple (up to 127) USB2 spectrometers with different detector types can be externally coupled (see section multi-channel spectrometers, page 32).

Technical Data

Optical Bench	Symmetrical Czerny-Turner, 75 mm focal length
Wavelength range	200 - 1160nm
Resolution	0.04 –20 nm, depending on configuration (see table)
Stray light	< 0.1%
Sensitivity (AvaLight-HAL, 8 µm fiber)	16.000 counts (16-bit AD)/µW –per ms integration time
UV Quantum efficiency	35-65% (200-300nm)
Detector	Back-thinned CCD image sensor 2048x14 pixels
Signal/Noise	500:1
AD converter	16 bit, 1.5 MHz
Integration time	2.24 ms – 10 min.
Interface	USB 2.0 high speed, 480 Mbps RS-232, 115.200 bps
Sample speed with on-board averaging	2.24 msec /scan
Data transfer speed	2.24 msec /scan
Digital IO	HD-26 connector, 2 Analog in, 2 Analog out, 3 Digital in, 12 Digital out, trigger, synchronization
Power supply	Default USB power, 350 mA Or with SPU2 external 12VDC, 350 mA
Dimensions, weight	175 x 110 x 44 mm(1 channel), 716 grams

Grating selection table for AvaSpec-2048x14

Use	Useable range	Spectral range (nm)	Lines/mm	Blaze (nm)	Order code
UV/VIS/NIR	200-1160**	900**	300	300	UA
UV/VIS	200-850	520	600	300	UB
UV	200-750	250-220*	1200	250	UC
UV	200-650	165-145*	1800	UV	UD
UV	200-580	115-70*	2400	UV	UE
UV	220-400	70-45*	3600	UV	UF
UV/VIS	250-850	520	600	400	BB
VIS/NIR	300-1160**	800**	300	500	VA
VIS	360-1000	500	600	500	VB
VIS	300-800	250-200*	1200	500	VC
VIS	350-750	145-100*	1800	500	VD
VIS	350-640	75-50*	2400	VIS	VE
NIR	500-1050	500	600	750	NB
NIR	500-1050	220-150*	1200	750	NC
NIR	600-1160**	500**	300	1000	IA
NIR	600-1160	500	600	1000	IB

** depends on the starting wavelength of the grating; the higher the wavelength, the bigger the dispersion and the smaller the range to select.*

*** please note that not all 2048 pixels will be used for the useable range*

Resolution table (FWHM) for AvaSpec-2048x14

Slit size (µm)						
Grating (lines/mm)	**10**	**25**	**50**	**100**	**200**	**500**
300	0.8	1.4	2.4	4.3	8.0	20.0
600	0.4	0.7	1.2	2.1	4.1	10.0
1200	0.1-0.2*	0.2-0.3*	0.4-0.6*	0.7-1.0*	1.4-2.0*	3.3-4.8*
1800	0.07-0.12*	0.12-0.21*	0.2-0.36*	0.4-0.7*	0.7-1.4*	1.7-3.3*
2400	0.05-0.09*	0.08-0.15*	0.14-0.25*	0.3-0.5*	0.5-0.9*	1.2-2.2*
3600	0.04-0.06*	0.07-0.10*	0.11-0.16*	0.2-0.3*	0.4-0.6*	0.9-1.4*

**depends on the starting wavelength of the grating; the higher the wavelength, the bigger the dispersion and the better the resolution*

Ordering Information

AvaSpec-2048x14-USB2	Fiber Optic Spectrometer, 75 mm Avabench, 2048x14 pixel back-thinned CCD detector, USB powered high speed USB2 interface, incl AvaSoft-Basic, USB interface cable, specify grating, wavelength range and options
AvaSpec-2048x14-SPU2	Fiber Optic Spectrometer, 75 mm Avabench, 2048x14 pixel back-thinned CCD detector, high speed USB2 interface, incl. switch for USB power or external power for RS232/BT, AvaSoft-Basic, USB interface cable, specify grating, wavelength range and options

Options

-SPU2-BT	Bluetooth® interface for USB2 platform only, including antenna and switch
SDXXX	Internal XXX MB SD card for on board data saving, for USB2 platform only
SLIT-XX	Slit size, please specify XX = 10, 25, 50, 100, 200, 500 µm
OSF-YYY	Order sorting filter for 2nd order effects filtering, please specify YYY= 375, 475, 515, 550, 600 nm
OSC	Order sorting coating with 590nm long pass filter for VA, BB (>350nm) and VB gratings in AvaSpec-2048x14
OSC-UA	Order sorting coating with 350 and 590nm longpass filter for UA gratings in AvaSpec-2048x14
OSC-UB	Order sorting coating with 350 and 590nm longpass filter for UB or BB (<350nm) gratings in AvaSpec-2048x14

2.9 AvaSpec-NIR256 Near-Infrared Fiber Optic Spectrometer

AvaSpec-NIR256



The AvaSpec-NIR256 Fiber Optic Spectrometer is based on the AvaBench-50 symmetrical Czerny-Turner design with 256 pixel InGaAs Detector Array. The spectrometer has a fiber optic entrance connector (standard SMA, others possible), collimating and focusing mirror and diffractional grating. A choice of 3 gratings with different dispersion and blaze angles enable applications in the 900-2500nm range. The AvaSpec-NIR256 includes a 16 bit AD converter, and USB2.0 high speed interface. The AvaSpec- NIR256-1.7 is especially suitable for measuring in the NIR range from 900-1750nm applications, e.g. plastics and water absorbance. The AvaSpec- NIR256-2.2/2.5 have a 2-stage Thermo-electrical Peltier-cooled InGaAs detector, specially suitable for measuring in the NIR range from 1000-2200/2500nm.
Digital IO ports enable external triggering and control of shutter and pulsed light sources from the Avantes line of instruments.
The new AvaSpec-NIR256 series have a USB2 interface with fast datasampling of 940 spectra per second and datatransfer in 1.56 msec and supports analog in-and outputs as well. Optional Bluetooth® (-BT) communication and an SD card for on-board saving of spectra can be added. The AvaSpec-NIR-256-1.7 runs on USB power, the AvaSpec-NIR-256-2.2/2.5 comes in a desktop housing and runs on 100-240VAC. Both come with AvaSoft-basic, a complete manual and USB interface cable. Multiple (up to 127) USB2 spectrometers with different detector types can be externally coupled.

Technical Data

Spectrometer platform	**AvaSpec-NIR256-1.7**	**AvaSpec-NIR256-2.2**	**AvaSpec-NIR256-2.5**
Optical Bench	Symmetrical Czerny-Turner, 50 mm focal length		
Wavelength range	900 - 1750nm	1000 - 2200nm	1000-2500nm
Resolution	6.0 - 50 nm	10.0 - 60 nm	15.0-90 nm
Stray light	< 0.1%		
Sensitivity (AvaLight-HAL, 8 µm fiber) counts (16-bit AD) per ms integration time	350	250	200
Detector	InGaAs linear array, 256 pixels	InGaAs linear array with 2 stage TE-cooling, 256 pixels	
Signal/Noise	4000:1	1200:1	
AD converter	16 bit, 500kHzHz		
Integration time	0.52 ms		

Interface	USB 2.0 high speed, 480 Mbps RS-232, 115.200 bps	
Sample speed with on-board averaging	1.06 msec /scan	
Data transfer speed	1.56 msec /scan	
Digital IO	HB-26 connector, 2 Analog in, 2 Analog out, 3 Digital in, 12 Digital out, trigger, synchronization	
Power supply	Default USB power, 350 mA Or with SPU2 external 12VDC, 350 mA	External 100-240 VAC
Dimensions	175 x 165 x 85 mm	9.5" desktop

Grating selection table for AvaSpec-NIR256

Use	Useable range	Spectral range (nm)	Lines/mm	Blaze (nm)	Order code
NIR	900-1750	750	200	1500	NIRA
NIR	1000-2200	980	150	2000	NIRZ
NIR	1000-2500	1470	100	2500	NIRY

Resolution table (FWHM) for AvaSpec-NIR256

	Slit size (µm)			
Grating (lines/mm)	**50**	**100**	**200**	**500**
100	15.0	25.0	50.0	90.0
150	10.0	15.0	30.0	60.0
200	6.0	12.0	24.0	50.0

Ordering Information

AvaSpec-NIR256-1.7 Fiber Optic Spectrometer, 50 mm Avabench, 256 pixel InGaAs detector, self powered high speed USB2 interface, incl. AvaSoft-Basic, USB interface cable, NIRA grating, 1000-1700nm, OSF-1000, specify slit

AvaSpec-NIR256-2.2 Fiber Optic Spectrometer, 50 mm Avabench, 256 pixel InGaAs detector with 2stage TEC, high speed USB2 interface, incl. AvaSoft-Basic, USB interface cable, NIRZ grating, 1000-2200nm, OSF-1000, specify slit

AvaSpec-NIR256-2.5 Fiber Optic Spectrometer, 50 mm Avabench, 256 pixel InGaAs detector with 2stage TEC, high speed USB2 interface, incl. AvaSoft-Basic, USB interface cable, NIRY grating, 1000-2500nm, OSF-1000, specify slit

Options

BT Bluetooth® interface for USB2 platform only, including antenna

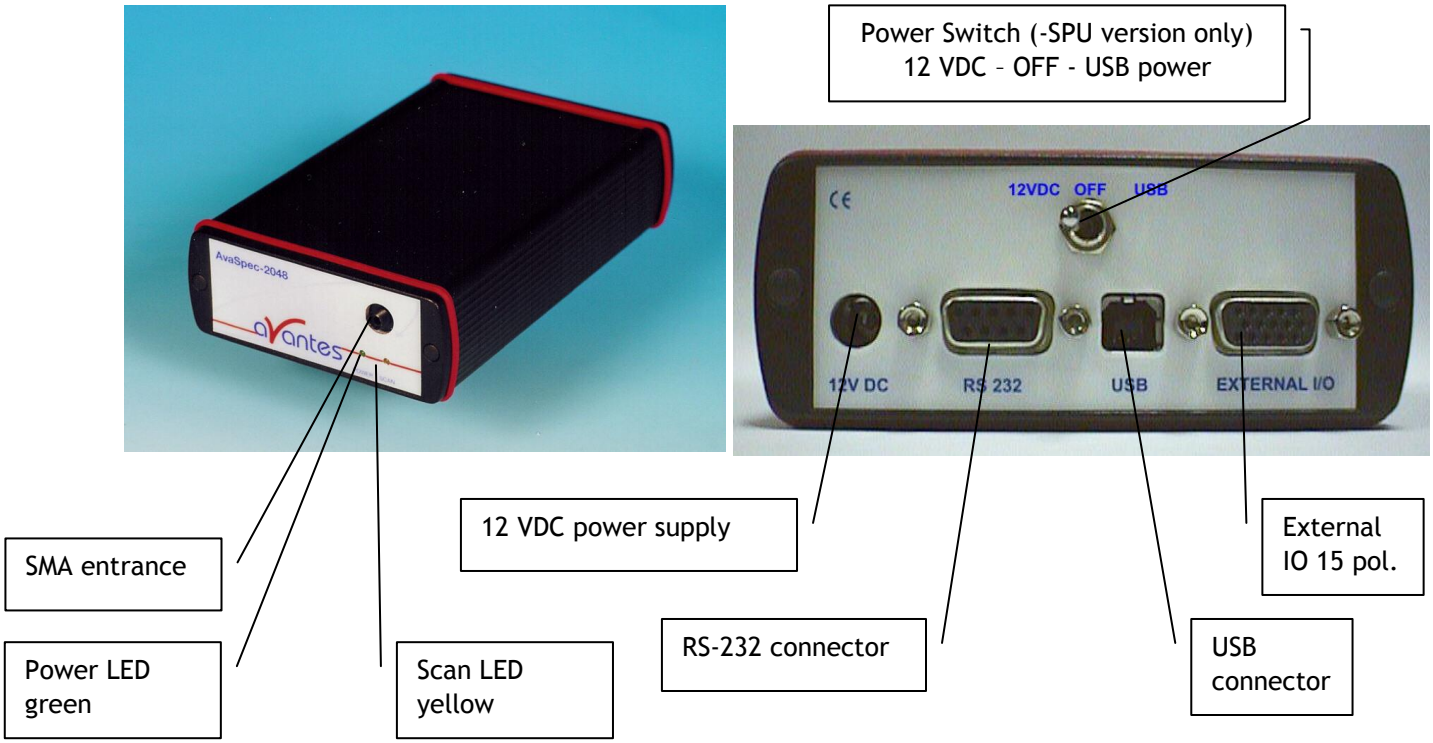
SDXXX Internal XXX MB SD card for on board data saving, for USB2 platform only

SLIT-XX Slit size, please specify XX = 50, 100, 200, 500 µm

N.B. In order to change a grating, wavelength range or any of the options, the unit needs to be returned to Avantes manufacturing, please ask for an RMA number (see page 4 of this manual). The cost for the socalled AvaSpec-Upgrade depends on the modification that needs to be done.

2.10 Spectrometer Connections

2.10.1 USB1 platform connections



Power LED green and scan LED yellow

The green and yellow LED´s act as status LED´s for the micro controller with following meaning:
Green LED = off, power is not connected
Green LED = on, power is on, micro controller ready, no errors
Green LED = blinking, permanent error detected by micro controller
Yellow LED = on, when scan is transmitted to PC

Power connector

The power connector is a Low power DC connector with GND on outer contact and +12V on inner contact. The outside diameter is 5.5mm, the inside diameter 2.1mm.
The electrical circuit is protected against reverse polarity and accepts voltages between 8 and 15V.

Power switch (-SPU version only)
Manual switch for power selection for the AvaSpec-SPU
Left – external power 12VDC, connect external power supply PS-12V/1.0A
Middle - OFF
Right – Power taken from USB bus, no additional power supply required

RS-232 connector
The RS232 interface has the following physical characteristics:

- 1 start bit, 8 data bits, 1 stop bit
- baud rate 115200 bps
- flow control with RTS/CTS
- female 9 pole Sub-D connector

Pin	Dir	Description
1	out	Data Carrier Detect (DTD), not connected
2	out	Transmit data (TX)
3	in	Receive data (RX)
4	in	Data Terminal Ready (DTR), connected to 6
5		Common
6	out	Data Set Ready (DSR), connected to 4
7	in	Request To Send (RTS)
8	out	Clear To Send (CTS)
9	out	Ring Indicator, not connected

USB connector

The USB interface has the following physical characteristics:

- USB version 1.1
- high speed, 12Mbit
- endpoint node, no HUB function

Pin	Description
1	V+
2	D-
3	D+
4	Common

External I/O connector

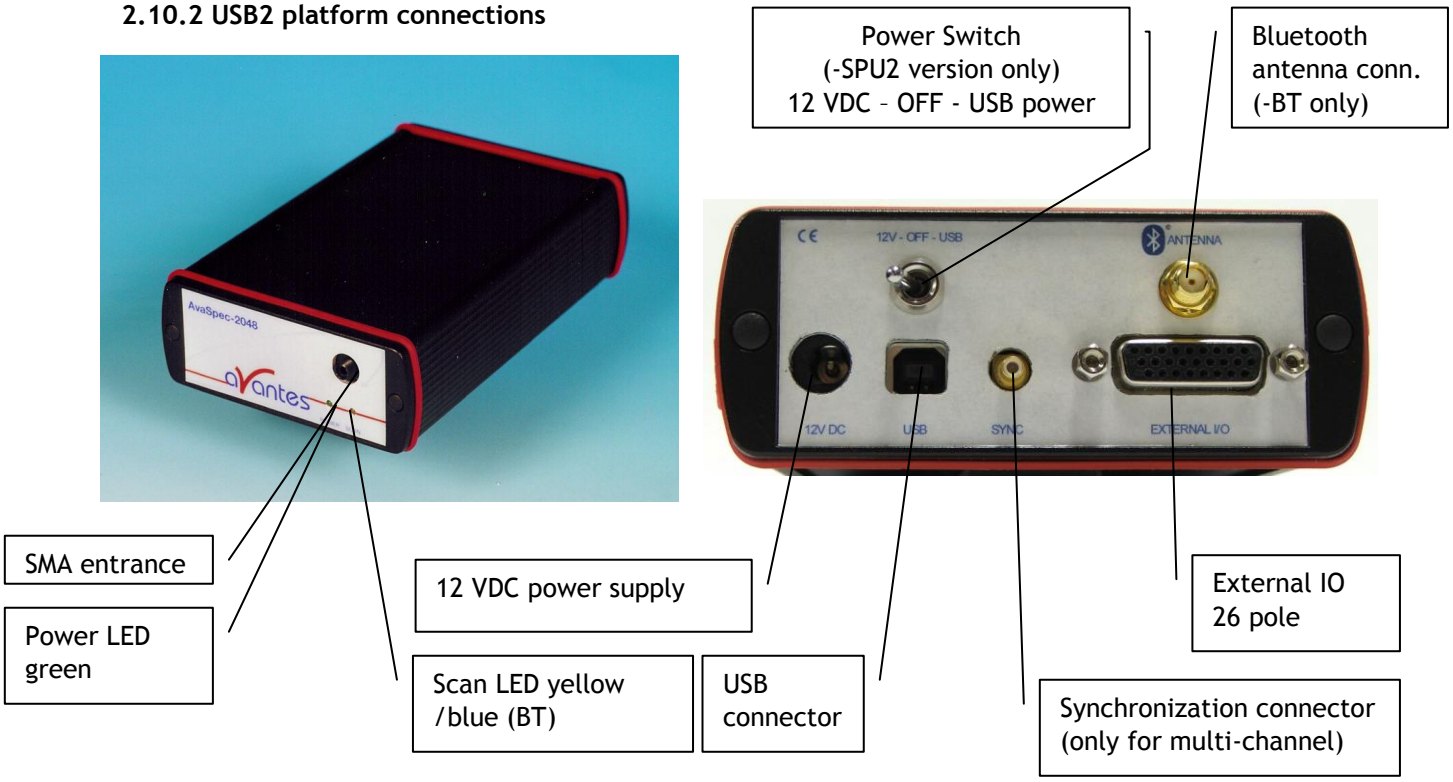
The external I/O connector is a female high density 15 poles Sub-D connector. The connections are as follows:

Pin	Name	Connect to	Comment
1	DO1	AVALIGHT-XE	Output, one ore more TTL pulses per scan
2	DO2	AvaLight-LED	Output, fixed frequency of 1 kHz
3	DO3	IC-DB15-extrig	Output, + 5VDC
4	DI1	Ext. trigger	TTL Input, external hardware trigger, start scan at rising edge
5	DO4	reg. outp. of µC	general purpose output
6	DO5	reg. outp. of µC	general purpose output
7	DO6	reg. outp. of µC	general purpose output
8	DI2	Ext. trigger	TTL Input, external software trigger
9	DO7	reg. outp. of µC	general purpose output
10	GND	GND	
11	DO8	reg. outp. of µC	general purpose output
12	DO9	reg. outp. of µC	general purpose output
13	DO10	shutter	Output, used to close shutter for AvaLight-HAL-S, AvaLight-DHc and AvaLight-DHS
14	DO11	AvaLight-LED-p14	With AvaSoft 6.2-OXY turns on-and off AvaLight-LED-p14
15	DO12	reg. outp. of µC	general purpose output

Ordering Information Interface cables

IC-DB9-2	Interface cable AvaSpec-USB1 platform to RS-232, 9-pole
IC-DB15-2	Interface cable AvaSpec-USB1 platform to AvaLights-S and AvaLight-XE
IC-Extrig-2	Interface cable AvaSpec to External trigger pushbutton, 2m
IC-DB15-Extrig-2	Interface Y-cable AvaSpec to External trigger pushbutton and AvaLight-S with shutter, 2m
IC-DB15-FOS2-2	Interface Y-cable AvaSpec to FOS-2 and AvaLight-S with shutter, 2m
IC-USB-2	Interface cable AvaSpec to USB port on PC, 2m

2.10.2 USB2 platform connections



Power LED green and scan LED yellow

The green and yellow LED´s act as status LED´s for the micro controller with following meaning:
Green LED = off, power is not connected
Green LED = on, power is on, micro controller ready, no errors
Green LED = blinking, permanent error detected by micro controller
Yellow LED = on, when scan is transmitted to PC

Power connector (only needed for RS-232 functionality with SPU2)

The power connector is a Low power DC connector with GND on outer contact and +12V on inner contact. The outside diameter is 5.5mm, the inside diameter 2.1mm.
The electrical circuit accepts voltages between 5 and 15V.
NOTE: Please use Avantes PS-12VDC/1.0A power supply or 12VDC batterypack only, serious damage to the electronics may occur, when other power supplies with different polarity and/or Voltage rating are used.

Power switch (-SPU2 version only)
Manual switch for power selection for the AvaSpec-SPU2
Left – external power 12VDC, connect external power supply PS-12V/1.0A or 12 VDC batterypack
Middle - OFF
Right – Power taken from USB bus, no additional power supply required

USB connector

The USB interface has the following physical characteristics:

- USB version 2.0
- high speed, 480Mbitps
- endpoint node, no HUB function
- 5VDC power supply

Pin	Description
1	V+
2	D-
3	D+
4	Common

Synchronization connector

SMB miniature 50R coax synchronization connector to synchronize to other AvaSpec-USB2 spectrometers only, order code for SMA cables is IC-COAX-SMB-0,25 for 250mm coax cable.

Bluetooth® antenna connector (only –BT models)

SMA coax 50R connection for minature dipole antenna for Bluetooth® interface.

External I/O connector

The external I/O connector is a female high density 26 poles Sub-D connector.

Pin	Name	Connect to	Comment
1	GND	GND(DB26/DB15-p10)	
2	DO2		general purpose TTL output, PWM
3	DO5		general purpose TTL output, PWM
4	DO8	FOS (DB26/DB15-p15)	general purpose TTL output, AvSoft FOS control
5	STROBE	AVALIGHT-XE (DB26/DB15-p1)	Output, one ore more TTL pulses per scan
6	Trig In	Ext. trigger	TTL Input, external hardware trigger
7	DI2		TTL input, AvaSoft-Save spectrum
8	GND	GND	
9	AI1		Analog input, 0-5VDC
10	RX	RS-232-RX (DB26/DB9-p3)	RS-232-RX
11	DO1	AvaLight-LED (DB26/DB15-p14)	general purpose TTL output, PWM, AvaSoft-PWM
12	DO4	shutter(DB26/DB15-p13)	Output, used to close shutter for AvaLight-HAL-S, AvaLight-DHc and AvaLight-DHS
13	DO7		general purpose TTL output, PWM
14	GND	GND	
15	5VDC	DB26/DB15-p3	5VDC output, max xx mA
16	DI3		TTL input, AvaSoft-Save reference
17	AO1		Analog output, 0-5VDC
18	AI2		Analog input, 0-5VDC
19	TX	RS-232-TX (DB26/DB9-p2)	RS-232-TX
20	DO3		general purpose TTL output, PWM
21	DO6		general purpose TTL output, PWM
22	DO9		general purpose TTL output, PWM
23	LASER OUT	LASER TTL for LIBS	TTL output, AvaSoft programmable delay and duration
24	DI1		TTL input, AvaSoft-Save dark
25	DO10		general purpose TTL output
26	AO2		Analog output, 0-5VDC

Ordering Information Interface cables

IC-DB26-2	Interface cable AvaSpec-USB2 platform to DB15 for AvaLight-S with shutter for auto save dark/ lamp off, AvaLight-XE control
IC-DB26/DB9-2	Interface cable AvaSpec-USB2 platform to RS232 DB9 cable
IC-DB26/DB9/DB15-2	Interface Y cable AvaSpec-USB2 platform to RS-232 (DB9) and AvaLight-S (DB15) with shutter for auto save dark/ lamp off, AvaLight-XE control
IC-DB26-FOS2-2	Interface Y-cable AvaSpec-USB2 platform to FOS-2 and AvaLight-S with shutter, 2m
IC-USB2-2	Interface cable AvaSpec-USB2 to USB port on PC, 2m
IC-Extrig-USB2	Interface cable AvaSpec-USB2 to External trigger pushbutton, 2m
IC-DB26-Extrig-USB2	Interface Y-cable AvaSpec-USB2 to External trigger pushbutton and AvaLight-S with shutter, 2m
IC-DB26-EXTRIG-BNC-2	Interface cable AvaSpec-USB2 platform to BNC plug External trigger, 2 m
IC-COAX-SMB-0,25	Synchronization coax cable with 2 SMB connectors 0.25m for Avaspec USB2 platform

2.11 AvaSpec Multichannel Fiber Optic Spectrometers

AvaSpec-4 channel in desktop



AvaSpec –USB1 platform

The AvaSpec USB1.1 platform Fiber Optic Spectrometers can be configured as single, dual, triple, quadruple or multi-channel instrument with up to 8 different spectrometer channels, all read out simultaneously, controlled by a master´s board microprocessor.
The simultaneous data-sampling allows fast read-out and enables monitoring of pulsed light sources with different channels looking at the same pulse.

Multi-channel spectrometers all consist of the same detector type (102/128, 256 or 1024 or 2048 pixels), the spectrometer channels can of course cover different wavelength ranges or have different resolution specifications. For each channel grating, wavelength range and options need to be specified.

The multi-channel spectrometers all run with one USB interface and under AvaSoft software. Multi-channel housing can be in 9.5" desktop (for 1-4 channels) or 19" rack mount housing (1-8 channels) The pinout of the backplane connector can be found in section 2.8.1.

AvaSpec –USB2.0 platform – maximum modularity

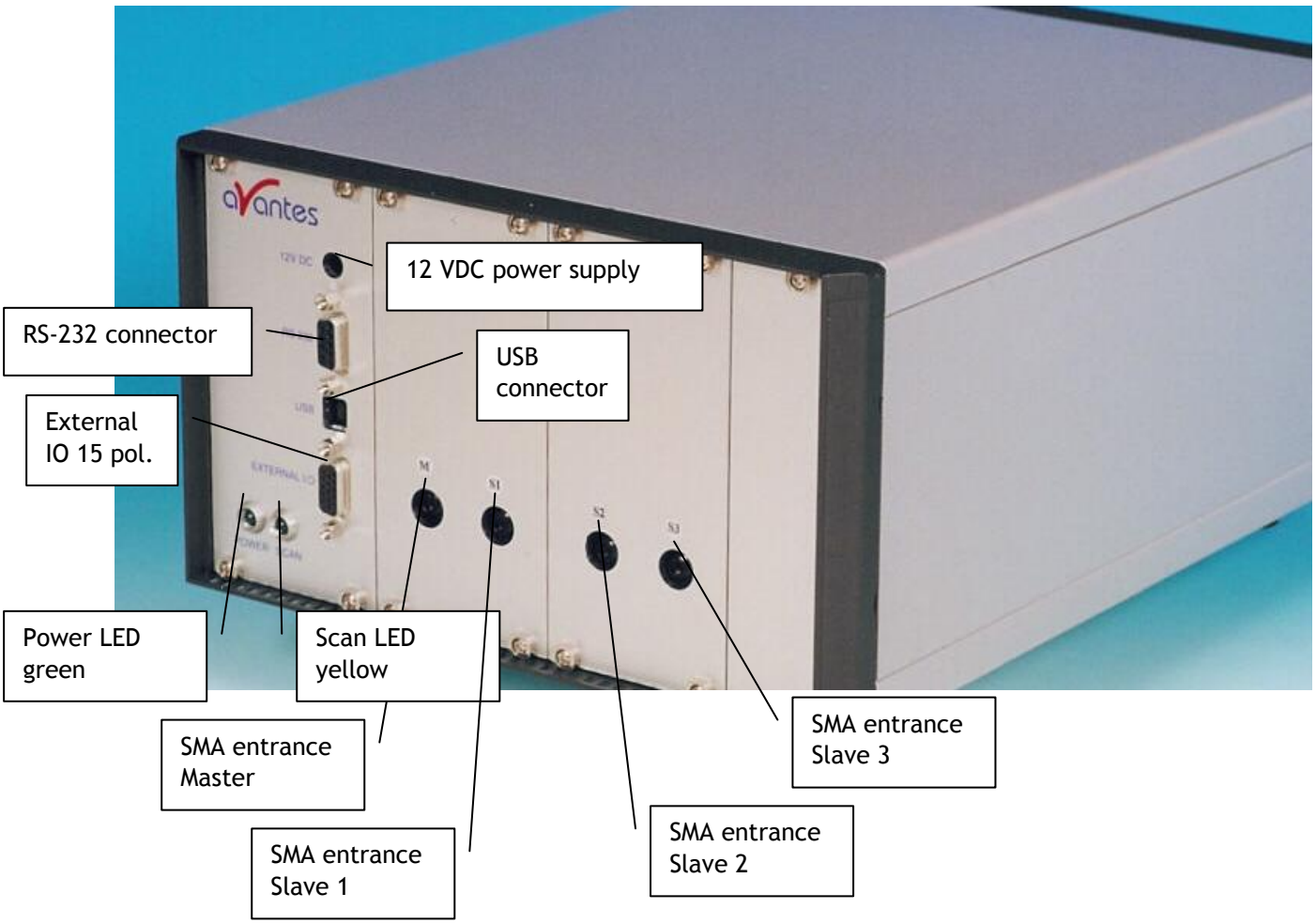
The new AvaSpec-USB2.0 platform offers maximum modularity for multi-channel applications. For each channel a different wavelength range, detector and integration time can be selected, without loosing the advantage of synchronization between the different channels. The AvaSpec-USB2.0 platform uses the USB2.0 bus to connect the different channels to the PC platform and supports up to 127 channels. New applications that can be realized with the AvaSpec-USB2.0 multi-channel platform:

- Different integration times or averaging setting per channel, still start each scan simultaneously for all synchronized channels
- Different detector types, such as UV/VIS and NIR detectors possible to cover a wide wavelength range with one spectrometer system
- More than 8 channels (even up to 127 channels) can be connected through USB2 hubs.

To order a USB2.0 multi-channel, please specify the different spectrometers (-RM) and options and the housing (up to 4 channels in desktop, up to 10 channels in rack mount).

The spectrometer units are internally connected by a synchronization cable, which allows simultaneous data-sampling. The synchronization enables monitoring of pulsed lightsources with different channels looking at the same pulse.
The pinout of the backplane connector can be found in 2.9.2

2.11.1 Multichannel connections USB1 platform



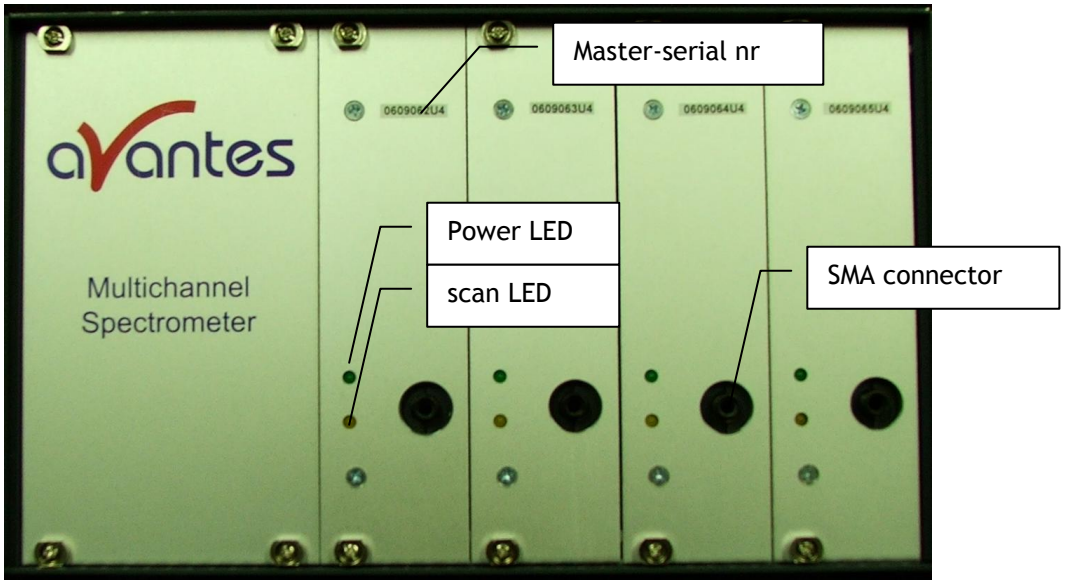
Internal connections by backplane connector

Please make sure that all connections to the 64-pole backplane connector is carried out by Avantes service personell only, otherwise the guarantee is not valid.
Only registed official Avantes rackmounted devices may be connected to the backplane.
A PS-12VDC/2.5A power supply unit may be required when lightsources and multiple channel spectrometers are included in one rackmount.

Pin description backplane connector

Pin	signal name	description	pin	signal name	description
A1	DC-IN	9-15V DC input	B1	0	
A2	DC-IN	9-15V DC input	B2	0	
A3	0		B3	0	
A4	0		B4	LED-YELLOW-C	led-yellow-cathode
A5	0		B5	LED-YELLOW-A	led-yellow-anode
A6	0		B6	0	
A7	0		B7	0	
A8	0		B8	LED-GREEN-C	led-green-cathode
A9	CDSCLK1	adc sample clock 1	B9	LED-GREEN-A	led-green-anode
A10	CDSCLK2	adc sample clock 2	B10	0	
A11	ADCCLK	adc data clock	B11	START	sensor start
A12	B-SLK	adc bus serial clock	B12	CLK1	sensor clock 1
A13	B-MTSR	adc serial data	B13	CLK2	sensor clock 2
A14	SSEL1	adc select 1	B14	NOR	sensor nor
A15	SSEL2	adc select 2	B15	RESET	sensor reset
A16	SSEL3	adc select 3	B16	CLAMP	sensor clamp
A17	B-SHA-MD	adc offset mode	B17	B-GAIN-H	sensor gain select
A18	0		B18	0	
A19	DO2	fixed frequency of 1 kHz	B19	0	
A20	DO1	one ore more TTL pulses per scan	B20	/WR-FIFO	write FIFO (all)
A21	DO6	external output 6	B21	/B-RS	FIFO reset (all)
A22	DO5	external output 5	B22	/RD-FIFO1	read select slave 1
A23	DO8	external output 8	B23	/RD-FIFO2	read select slave 2
A24	DO9	external output 9	B24	/RD-FIFO3	read select slave 3
A25	DO10	Output, used to close shutter	B25	Q0	FIFO data bit 0
A26	DO11	external output 11	B26	Q1	FIFO data bit 1
A27	DO12	external output 12	B27	Q2	FIFO data bit 2
A28	DO4	external output 4	B28	Q3	FIFO data bit 3
A29	DI1	TTL input, external hardware trigger, start scan at rising edge	B29	Q4	FIFO data bit 4
A30	DO7	external output 7	B30	Q5	FIFO data bit 5
A31	DO3	external output 3	B31	Q6	FIFO data bit 6
A32	DI2	external input 2	B32	Q7	FIFO data bit 7

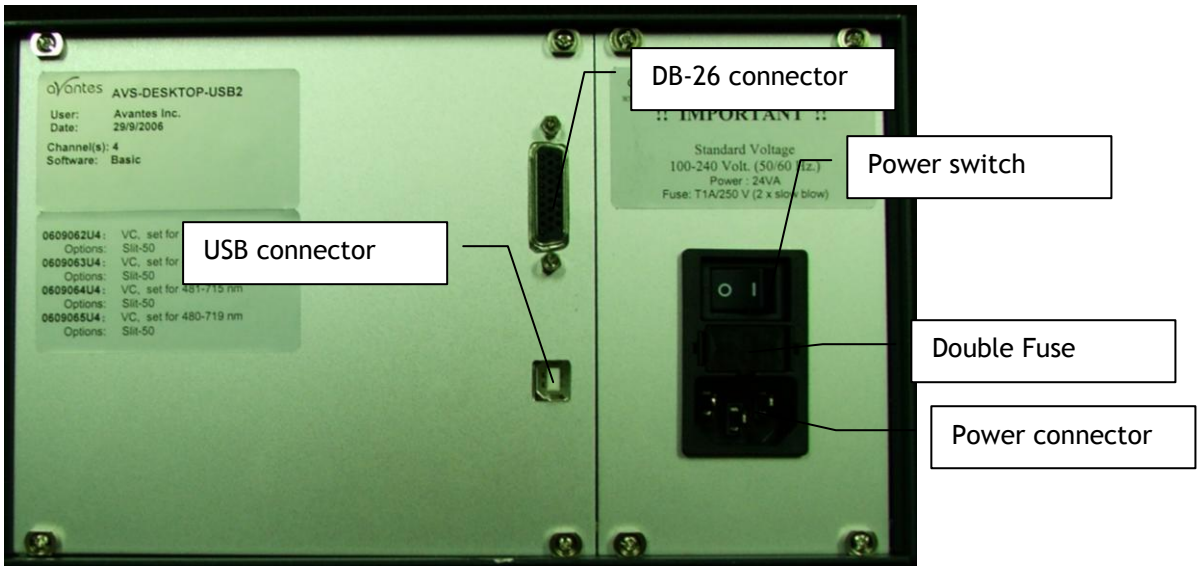
2.11.2 Multichannel connections USB2 platform



All spectrometer channels in the Multichannel instrument are internally synchronized.
The most left spectrometer, as seen from the front, is the master spectrometer, that provides the synchronization signal. This master spectrometer is connected to the HD-26 connector on the backside of the spectrometer.

Front side: Power LED green and scan LED yellow per channel

The green and yellow LED´s act as status LED´s for the micro controller with following meaning:
Green LED = off, power is not connected
Green LED = on, power is on, micro controller ready, no errors
Green LED = blinking, permanent error detected by micro controller
Yellow LED = on, when scan is transmitted to PC



Back side: USB connector

The USB interface is an internal 4- or 7-hub, depending on the amount of spectrometer channels, built into the multichannel instrument.
The USB2 connector has the following physical characteristics:

- USB version 2.0
- high speed, 480Mbitps
- endpoint node, internal HUB function
- 5VDC power supply

Pin	Description
1	V+
2	D-
3	D+
4	Common

Back side: Power connector with double Fuse and switch

The power connector for 100-240 VAC, 500 mA, is located on the rear of the Multichannel AvaSpec. Be carefull to use for designated power range only, please use included power cord with the instrument. For UK, US and Australian power cords, contact Avantes Technical Support.
The 2 Fuses are 2A slow blowing Fuse.



Disconnect power before opening housing or replace Fuse.
The installation category for this equipment is Class 2, it is not permitted to connect equipment to the AvaSpec mulichannel with a power supply without SELV or class II qualification.

External I/O connector

The external I/O connector is a female high density 26 poles Sub-D connector, connected to the Master spectrometer channel.

Pin	Name	Connect to	Comment
1	GND	GND(DB26/DB15-p10)	
2	DO2		general purpose TTL output, PWM
3	DO5		general purpose TTL output, PWM
4	DO8	FOS (DB26/DB15-p15)	general purpose TTL output, AvSoft FOS control
5	STROBE	AVALIGHT-XE (DB26/DB15-p1)	Output, one ore more TTL pulses per scan
6	Trig In	Ext. trigger	TTL Input, external hardware trigger
7	DI2		TTL input, AvaSoft-Save spectrum
8	GND	GND	
9	AI1		Analog input, 0-5VDC
10	RX	RS-232-RX (DB26/DB9-p3)	RS-232-RX
11	DO1	AvaLight-LED (DB26/DB15-p14)	general purpose TTL output, PWM, AvaSoft-PWM
12	DO4	shutter(DB26/DB15-p13)	Output, used to close shutter for AvaLight-HAL-S, AvaLight-DHc and AvaLight-DHS
13	DO7		general purpose TTL output, PWM
14	GND	GND	
15	5VDC	DB26/DB15-p3	5VDC output, max xx mA
16	DI3		TTL input, AvaSoft-Save reference
17	AO1		Analog output, 0-5VDC
18	AI2		Analog input, 0-5VDC
19	TX	RS-232-TX (DB26/DB9-p2)	RS-232-TX
20	DO3		general purpose TTL output, PWM
21	DO6		general purpose TTL output, PWM
22	DO9		general purpose TTL output, PWM
23	LASER OUT	LASER TTL for LIBS	TTL output, AvaSoft programmable delay and duration
24	DI1		TTL input, AvaSoft-Save dark
25	DO10		general purpose TTL output
26	AO2		Analog output, 0-5VDC

Ordering Information

CONN-DB26-RM	Extra DB26-IO connector output for Desktop/Rackmount for USB2 platform multichannel AvaSpec
IC-DB26-2	Interface cable AvaSpec-USB2 platform to DB15 for AvaLight-S with shutter for auto save dark/ lamp off, AvaLight-XE control
IC-DB26/DB9-2	Interface cable AvaSpec-USB2 platform to RS232 DB9 cable
IC-DB26/DB9/DB15-2	Interface Y cable AvaSpec-USB2 platform to RS-232 (DB9) and AvaLight-S (DB15) with shutter for auto save dark/ lamp off, AvaLight-XE control
IC-DB26-FOS2-2	Interface Y-cable AvaSpec-USB2 platform to FOS-2 and AvaLight-S with shutter, 2m
IC-DB26-EXTRIG-BNC-2	Interface cable AvaSpec-USB2 platform to BNC plug External trigger, 2 m

2.12 AvaSpec-2048TEC Thermo-electric cooled Fiber Optic Spectrometer

AvaSpec-2048TEC



The AvaSpec-2048TEC is a special version of the AvaSpec-2048, where the Sony 2048 CCD detector is mounted on a one-stage Peltier cooling device. This Peltier cooling element can reduce the temperature of the CCD chip by ca. 30 degrees C, improving the dynamic range by at least a factor of 10. As an additional benefit from the cooling the dark noise is reduced by a factor of 2-3.
The above features enable the AvaSpec-2048TEC to be implemented in low light-level applications, such as fluorescence and Raman measurements, where integration times of more than 5 seconds are needed. The AvaSpec-2048TEC can be delivered as one or 2-channel instrument and has all the standard options, gratings and specifications the normal AvaSpec-2048 has.
The AvaSpec-2048TEC is built into a desktop housing, has a cooling fan to actively ventilate the heatsink of the Peltier cooling element and an internal power supply.

Technical Data

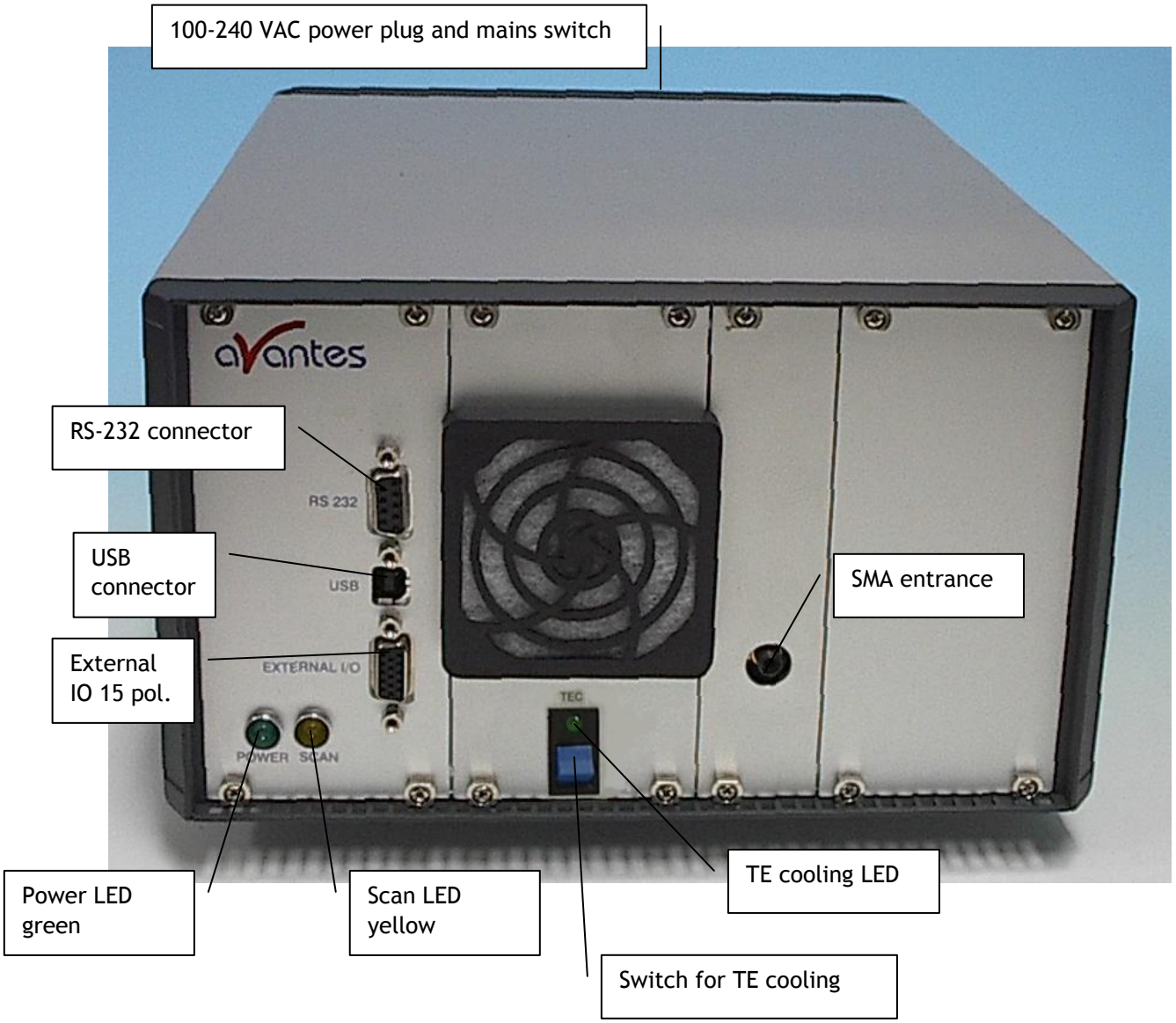
Temperature cooled CCD	ΔT = ca. -30 °C versus ambient
Time to stabilize	1-2 Minutes
Dynamic Range improvement for it > 5 seconds	> Factor 10
Dark Noise improvement for it > 5 seconds	Factor 2-3
Peltier cooling internal Power supply	Ca. 3.0 V, 4A
External Power supply	100-240 VAC, 30W
Dimensions	310 x 235 x 135 mm (1 channel) Desktop 310 x 450 x 135 mm (2 channel) 19” Rackmount

Ordering Information

AvaSpec-2048TEC	Thermo-Electric Cooled Fiber Optic Spectrometer, 75 mm Avabench, 2048 pixel TE cooled CCD detector, USB/RS-232 interface, incl AvaSoft-Basic, USB cable in desktop housing, specify grating, wavelength range and options
AvaSpec-2048TEC-2	Multichannel Thermo-Electric Cooled Fiber Optic Spectrometer, 2 * 75 mm Avabench, 2048 pixel TE cooled CCD detector, USB/RS-232 interface, incl AvaSoft-Basic, USB cable, for 2 channels in desktop housing specify grating, wavelength range and options

Options
See under AvaSpec-2048

2.12.1 Connections



Power LED green and scan LED yellow

The green and yellow LED´s act as status LED´s for the micro controller with following meaning:
Green LED = off, power is not connected
Green LED = on, power is on, micro controller ready, no errors
Green LED = blinking, permanent error detected by micro controller
Yellow LED = on, when scan is transmitted to PC

TE Cooling switch and indicator
The blue switch is used to switch on the CCD detector cooling, the green LED=on indicates that the CCD detector cooling is switched on.
Switch in down position Cooling is on
Switch in up position Cooling is off

RS-232 connector

The RS232 interface has the following physical characteristics:

- 1 start bit, 8 data bits, 1 stop bit
- baud rate 115200 bps
- flow control with RTS/CTS
- female 9 pole Sub-D connector

Pin	Dir	Description
1	out	Data Carrier Detect (DTD), not connected
2	out	Transmit data (TX)
3	in	Receive data (RX)
4	in	Data Terminal Ready (DTR), connected to 6
5		Common
6	out	Data Set Ready (DSR), connected to 4
7	in	Request To Send (RTS)
8	out	Clear To Send (CTS)
9	out	Ring Indicator, not connected

USB connector

The USB interface has the following physical characteristics:

- USB version 1.1
- high speed, 12Mbit
- endpoint node, no HUB function

Pin	Description
1	V+
2	D-
3	D+
4	Common

Power connector with Fuse and switch (rear panel)

The power connector for 100-240 VAC is located on the rear of the AvaSpec-2048TEC. Be carefull to use for designated power range only, please use included power cord with the instrument. For UK, US and Australian power cords, contact Avantes Technical Support. The Fuse is a 2A slow blowing Fuse.



Disconnect power before opening housing or replace Fuse.
The installation category for this equipment is Class 2, it is not permitted to connect equipment to the AvaSpec-TEC with a power supply without SELV or class II qualification.

External I/O connector

The external I/O connector is a female high density 15 poles Sub-D connector. The connections are as follows:

Pin	Name	Connect to	Comment
1	DO1	AVALIGHT-XE	Output, one ore more TTL pulses per scan
2	DO2	External pulsed laser	Output, TTL pulse of 10 µsec when activated in FT mode
3	DO3	IC-DB15-extrig	Output, + 5VDC
4	DI1	Ext. trigger	TTL Input, external hardware trigger, start scan at rising edge
5	DO4	reg. outp. of µC	general purpose output
6	DO5	reg. outp. of µC	general purpose output
7	DO6	reg. outp. of µC	general purpose output
8	DI2	Ext. trigger	TTL Input, external software trigger
9	DO7	reg. outp. of µC	general purpose output
10	GND	GND	
11	DO8	reg. outp. of µC	general purpose output
12	DO9	reg. outp. of µC	general purpose output
13	DO10	shutter	Output, used to close shutter for AvaLight-HAL-S, AvaLight-DHc and AvaLight-DHS
14	DO11	AvaLight-LED-p14	With AvaSoft 6.2-OXY turns on-and off AvaLight-LED-p14
15	DO12	reg. outp. of µC	general purpose output

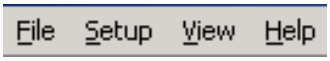
3 AvaSoft-Basic manual

The AvaSoft-Basic software is delivered with every Avantes spectrometer. The AvaSoft full version software contains many additional features and applications. The full version comes with a separate manual. Please refer to the software section in the Avantes Fiber optic Spectroscopy Catalogue for an overview of the extra functionality in AvaSoft-Full. A detailed description about all features in the full version can be found in the help files, or in PDF format on the AvaSpec product CD-ROM that came with your spectrometer system.
AvaSoft-Basic 7 is available for both -USB1 and –USB2 platforms, you will find the relevant instructions for the –USB2 platform spectrometers marked with USB2.

AvaSoft-Basic features user friendly, mouse oriented pull down menus. The mouse controls movements of a data cursor for instantaneous readout of wavelength, pixel and y-axis magnitude. Mouse dragging is a fast and elegant way to zoom in both x and y direction at the same time. Buttons in the main window are available for on-line/off-line spectral analyses (start/stop), for easy saving of reference, dark and experiment spectra, printing, changing the view to absorbance, transmittance, irradiance or raw scope data, rescaling the y-axis and set scale for x- and y-axis. Spectra that were saved before can be displayed graphically and compared to other saved spectra, or to the online measured spectra. The user sets the data collection parameters, such as CCD detector integration time, auto-dark correction, signal averaging and spectral smoothing in common dialog boxes.

3.1 Main Window

Menu bar



The menus and submenus are described in section 3.2

Button bar

-USB1 platform



-USB2 platform





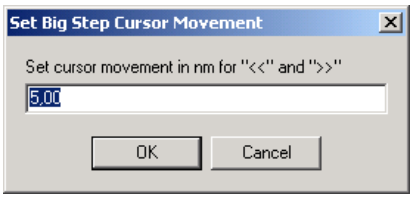
Start/Stop button

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.



Channel button (USB1 platform only)

After clicking the Channel button, a dialog is shown in which the spectrometer channels can be selected, for which data will be acquired and displayed. The same result can be achieved with the option View-Channel.



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.



Auto scale 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-Auto scale 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

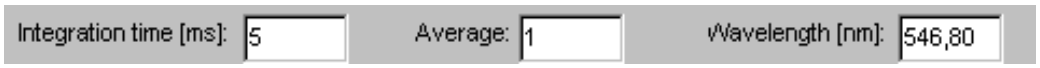


Graphic Reset button

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

Edit bar

-USB1 platform



-USB2 platform multichannel



For USB1 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 CCD readout frequency and therefore the exposure- or integration time of the CCD 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 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 90% of the full ADC scale (14750 counts for the 14bit ADC, 59000 counts for the 16bit ADC).. When at minimum integration the signal is still too high, an attenuator (FOA-INLINE), 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.

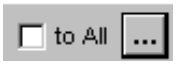
If measurements are done in a mode in which reference and dark data are required (all modes except Scope mode), then new reference and dark spectra need to be saved after the integration time has been changed.

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.

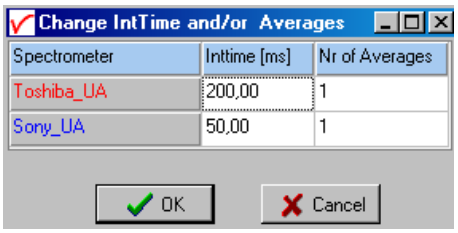
Wavelength[nm]
The wavelength shows the position of the cursor, which becomes visible if the cursor button is down. The amplitude of the signal, which is given in the status bar at the bottom of the main window, is the amplitude at the wavelength shown in this field.

Multichannel USB2 only

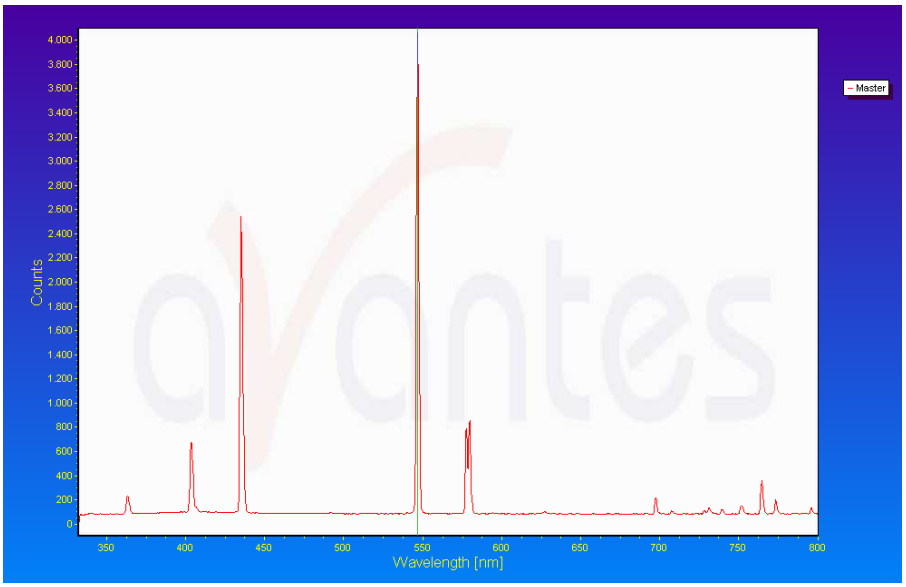


For multichannel USB2 spectrometers the integration time and averaging can be set for all channels at the same value by clicking to All.

If the dashed box is clicked, different integration time and averaging can be set per channel .

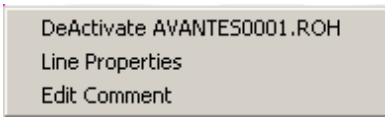


Graphical region
The graphical region displays the data in an XY-diagram, with at the X-axis the wavelength in nanometer, and at the Y-axis the detector counts. After loading or saving a reference and dark spectrum, other units can be selected at the Y-axis: Absorbance Units, Percentage Transmittance, or Relative Irradiance.



Display saved Graph and Line style editor

By clicking on the legenda with the right mouse button, multiple spectra, that were saved earlier can be displayed.
New in AvaSoft 7 is that displayed graphs can be deleted or properties of the displayed graphs, such as line style or color or comments can be changed. This is done by clicking with the right mouse button on the line in the graphical display. A small line edit box will occur.



Now the line can be deactivated or the line properties can be changed as depicted in the border editor or the comments can be edited.



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.

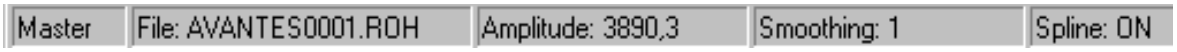
Zoom out: drag with the left mouse button within the white rectangle, but in stead of dragging the mouse downwards and to the right, drag it into another direction. After releasing the mouse button, both the X- and Y-axis will be reset to their default values.

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.

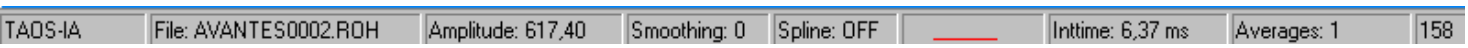
Status bar

USB1



For each selected spectrometer channel, 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. The field at the right of the Spline setting is used to indicate that the spectrometer is receiving too much light at a certain wavelength range (=16383 counts before correcting for dynamic dark, smoothing or averaging), in which case the label “saturated” will become visible.

USB2



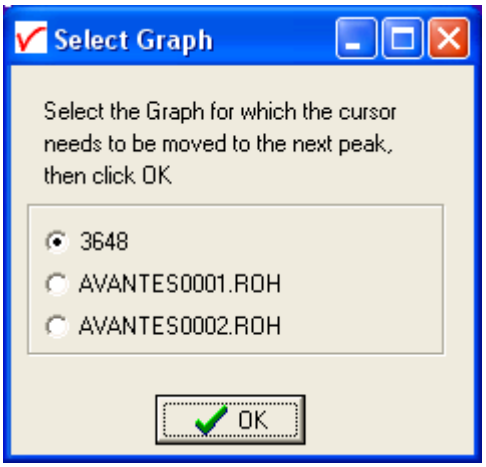
For each selected spectrometer channel, a statusbar at the bottom of the main window shows the name label of the connected spectrometer channel, the file to which the data will be saved, amplitude at current wavelength, the current settings for the smoothing and spline parameters, the line color and style in the graphical display, the real integration time and averages per channel and final the number of scans taken since the start button was clicked. The field at the right is used to indicate that the spectrometer is receiving too much light at a certain wavelength range (=16383 counts for 14bit ADC, 65535 counts for 16bit ADC, before correcting for dynamic dark, smoothing or averaging), in which case the label “saturated” will become visible.

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 instead of the CTRL key, the same procedure will be used to move to the closest valley.

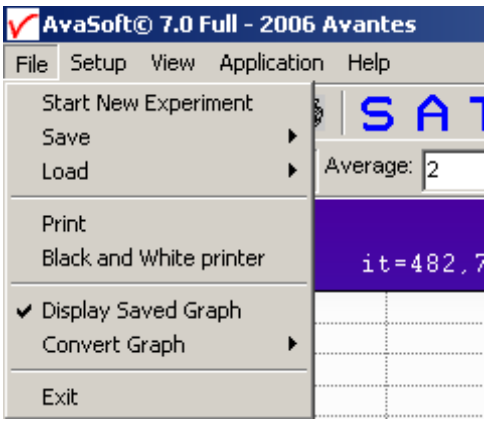
If more than one spectrum is being displayed, a dialog, as shown at the right, pops up in which the spectrum for which the peak finder needs to be activated can be selected out of all displayed spectra.



3.2 Menu Options

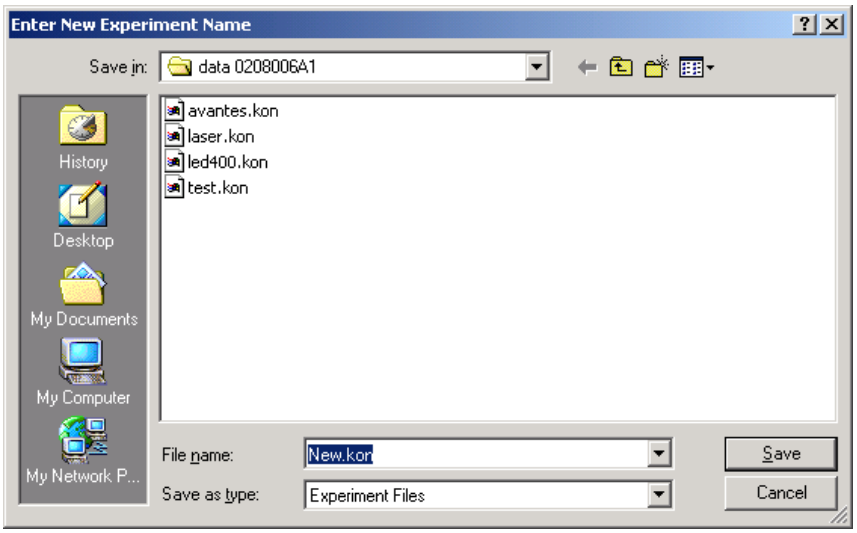
In sections 3.2.1 to 3.2.4 the four main menu options (File, Setup, View and Help) and their submenus are described in detail.

3.2.1 File Menu



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 “test”, the first graphic file that will be saved in scope mode, will be called test0001.ROH, the sequence number will be automatically incremented, so the next file that will be saved in scope mode will be called test0002.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. For USB1 platform the default folder in which data is saved is called “data <serialnumber>”, in which <serialnumber> refers to the serial number of the AvaSpec spectrometer that is being used (0208006A1 in the figure above), for USB2 platform the default directory is “data”.
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.

File Menu: Load Dark

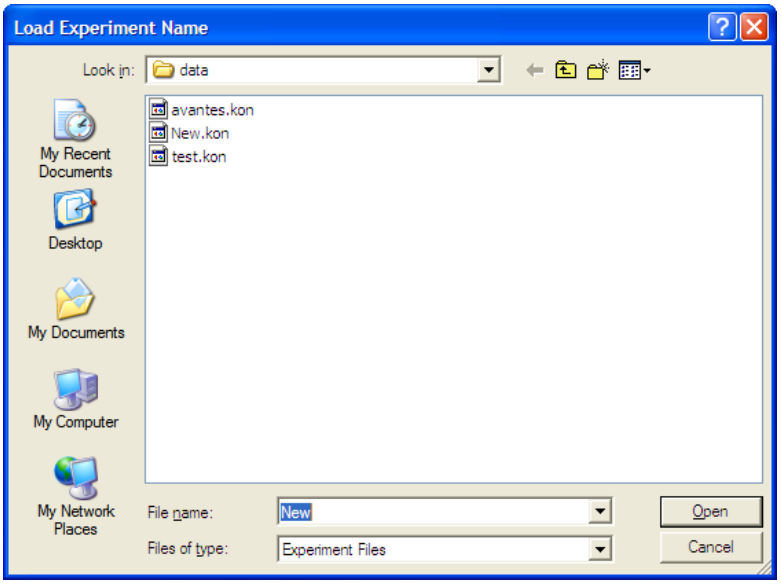
With this option, dark data can be loaded, that have been saved before. If AvaSoft is in static mode, the dark data that will be loaded are shown on the screen first.

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.

File Menu: Load Experiment

With this option, an experiment name can be loaded, that has been used before. This 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 folder name.



File Menu: Save Dark

With this option, dark data are saved. For USB1 platform 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). For USB2 platform the name of the dark data file is "serialnr.drk". 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.

File Menu: Save Reference

With this option, reference data are saved. For USB1 platform 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). For USB2 platform the name of the reference data file is "serialnr.ref".

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.

File Menu: Save Experiment

With this option, graphic files are 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.

Saving graphic files if one spectrometer channel is enabled
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 "avantes". Then, saving one spectrum in scope mode, one in absorbance mode and two in transmittance mode results in the following files:

avantes0001.roh:	spectrum data in scope mode
avantes0001.rcm:	comments for the spectrum saved in avantes0001.roh
avantes0001.abs:	spectrum data in absorbance mode
avantes0001.acm:	comments for the spectrum saved in avantes0001.abs
avantes0001.trm:	spectrum transmittance mode
avantes0001.tcm:	comments for the spectrum saved in avantes0001.trm
avantes0002.trm:	spectrum data in transmittance mode
avantes0002.tcm:	comments for the spectrum saved in avantes0002.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 avantes0002.roh, avantes0002.abs and avantes0003.trm, as well as the comment files avantes0002.rcm, avantes0002.acm and avantes0003.tcm.

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

Saving graphic files if multiple spectrometer channels have been enabled

If graphic files are saved while more than one channel is enabled at the same time (see option View-Channel), then the graphic filename for each channel that is displayed gets a different sequence number. For example, the result of saving one experiment in triple view mode is three graphic data files and three comment files, for instance:

avantes0002.roh: spectrum data in scope mode (e.g. spectrometer 1 or Master)

avantes0003.roh: spectrum data in scope mode (e.g. spectrometer 2 or Slave1)

avantes0004.roh: spectrum data in scope mode (e.g. spectrometer 3 or Slave 2)

avantes0002.rcm: comments for the spectrum saved in avantes0002.roh

avantes0003.rcm: comments for the spectrum saved in avantes0003.roh

avantes0004.rcm: comments for the spectrum saved in avantes0004.roh

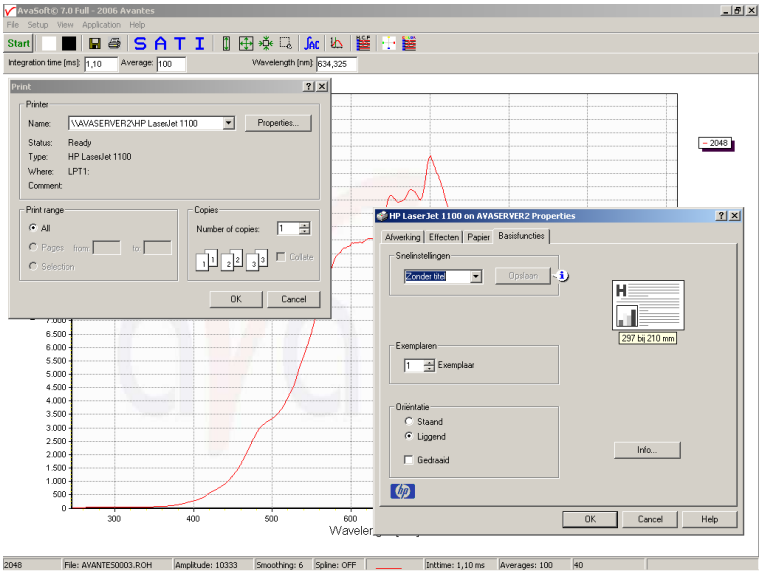
For each channel a different comment line can be entered.

To make it easier to select the graphic files later on with the option File-Display Saved Graph, all comment lines start with a short name for the channel at which the graph has been saved: M for Master, S1 for Slave1 and so on.

After saving, the sequence numbers in this example (triple view mode) will automatically have been increased to 0005, 0006 and 0007, for resp. Master, Slave1 and Slave2.

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.

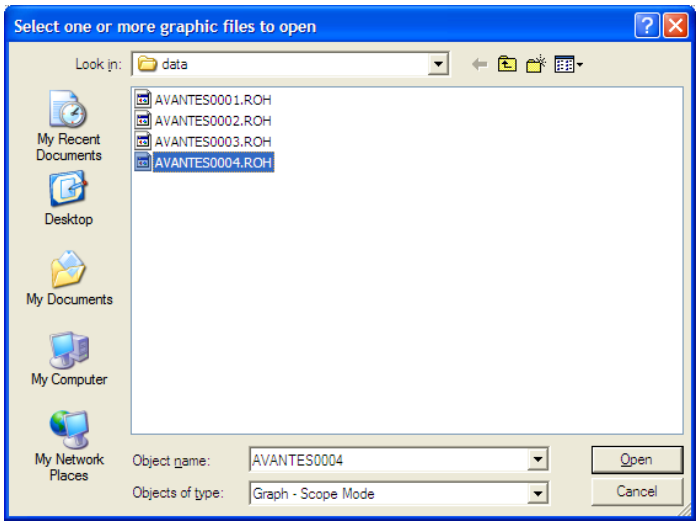


File Menu: Black and White printer

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.

File Menu: Display Saved Graph

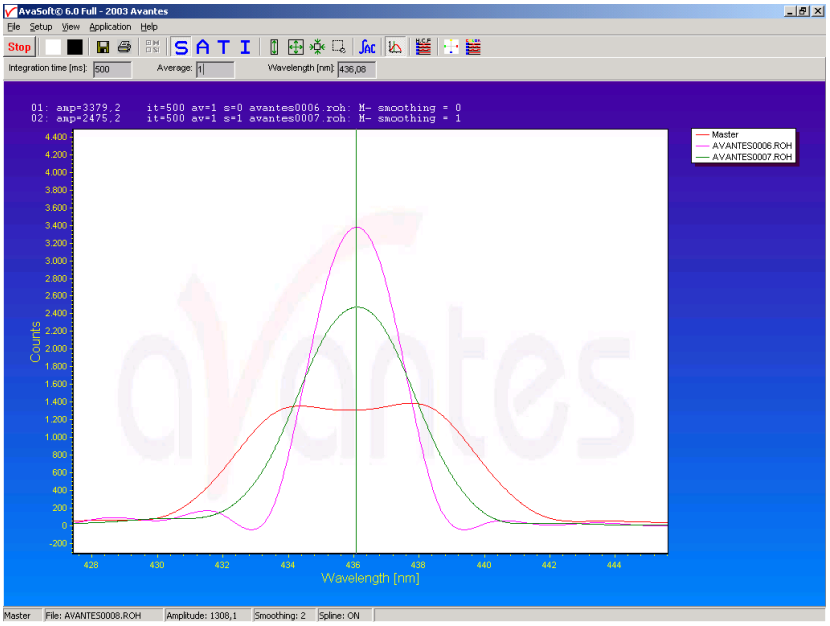
This option requires that graphic files were saved earlier by using the option File-Save Experiment. After choosing this option or clicking with the right mouse button on the legenda in the display window, a window shows all files in the current measure mode. In the example at the right, the measure 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 folder name.

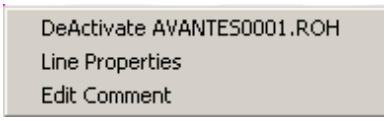
If a graphic file is marked by a (single) mouse click on the filename, the comment line for this file appears at the top of the graphical region in the main window. Selecting multiple filenames can be realized by using the CTRL or SHIFT key in combination with the mouse. If the CTRL key is pressed, all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



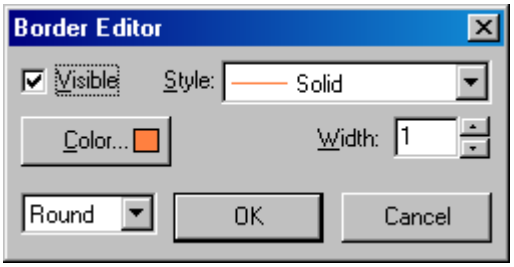
Select the name of the file(s) to be displayed and click the Open button. To leave this dialog without displaying graphic files, click the CANCEL button.

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. If the active spectrometer channels (e.g. Master) have not been unselected with the View Channel option, 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.



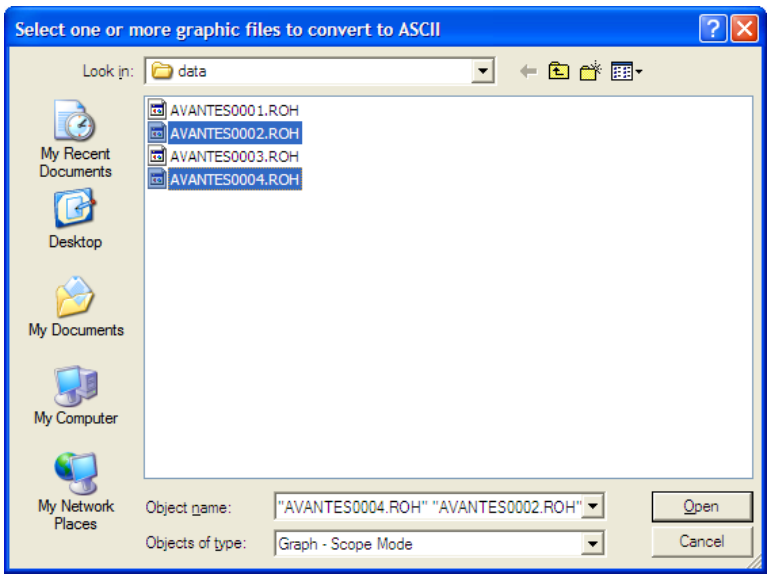
New in AvaSoft 7 is that displayed graphs can be deleted or properties of the displayed graphs, such as line style or color or comments can be changed. This is done by clicking with the right mouse button on the line in the graphical display. A small line edit box will occur.



Now the line can be deactivated or the line properties can be changed as depicted in the border editor or the comments can be edited.

The menu option File-Display Saved Graph is preceded by a checkmark as long as the earlier saved graphics are displayed. To clear all earlier saved graphics at once, 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.

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 folder name.

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:

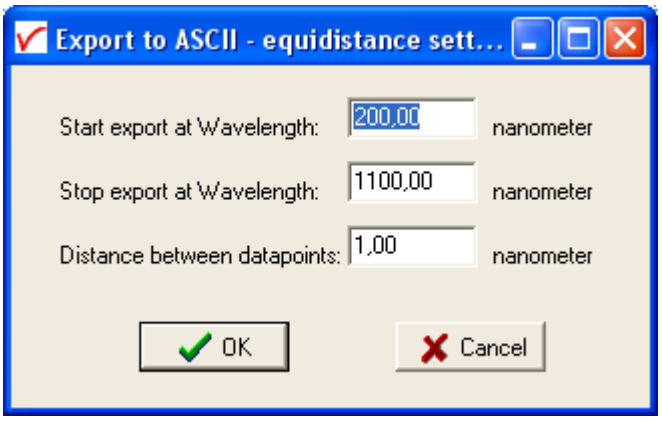
- the comment line
- the integration time
- the number of scans that has been averaged
- the number of pixels used for smoothing
- the serial number of the spectrometer that was used to save the data

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).

File Menu: Convert Graph - to ASCII Equi distance

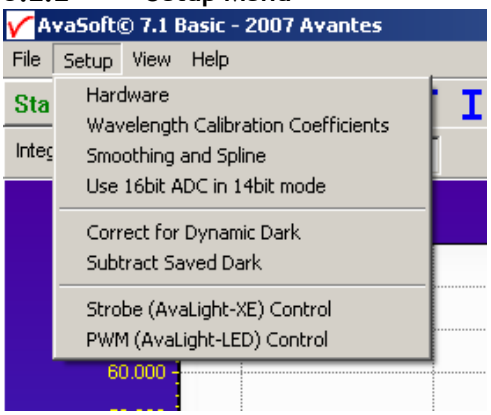
This option requires that graphic files were saved earlier by using the option File-Save Experiment. After selecting the option “File/ Convert Graph/To ASCII – Equi distance”, the wavelength range for which thedata should be converted, and the distance between two successive data points can be entered in the dialog as shown at the right. After clicking the OK button, you can select the files which need to be converted. Selecting these files is the same as for converting to ASCII without the equi distance feature, as described above.



Also the information in the header file is the same as for converting to ASCII without the equi distance feature. The data in the *.TRT, *.TAT, *.TTT and *.TIT files is presented in two columns. The first column gives the equally spaced wavelength in nanometers. The second column shows the interpolated value for scopedata (in a *.TRT file), absorbance (in a *.TAT file), transmittance (in a *.TTT file) or irradiance (in a *.TIT file).

File Menu: Exit
Closes AvaSoft.

3.2.2 Setup Menu

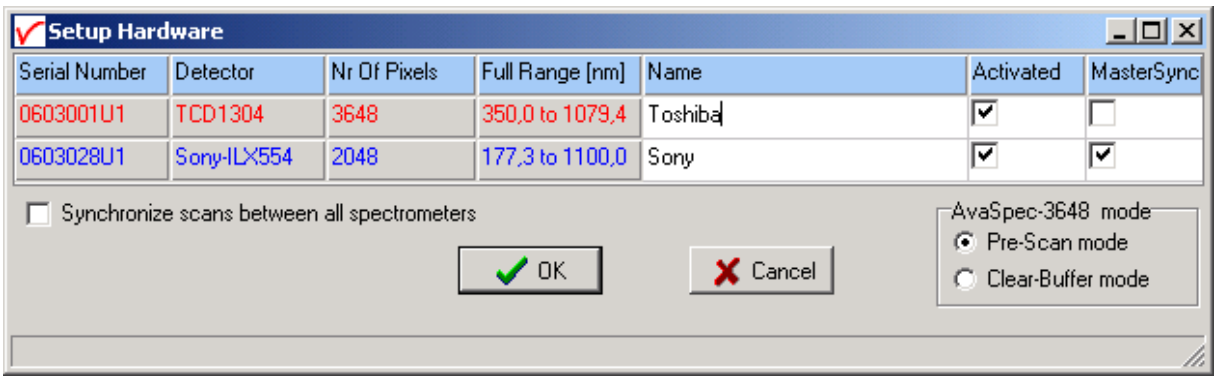


Setup Menu: Hardware

USB1 platform

This menu option displays a list of AvaSpec serial numbers that are connected to the PC's USB port(s) and COM port(s) and which are not used by another (instance of the) application. This option can be used to allocate a spectrometer to an application (for example if one spectrometer is running with AvaSoft-Basic and another spectrometer needs to run with AvaSoft-Raman software). But it can also be used to run multiple spectrometers simultaneously, just by restarting AvaSoft multiple times. After clicking the OK button, AvaSoft will communicate with the spectrometer serial number that has been activated in the dialog.

USB2 platform



This option shows all connected spectrometers and allows you to change the name of the channel and to deactivate and activate spectrometers. For synchronization of scans a master sync spectrometer needs to be dedicated, in Multichannel platforms usually the spectrometer from the left as seen from the front is prededicated as master sync by Avantes.

AvaSpec-3648-USB only

The Toshiba detector, as implemented in the AvaSpec-3648, can be used in 2 different control modes:

1. The Prescan mode (default mode).

In this mode the Toshiba detector will generate automatically an additional prescan for every request from the PC, the first scan contains non-linear data and will be rejected, the 2nd scan contains linear data and will be showed on the screen and/or saved. This prescan mode is default and should be used in most applications, like with averaging (only one prescan is generated for a nr of averages), with the use of an AvaLight-XE (one or more flashes per scan) and with multichannel spectrometers. The advantage of this mode is a very stable and linear spectrum. The disadvantage of this mode is that a minor (<5%) image of the previous scan (ghostspectrum) is included in the signal.
This mode cannot be used for fast external trigger and accurate timing, since the start of the scan is always delayed with the integration time (min. 3.7 ms).

2. The Clear-Buffer mode.
   In this mode the Toshiba detector buffer will be cleared, before a scan is taken. This clear-buffer mode should be used when timing is important, like with fast external triggering. The advantage of this mode is that a scan will start at the time of an external trigger, the disadvantage of this mode is that after clearing the buffer, the dector will have a minor threshold, in which small signals (<500 counts) will not appear and with different integration times the detector is not linear.

Setup Menu: Wavelength Calibration Coefficients
After clicking this option, a dialog is shown in which the wavelength calibration coefficients can be changed manually and start/stoppixels can be set to speed up datatransfer.

Background

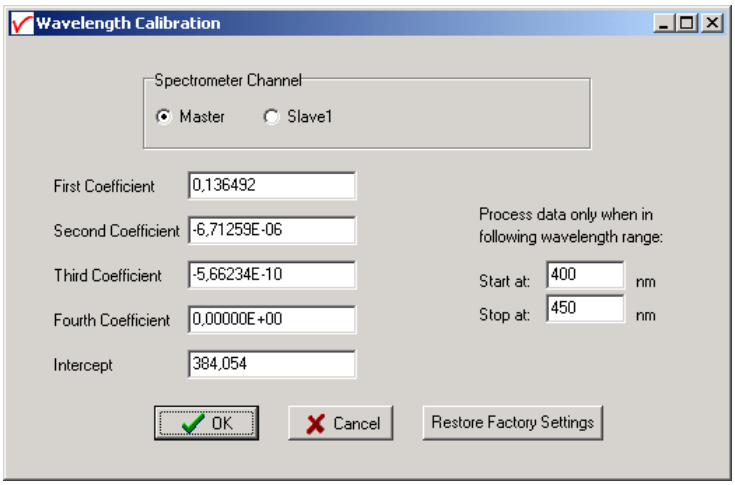
The wavelength λ that corresponds to a pixel number (pixnr) in the detector in the spectrometer can be calculated by the following equation:

$\lambda = \text{Intercept} + X1*pixnr + X2*pixnr^2 + X3*pixnr^3 + X4*pixnr^4$

in which Intercept and X1 to X4 correspond to Intercept and First to Fourth Coefficient in the figure below.

For example, if we want to calculate the wavelength at pixel number 1000, using the numbers in the figure at the right, the wavelength becomes:

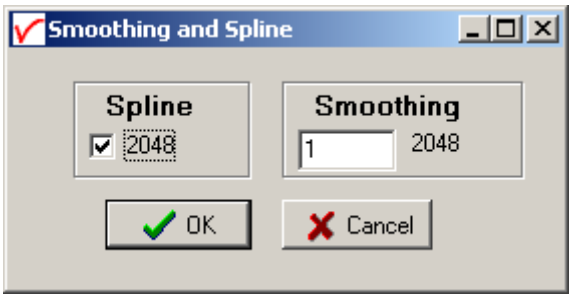
λ = 384,054 + 0,136492*1000 +
-6,71259E-6*1E6 +
-5,66234E-10*1E9
= 513,267 nm.



The 'Restore Factory Settings' button restores for all spectrometer channels the original wavelength calibration coefficients that were saved to the EEPROM during factory calibration.

The "Process data only when in following wavelength range" option can be used to transfer only a limited number of pixels from the spectrometer to the PC. This can significantly speed up the transfer time (e.g. for the AvaSpec-2048 from 30 ms at full wavelength down to 14 ms for a small selection of 10 pixels). A second advantage is data reduction, because only the spectral data will be saved at the pixels for which the wavelength is in the specified wavelength range.

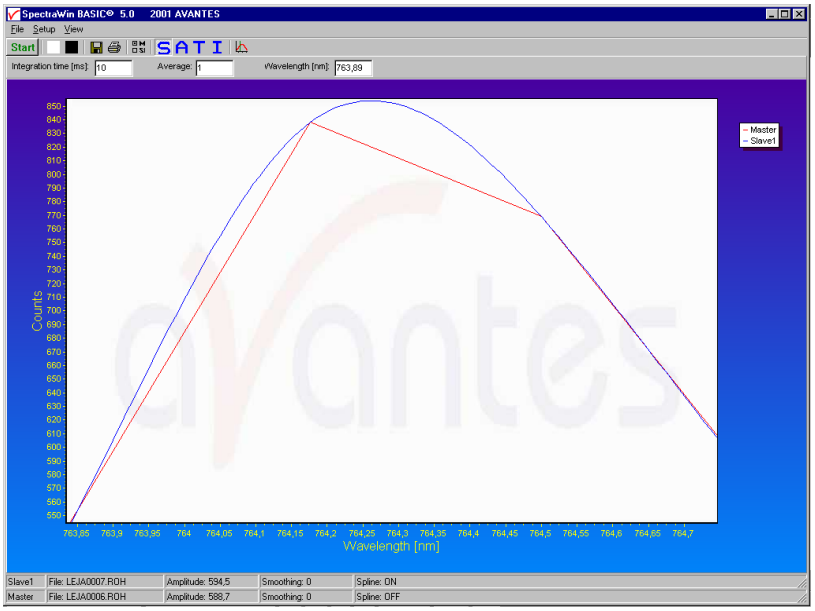
Setup Menu: Smoothing and Spline



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, which 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. Note that for the AvaSpec-2048 with 2048 pixels, the effect of spline interpolation is not visible if the data is shown at full scale. The monitor resolution is much less than 2048 pixels. The effect of spline interpolation can only be visualized if the number of detector pixels that are displayed is smaller than the number of monitor pixels at the x-axis.

Smoothing

To get a smoother spectrum without losing information it is important to set in the software 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 AvaSpec-2048, the distance between the pixels on the CCD-array is 14 micron.

With a 200 micron fiber (no slit installed) connected, the optical pixel resolution is about 14.3 CCD-pixels. With a smoothing parameter set to 7, each pixel will be averaged with 7 left and 7 right neighbor pixels. Averaging over 15 pixels with a pitch distance between the CCD pixels of 14 micron will cover 15*14 = 210 micron at the CCD array. Using a fiber diameter of 200 micron means that we will lose resolution when setting the smoothing parameter to 7. Theoretically the optimal smoothing parameter is therefore 6.
The formula is ((slit size/pixel size) – 1)/2
In the table below, the recommended smoothing values for the AvaSpecs spectrometer are listed as function of the light beam that enters the spectrometer. This light beam is the fiber core diameter, or if a smaller slit has been installed in the spectrometer, the slit width. Note that this table shows

the optimal smoothing without losing resolution. If resolution is not an important issue, a higher smoothing parameter can be set to decrease noise against the price of less resolution.

Slit or Fiber	**AvaSpec-102** **Pixel 77 µm**	**AvaSpec-128** **Pixel 63.5 µm**	**AvaSpec-256** **AvaSpec-1024** **Pixel 25 µm**	**AvaSpec-2048** **AvaSpec-2048x14** **Pixel 14 µm**	**AvaSpec-3648** **Pixel 8 µm**	**AvaSpec-NIR256** **Pixel 50 µm**
10µm	n.a.	n.a.	n.a.	0	0	n.a.
25µm	n.a.	n.a.	0	0-1	1	n.a.
50µm	0	0	0-1	1-2	2-3	0
100µm	0-1	0-1	1-2	3	5-6	0-1
200µm	1	1	3-4	6-7	12	1-2
400µm	2	2-3	7-8	13-14	24-25	3-4
500µm	3	3-4	9-10	17	31	4-5
600µm	3-4	4	11-12	21	37	5-6

Setup Menu: Use 16bit ADC in 14bit mode (only USB2 platform, HW rev 1D and later)

The 14bit AD Converter used with the as5216 boards revision 1B and 1C inside the AvaSpec-USB2 has been replaced by a 16bit ADC since the release of the as5216 board revision 1D. Therefore, the default range in Scope Mode for an AvaSpec-USB2 has changed from a 14bit range (0..16383) to 16bit (0..65535).
If the menu option "Use 16bit ADC in 14bit mode" is enabled (preceded by a checkmark), the 16bit range AD Counts will be converted to a 14bit range by the as5216.dll (divide by 4.0). This option has been added for customers who have been already working with earlier versions of the AvaSpec-USB2 with 14bit ADC, and want to be able to compare the data in scope mode between both spectrometers. Note that by setting the 16bit ADC into 14bit mode, you will not loose resolution because the numbers are not truncated or rounded to integer numbers, e.g. 5 counts in 16bit mode will become 1.25 counts in 14-bit mode.
If multiple AvaSpec-USB2 spectrometers are connected simultaneously and one or more devices don't support the 16bit ADC (rev 1B or rev 1C as5216 board), all spectrometers will be set automatically into 14bit mode (range 0..16383 AD counts).

Setup Menu: Correct for Dynamic Dark (AvaSpec-2048/3648 only)

The pixels of the CCD detector (AvaSpec-2048/3648/2048x14) are thermally sensitive, which causes a small dark current, even without light exposure. To get an approximation of this dark current, the signal of the first 14 optical black pixels of the CCD-detector can be taken and subtracted from the raw scope data. This will happen if the correct for dynamic dark option is enabled. As these 14 pixels have the same thermal behavior as the active pixels, the correction is dynamic.
Note that this option is different from the dark current that needs to be saved before any transmittance or absorbance measurements can be taken (File-Save Dark). If the correct for dynamic

dark option has been changed, it will be necessary to save a new dark and reference spectrum because the raw data has been changed.

If this menu option is preceded by a checkmark, the scope data is corrected with the dynamic dark algorithm. It is recommended to leave this setting checked, which is the default state.

Setup Menu: Subtract Saved Dark

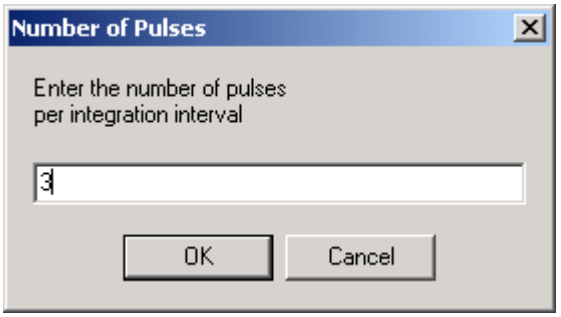
This option is used to subtract the dark spectrum that has been saved (File-Save Dark) from the raw scope data. After starting up AvaSoft, this menu option is always unselected, because a dark spectrum needs to be saved or loaded before it can be subtracted.
If this menu option is preceded by a checkmark,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

Setup Menu: Strobe Enable

This option can be used to enable or disable an external strobe (e.g. the AvaLight-XE) attached to an AvaSpec spectrometer. The measured light intensity of the AVALIGHT-XE is independent of the integration time in AvaSoft. To increase light intensity, the number of pulses per integration interval should be increased. The maximum frequency at which the AVALIGHT-XE operates is 100 Hz. This means that the minimum integration time for 1 pulse per scan is 10 ms. When setting the number of pulses e.g. to 3, the minimum integration time becomes 30 ms. It is recommended to keep the integration time as low as possible to avoid unnecessary increase of noise.

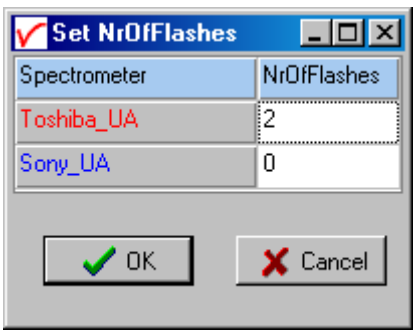
USB1 platform

The AvaLight-XE needs to be attached to the AvaSpec by connecting an IC-DB15-2 interface cable to the high density 15 pole Sub-D connectors at the AvaSpec and AvaLight -XE. If used with an old XE-2000, the XE-2000 has the possibility to switch between Single Flash and Multi Flash (in that case there will be a switch at the backside of the XE-2000), make sure that the switch is always in the Single Flash position, when using the XE-2000 with an AvaSpec spectrometer (in Single Flash mode the XE-2000 is triggered at pin 1, in Multi Flash mode at pin 2). When clicking the “Strobe Enable” menu option, a dialog is shown in which this number of pulses can be set.If this menu option is preceded by a checkmark, the strobe control function has been enabled. To disable the strobe, simply click the menu option when preceded by a checkmark.



Strobe (AvaLight-XE) Control USB2 platform

The AvaLight-XE needs to be attached to AvaSpec-USB2 by connecting an IC-DB26-2 interface cable between the high density 26 pole Sub-D connectors at the AvaSpec-USB2 and the 15-pole DB connector of the AvaLight -XE. If used with a multichannel system, make sure that the AvaLight-XE is connected to the master sync spectrometer, only the number of flashes per scan set for the master synch spectrometer will determine flash rate. To disable the strobe, simply enter 0 under the NrOfFlashes.



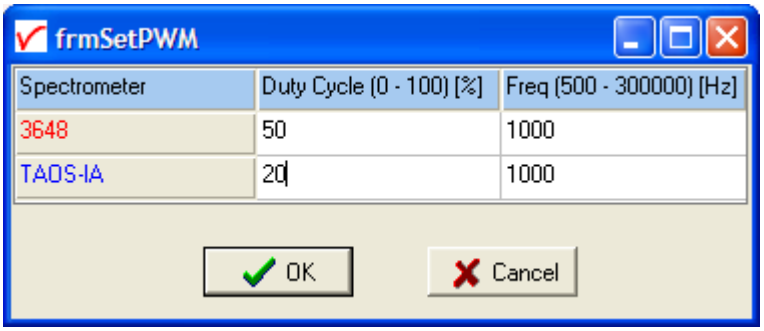
Setup Menu: 1 kHz Enable (DO2) for USB1 platform

Pin 2 of the high density 15 pole Sub-D connector at the AvaSpec can be used to generate an 1 kHz signal. This signal can be used to control an AvaLight-LED light source in pulsed mode.

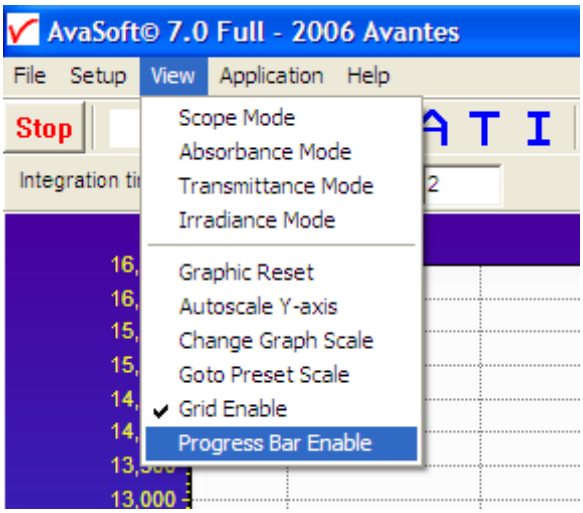
Setup Menu: PWM (AvaLight-LED) control for USB2 platform

The AvaLight-LED needs to be attached to AvaSpec-USB2 by connecting an IC-DB26-2 interface cable between the high density 26 pole Sub-D connectors at the AvaSpec-USB2 and the 15-pole DB connector of the AvaLight –LED (DO1 – pin11).

The frequency can be set between 500 Hz and 300 kHz, the duty cycle between 0 and 100%.
If used with a multichannel system, all channels can have their own independent PWM setting for both frequency and duty cycle.
To disable the PWM output, simply enter 0 under the Duty Cycle.



3.2.3 View Menu



View Menu: Scope Mode
The display is set to Scope Mode, showing a real-time raw data signal, with on the Y-axis the readout of the AD-converter and on the X-axis the calculated wavelength.

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:

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

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.

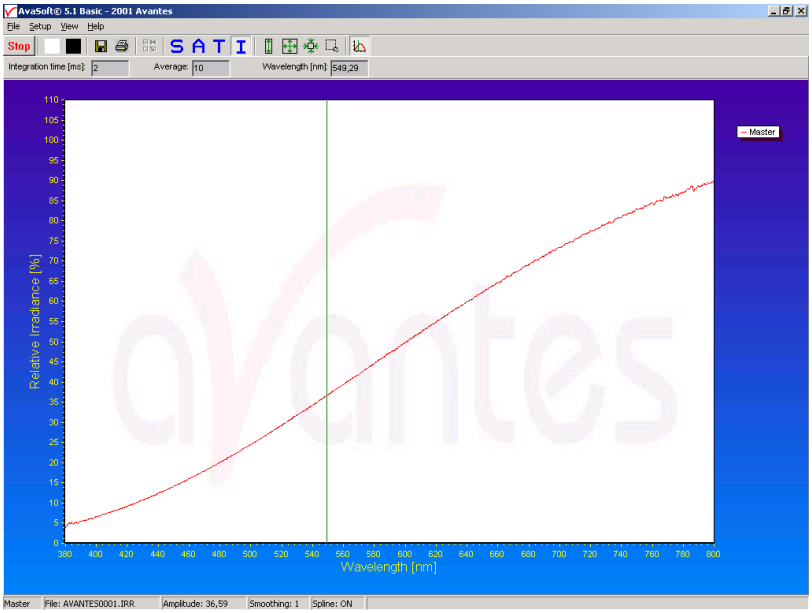
View Menu: Irradiance Mode
For relative irradiance measurements, a light source of known color temperature is needed as a reference, for example the AvaLight-HAL with color temperature of 2900K. The **relative** radiance energy at wavelength λ is then calculated using the current sample, the reference 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 a fiber to the Spectrometer input port.
3. Adjust the Smoothing Parameters in the Setup menu to optimize smoothing for the Fiber/Slit diameter that is used.
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 90% of the full ADC scale (14750 counts for the 14bit ADC, 59000 counts for the 16bit ADC). 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** (2850K for AvaLight-HAL with default jumper setting) 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 90% of the full ADC scale (14750 counts for the 14bit ADC, 59000 counts for the 16bit ADC).
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 on the next page. The maximum of the reference Planck-curve has been set to 100.



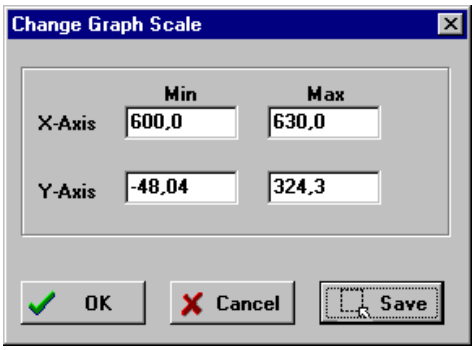
View Menu: Channel (only for USB1 platform)



After selecting this option, a dialog is shown in which the channels to be displayed can be selected. Depending on the number of available channels in the spectrometer system that is used, up to 8 spectrometer channels can be selected. If displaying graphs that were saved before (File-Display Saved Graph), the active channels also remain visible, to be able to measure online against a saved graph background. To view only the saved graphs, all active channels need to be unselected.

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.



View Menu: Graphic Reset

When selecting this option, the graph will be reset for all available channels in the spectrometer. This means that both the default X- and Y-axes will be shown.

View Menu: Auto scale 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. This will be realized for all channels in the current view mode.

View Menu: Goto Preset Scale

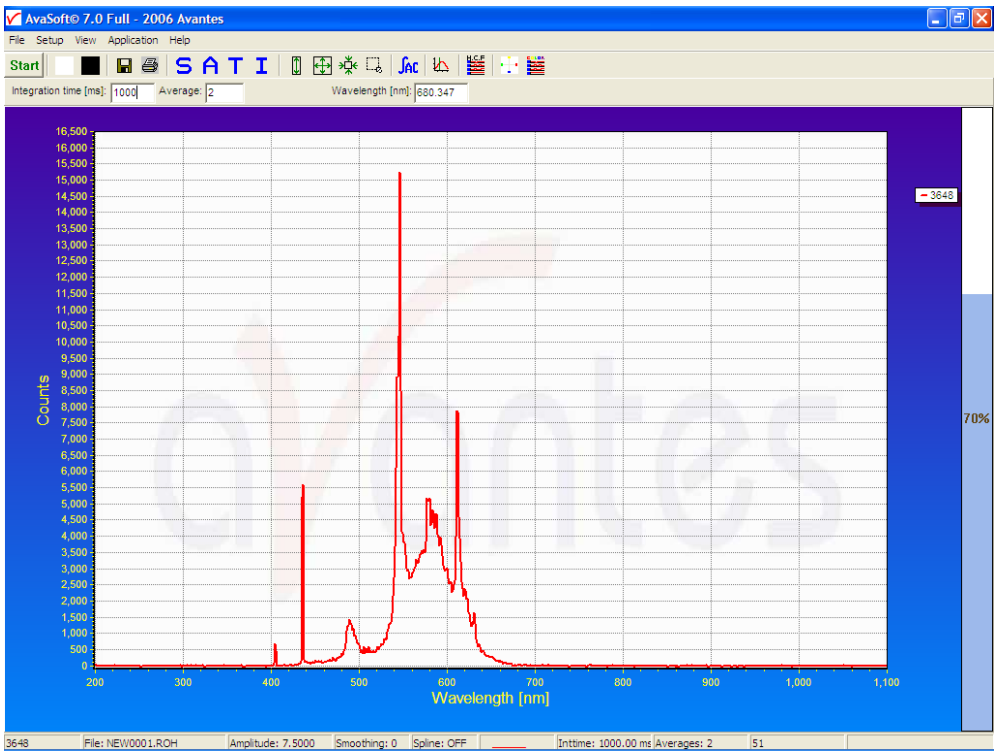
By clicking this menu option, the scale for X- and Y-axis will be set to a range that has been set before . The same result can be achieved by clicking the Goto Preset Scale Button in the button bar.

View Menu: Grid Enable

With the Grid Enable option activated, a grid will be displayed in the graph as shown in the figure below.

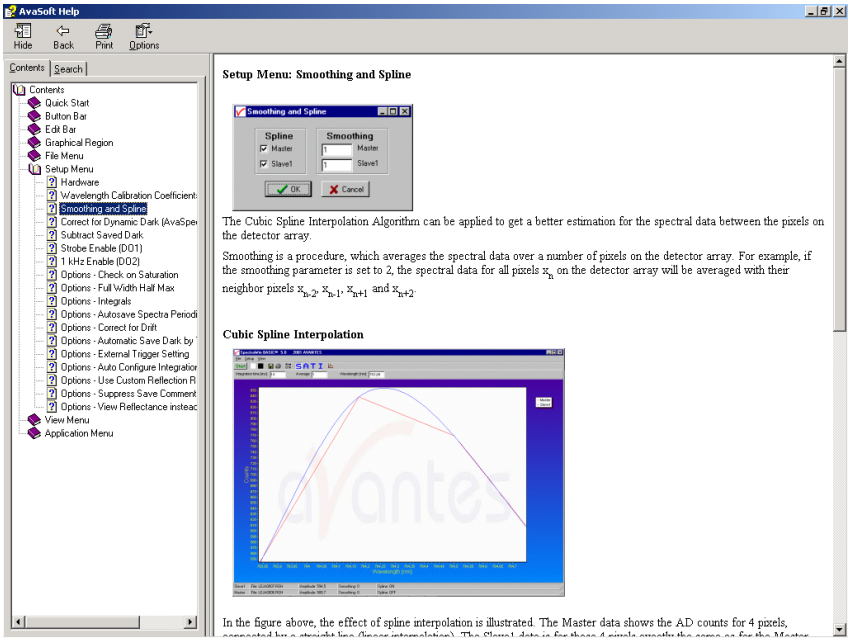
View Menu: Progress Bar Enable

If using long integration times or a high number of averages, it can take a few or more seconds before a new scan is received by the application. To get an indication about how much time it will take until the next scan arrives, a progress bar can be displayed. After enabling the progress bar by clicking the menu option, it will be displayed after the next scan has arrived. The progress bar will be shown only if the time between scans is more than one second. The time between scans is roughly the integration time, multiplied with the number of averages. However, if the number of averages is high, the time between scans can get longer because of the overhead time that is spent on transmitting the high number of average spectra to the PC.



3.2.4 Help Menu

The information in this manual can also be found in the help menu. Further, a lot of additional features that are standard in the FULL version of AvaSoft are described in this help file, as well as the add-ons that are available with this FULL version, like color, process control, absolute irradiance and AvaSoft-XLS. 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.



Instead of browsing through the contents to a specific topic, the search TAB can be selected. 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.

3.3 Troubleshooting

If there are any failures, please don't hesitate to contact us:

Avantes Technical Support
Soerense Zand Noord 26
NL-6961 RB Eerbeek
The Netherlands

Tel.: +31-(0)313-670170
Fax.: +31-(0)313-670179

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

4 Light Sources

Avantes offers a variety of UV/VIS/NIR and Calibration light sources. In the following paragraphs you will find the technical documentation on the following light sources:

- AvaLight-HAL Tungsten halogen light source
- AvaLight-HAL-S Tungsten halogen light source with shutter
- AvaLight-HAL-CAL Calibrated Tungsten halogen light source
- HL-6000-S Halogen light source with TTL shutter
- AvaLight-LED-XXX LED light source
- AvaLight-DHc Compact Deuterium Halogen light source
- AVALIGHT-XE Xenon pulsed light source
- AvaLight-DHS Deuterium Halogen light source with filter holder/shutter
- AvaLight-DH-CAL Calibrated UV-VIS light source
- AvaLight-CAL Mercury Argon/Neon calibration light source

All of these light sources easily couple to our wide range of spectrometers and accessories through SMA905 coupled fiber optics, which are described in chapter 5.



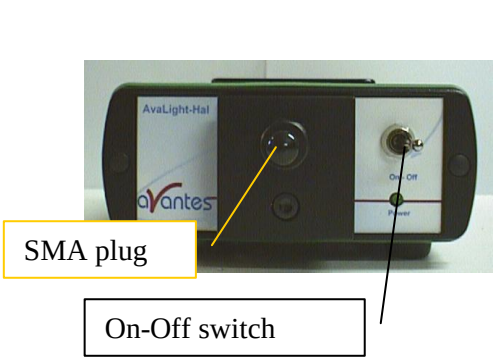
4.1 AvaLight-HAL Tungsten Halogen light source

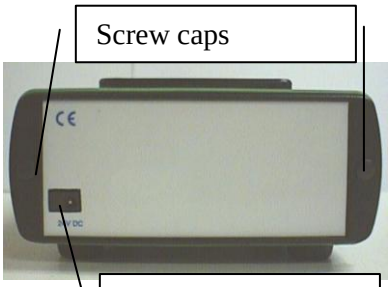
Parts Included

1. AvaLight-HAL Halogen Light source
2. The AvaLight-HAL Operating manual
3. PS-24V/1.25A 100-240VAC power supply (should have been ordered separately)

Starting up

1. Plug in the PS-24V power supply .
2. Plug in the connector of the power supply into the socket of AvaLight-HAL.
3. Connect the SMA-connectors of your fibers to the SMA-plug
4. Switch on the Halogen lamp with the switch.







PS-24VDC power supply

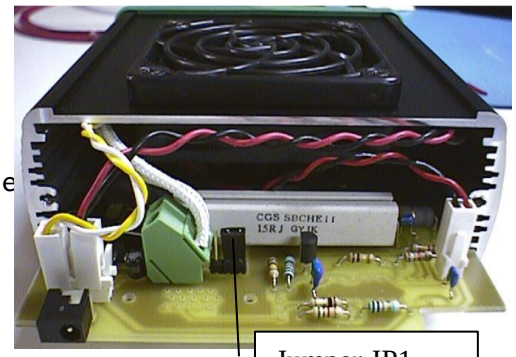
Settings for high power or long lifetime

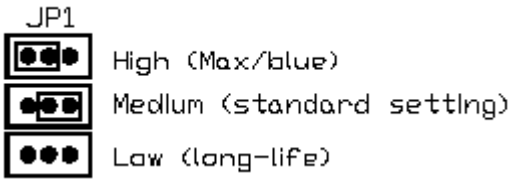
The AvaLight-HAL is factory set for optimal power output (medium setting), with an internal jumper the optical energy can be controlled (see table).

Jumper setting	Optical output	Color temperature	Exp. Lifetime
LOW	70%	Ca. 2.700K	> 2.000 hrs.
MEDIUM (default)	100%	Ca. 2.850K	1.000 hrs
HIGH	150%	Ca. 3.000K	< 1.000 hrs.

The internal jumper settings can be changed, please follow instructions:

1. Remove screw protection caps on the backside
2. Loosen 2 screws with philips screwdriver
3. remove backplane
4. take out electronics board
5. Adjust jumper settings according to scheme below
6. put back electronics board, be carefull not to pinch the e
7. put back backplane, screws and screw protection caps





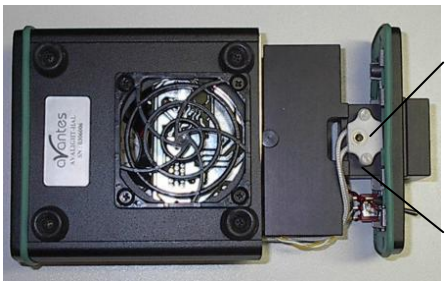
Adjustment of focusing in SMA fiber

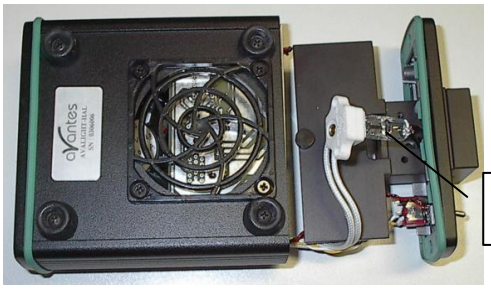
The AvaLight is factory adjusted to optimally focus the output into a 200µm fiber. If lower optical power is recommended or a different fiber (bundle) diameter is used, the optical power can be adjusted.

1. Connect your fiber optic spectrometer or your optical power meter to a fiber to the AvaLight-HAL SMA socket (4) .
2. Loosen blocking-screw with delivered Allen key (1,3mm).
3. By shifting the SMA socket you can optimize your optical power.
4. Secure position by tightening the blocking screw .

Changing the light source bulb

1. Plug out the power connector from the socket.
2. Remove screw protection caps on the frontside
3. Loosen 2 screws with philips screwdriver
4. turn the lightsource upside down
5. take out the frontplate and lamphouse
6. remove 2 nylon screws from lamp socket
7. take out the lamp socket
8. take out the bulb (carefull, may be hot)
9. replace by new bulb, do not touch glass with your fingers
10. put back lamp socket and nylon screws
11. Slide back front plate and lamp house, be carefull not to pinch the electrical wires
12. put back screws and protection caps





Technical Data

	AvaLight-HAL (standard)	AvaLight-HAL (long life)	AvaLight-HAL (high power)
Wavelength Range	360 - 2500 nm		
Stability	± 0.1%		
Time to stabilize	Ca. 15 min.		
Output to bulb	12.7 VDC/ 0.9A	11.3 VDC/ 0.8A	14.1 VDC/ 1.0A
Bulb Life	1000 hrs	> 2000 hrs	< 1000 hrs
Optical power 200µm fiber	0.5 mWatt	0.35 mWatt	0.7 mWatt
Optical power 600µm fiber	4.5 mWatt	3.2 mWatt	6 mWatt
Optical power 1000µm fiber	10 mWatt	7 mWatt	14 mWatt
Bulb Color Temperature	2.850 K	2.700 K	3.000 K
Power requirement	24 VDC (+inside, GND outside)/ 1.25A		
Dimensions (mm)	132 x 110 x 44 mm		

4.2 AvaLight-HAL-S Tungsten Halogen Light Source with shutter

Parts Included

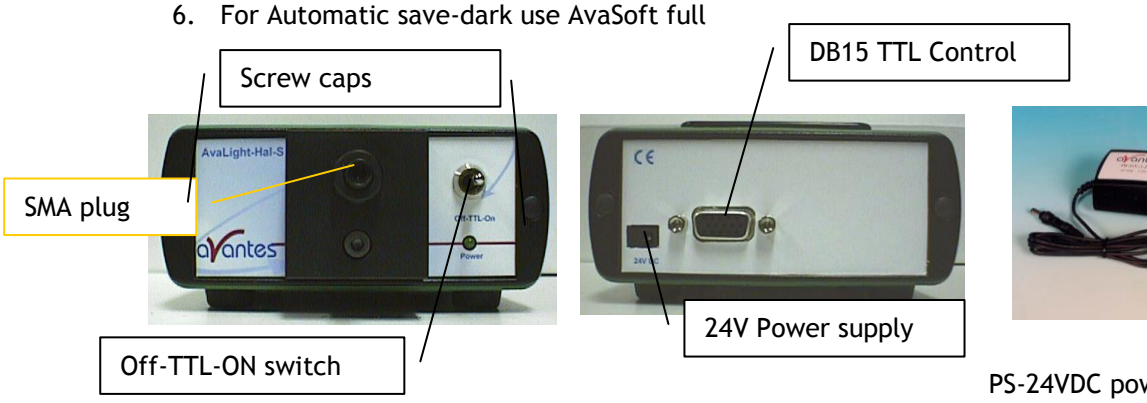
1. AvaLight-HAL Halogen Light source
2. The AvaLight-HAL Operating manual
3. PS-24V/1.25A 100-240VAC power supply (should have been ordered separately)
4. Optional IC-DB15-2 (to connect to USB1 platform)or IC-DB26-2 (to connect to USB2 platform) connection cable, should have been ordered separately

Starting up

1. Plug in the PS-24V power supply .
2. Plug in the connector of the power supply into the socket of AvaLight-HAL.
3. Connect the SMA-connectors of your fibers to the SMA-plug
4. For automatic TTL-shutter control insert interface cable IC-DB15-2 for USB1 platform or IC-DB26-2 for USB2 platform, plug in connector and connect to AvaSpec spectrometer
5. Choose operating mode for the mode-switch:

Switch position	TTL signal	Lightsource	Shutter
OFF	X	OFF	Closed
TTL	Not connected	ON	Close
	High	ON	Open
	Low	ON	Close
ON	X	ON	Open

6. For Automatic save-dark use AvaSoft full





PS-24VDC power supply

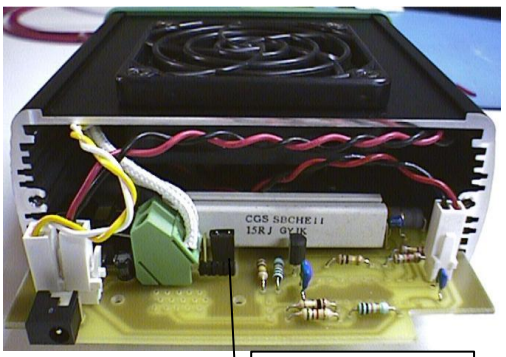
Settings for high power or long lifetime

The AvaLight-HAL-S is factory set for optimal power output (medium setting), with an internal jumper the optical energy can be controlled (see table).

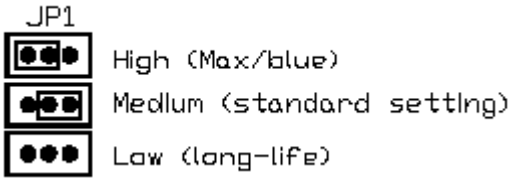
Jumper setting	Optical output	Color temperature	Exp. Lifetime
LOW	70%	Ca. 2.700K	> 2.000 hrs.
MEDIUM (default)	100%	Ca. 2.850K	1.000 hrs
HIGH	150%	Ca. 3.000K	< 1.000 hrs.

The internal jumper settings can be changed, please follow instructions:

8. Remove screw protection caps on the backside
9. Loosen 2 screws with philips screwdriver
10. remove backplane
11. take out electronics board
12. Adjust jumper settings according to scheme below
13. put back electronics board, be carefull not to pinch the electrical wires
14. put back backplane, screws and screw protection caps



Jumper JP1



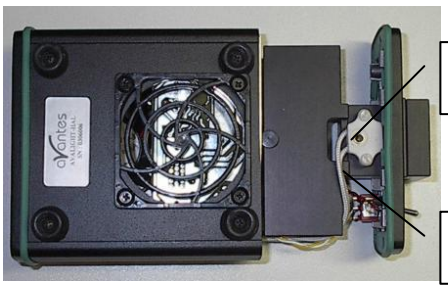
Adjustment of focusing in SMA fiber

The AvaLight is factory adjusted to optimally focus the output into a 200µm fiber. If lower optical power is recommended or a different fiber (bundle) diameter is used, the optical power can be adjusted.

5. Connect your fiber optic spectrometer or your optical power meter to a fiber to the AvaLight-HAL SMA socket (4) .
6. Loosen blocking-screw with delivered Allen key (1,3mm).
7. By shifting the SMA socket you can optimize your optical power.
8. Secure position by tightening the blocking screw .

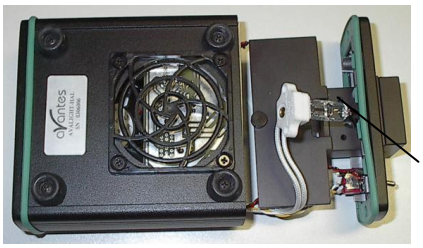
Changing the light source bulb

1. Plug out the power connector from the socket.
2. Remove screw protection caps on the frontside
3. Loosen 2 screws with philips screwdriver
4. turn the lightsource upside down
5. take out the frontplate and lamphouse
6. remove 2 nylon screws from lamp socket
7. take out the lamp socket
8. take out the bulb (carefull, may be hot)
9. replace by new bulb, do not touch glass with your fingers
10. put back lamp socket and nylon screws
11. Slide back front plate and lamp house, be carefull not to pinch the electrical wires
12. put back screws and protection caps



Lamp socket

Lamp house



Light bulb

Technical Data

	AvaLight-HAL (standard)	AvaLight-HAL (long life)	AvaLight-HAL (high power)
Wavelength Range	360 - 2500 nm		
Stability	± 0.1%		
Time to stabilize	Ca. 15 min.		
Output to bulb	12.7 VDC/ 0.9A	11.3 VDC/ 0.8A	14.1 VDC/ 1.0A
Bulb Life	1000 hrs	> 2000 hrs	< 1000 hrs
Optical power 200µm fiber	0.5 mWatt	0.35 mWatt	0.7 mWatt
Optical power 600µm fiber	4.5 mWatt	3.2 mWatt	6 mWatt
Optical power 1000µm fiber	10 mWatt	7 mWatt	14 mWatt
Bulb Color Temperature	2.850 K	2.700 K	3.000 K
DB-15 connector	Pin 10 = GND Pin 13 = TTL input, high – shutter open, low shutter closed		
Power requirement	24 VDC (+inside, GND outside)/ 1.25A		
Dimensions (mm)	132 x 110 x 44 mm		

Ordering Information

AvaLight-HAL	10W Tungsten Halogen Lamp, fan-cooled, needs extra PS-24V/1.25A power supply
AvaLight-HAL-S	10W Tungsten Halogen Lamp, fan-cooled, incl. TTL shutter, needs extra PS-24V/1.25A power supply
AvaLight-HAL-S-RM	Rack mounted version of the 10W Tungsten Halogen Lamp, fan-cooled, incl. TTL shutter
IC-DB15-2	Interface cable AvaSpec-USB1 platform to AvaLight-HAL-S
IC-DB26-2	Interface cable AvaSpec-USB2 platform to AvaLight-HAL-S
AvaLight-HAL-B	10W Tungsten Halogen Replacement bulb for AvaLight-HAL, AvaLight-HAL-S
CUV-HAL	Direct attach cuvette holder for AvaLight-HAL
PS-24V/1.25A	Power supply 100-240VAC/24VDC, 1.25A, necessary for AvaLight-HAL

4.3 AvaLight-HAL-CAL Calibrated Tungsten Halogen light source

Parts Included

1. AvaLight-HAL-CAL Calibrated Tungsten Halogen light source
2. CC-UV/VIS cosine corrector, mounted in the AvaLight-HAL-CAL
3. Printed Calibration sheet in $\mu W/cm^2nm$
4. CD/Diskette with Calibrated output as *.lmp file, to be read in directly by AvaSoft-IRRAD
5. Calibrated PS-24V/1.25A power supply.

Starting up

1. Plug in the power supply.
2. Plug in the connector of the power supply into the socket of AvaLight-HAL-CAL.
3. Connect the SMA-connector of your fiber to the SMA-plug of the CC-UV/VIS
4. Switch on the Halogen lamp with the frontside switch.

Changing of the bulb

Since the light source is calibrated, the bulb exchange and recalibration can only be done in our calibration lab.

N.B. The AvaLight-HAL-CAL cannot be used as a light source for standard reflection/absorption spectroscopy.

How to take absolute irradiance measurements with AvaSoft 7 full

1. Start the AvaSoft 7 software, and click the Start button in the main window.
2. Connect a fiber to the Spectrometer input port.
3. Start the Absolute Irradiance Application software by clicking the menu option: Application/Absolute Irradiance. Click the “Perform Intensity Calibration” button.
4. Select the spectrometer channel that will be calibrated, the calibration lamp file and enter the diameter of the fiber/cosine corrector or integrating sphere sample port that is used.
5. Turn on the reference light source (e.g. AvaLight-HAL-CAL or AvaLight-HAL-CAL-ISP). If a cosine corrector is used at the end of the fiber, mount it directly on the reference light source. If an integrating sphere is used at the end of the fiber, put the integrating sphere sample port over the light output port.
6. Verify that the calibration lamp is ON for at least 15 minutes, and click the “Start Intensity Calibration” button. Try to adjust the integration time while looking at the reference light, such that the maximum count over the wavelength range is around 14000 counts. It’s also possible to let AvaSoft search for an optimal integration time by clicking the ‘∫AC’ button.
7. Adjust the Smoothing Parameter to optimize smoothing for the Fiber/Slit diameter that is used.
8. If a good reference signal is displayed, click the white “Save Reference” button. A white line will mark the reference spectrum. Then switch off the calibration lamp, wait until the spectrum becomes flat, near the bottom of the scale, and click the black button to save a dark spectrum. A black line will mark the dark spectrum.
9. Click the “Save Calibration” button. A dialog shows up in which the current settings in this intensity calibration are shown. If the calibration has been performed with diffuser, the intensity calibration data will be saved to an ASCII file with extension *.dfr, with bare fiber this

extension will be *.fbr. The name of the intensity calibration file can be entered after clicking the "Save As" button.

10. Switch to the Irradiance Chart TAB to enter the hardware setup and select the colorimetric, radiometric, photometric and/or peak parameters of interest. Then click OK.
11. Measure the output parameters in the experiment. If needed, change the integration time, such that the maximum in Scope Mode is around 14000 A/D Counts . Block the light path to the spectrometer, and save a dark spectrum. If the (ir)radiance of the light to be measured needs to be displayed against time, click the time measurement TAB in the settings dialog as described in section 4.4.6.
12. The intensity calibration as performed under point 9 can be loaded in future experiments by selecting the option "Load Intensity Calibration", as described below under Quick Start (2). After loading an intensity calibration, a dark spectrum needs to be saved before switching to Irradiance mode.

Technical Data

Wavelength Range	350-1095 / 1100-2500nm
Calibration Accuracy Repeatability	± 0.5 %
Calibration Relative Uncertainty to NIST standard	± 9.5 % (350-1100nm) ± 6.5% (1100-1950nm) ± 9,5% (1950-2500nm)
Calibration valid for	60 hrs
Time to stabilize	Ca. 15 Min.
Bulb Output (CC-UV/VIS)	Ca. 170µW/cm^{2}nm (@800nm)
Power requirement	24 VDC / 1.2A
Dimensions (mm)	132 x 110 x 44

Ordering information

AvaLight-HAL-CAL	NIST traceable Halogen Lamp with CC-UV/VIS-CAL diffuser, incl. PS-24V/1.25A
AvaLight-HAL-CAL-ISP30	NIST traceable Halogen Lamp for use with AvaSphere-30-IRRAD, incl. PS-24V/1.25A
AvaLight-HAL-CAL-ISP50	NIST traceable Halogen Lamp for use with AvaSphere-50-IRRAD, incl. PS-24V/1.25A
AvaLight-HAL-CAL-ISP80	NIST traceable Halogen Lamp for use with AvaSphere-80-IRRAD, incl. PS-24V/1.25A
HL-Recal	AvaLight-HAL-CAL recalibration service 350-1095nm
HL-Recal-NIR	AvaLight-HAL-CAL extended or recalibration service 1100-2500nm

4.4 AvaLight-LED LED Light Source

Parts included

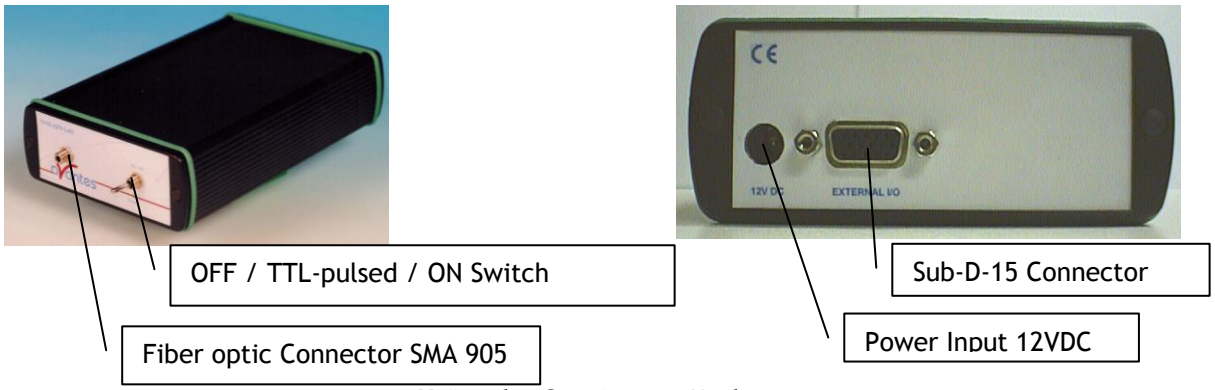
Your package should contain:

1. AvaLight-LED
2. The AvaLight-LED Operating Manual
3. Optional IC-DB15-2 (to connect to USB1 platform)or IC-DB26-2 (to connect to USB2 platform) connection cable, should have been ordered separately.
4. PS-12V/1.0A power supply, should have been ordered separately.

Starting up

1. Plug the power supply into a standard 220V outlet and into the back of the AvaLight-LED
2. Screw an optical fiber onto the SMA connector on the front of the light source.

Designations and Functions of Panel Controls



Using the Continuous Mode

1. Turn the switch on the AvaLight-LED to “ON” The continuous mode simply means that the light coming from the AvaLight-LED is continuous.
2. To Turn the lamp off, simply change the position of the switch to „OFF”

Using the Pulsed Mode

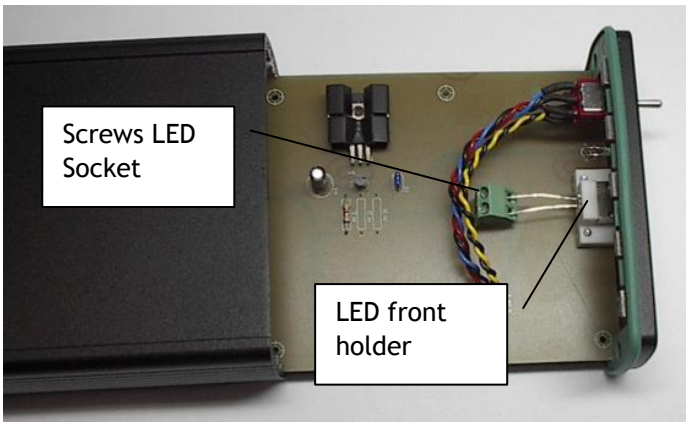
1. Plug one end of the IC-DB-15-2 /IC-DB26-2 interface cable into the back of the AvaLight-LED and the other end into the back of the AvaSpec-Spectrometer.
2. Turn the switch of the AvaLight-LED to „TTL“ for Pulsed mode of operation.
3. The pulsing of the AvaLight-LED is controlled through the AvaSpec spectrometer and fixed to 1 kHz with a 50% duty cycle for the USB1 platform and 500 Hz-300 kHz with 0-100% duty cycle for the USB2 platform, the newer type AvaLight-LED-p14 uses the input from pin 14 of the controlling of the LED (only on, when spectra are acquired).

Table of DB-15/DB26 connector

Pin	Description
2	TTL Input from AvaSpec-USB1 (1KHz, 50%) or AvaSpec-USB2 PWM 500 Hz-300 kHz with 0-100% duty cycle
10	GND
14	TTL input from AvaSpec with AvaSoft -OXY

LED Lamp replacement

1. Plug out the power connector from the socket.
2. Remove screw protection caps on the frontside
3. Loosen 2 screws with philips screwdriver
4. take out the frontplate and electronics board
5. untighten 2 screws from LED socket
6. slightly bend the electrical wires out of LED socket
7. take out the LED from LED front holder
8. replace by new LED, make sure the Anode and Kathode are connected in the same way and LED legs make no short circuit.
9. Apply power to see if the LED is illuminating
10. Slide back electronics board and front plate, tighten screws and put back screw caps



Technical Data

	AvaLight-LED380	AvaLight-LED400	AvaLight-LED470	AvaLight-LED590
Power Supply	12 VDC/ 800mA			
Spectral Range*	380 nm	400 nm	470 nm	590 nm
FWHM (nm)	15 nm	11 nm	30 nm	30 nm
LED output	10 µWatt	25 µWatt	25 µWatt	25 µWatt
Connector	SMA 905			
Power Supply	12 VDC(+inside, GND outside), 40 mA			
Dimensions	175 x 110 x 44 mm			

** other wavelengths available on request*

Ordering Information

AvaLight-LED-XXX	Light Emitting Diode Lightsource, specify wavelength XXX
AvaLight-LED-470-p14	Light Emitting Diode Lightsource, 470 nm for use with AvaSoft-Oxy
AvaLight-LED-XXX-RM	Rackmount version of the Light Emitting Diode Lightsource, specify wavelength XXX
IC-DB15-2	Interface cable AvaSpec-USB1 platform to AvaLight-LED
IC-DB26-2	Interface cable AvaSpec-USB2 platfom to AvaLight-LED for PWM
PS-12V/1.0A	Power supply 100-240 VAC/12VDC, 1.0 A for AvaLight-LED

4.5 AvaLight-DHc Compact Deuterium-Halogen Light Source

Parts included

1. AvaLight-DHc Deuterium-Halogen light source
2. The AvaLight-DHc Operating manual.
3. Optional IC-DB15-2 (to connect to USB1 platform)or IC-DB26-2 (to connect to USB2 platform) connection cable, should have been ordered separately
4. 12V/1.0A DC-Poweradapter, should have been ordered separately

Safety Instructions

➔ **Instructions:** All the safety and operating instructions should be read before the unit is operated. Before using the power supply for the first time check for transport damage.

➔ **Warning:** All warnings on the unit and in the operating instructions should be adhered to.

Unpacking Instructions:

1. Unpack your new power supply and AvaLight-DHc carefully. Although the deuterium lamp is rigidly mounted dropping this instrument can cause permanent damage.
2. Inspect the outside of the instrument and make sure that there is no damage to your unit. In case of damage contact the dealer immediately and DO NOT USE THE INSTRUMENT!
3. Use this instrument in a clean laboratory environment

Moisture
The unit is designed for operation in dry rooms only.

Heat
The unit should be situated away from radiators, hot bodies, ovens or other heat sources.

Power Sources
The unit should be connected to a power supply only of the type described in the operating instructions or as marked on the unit.

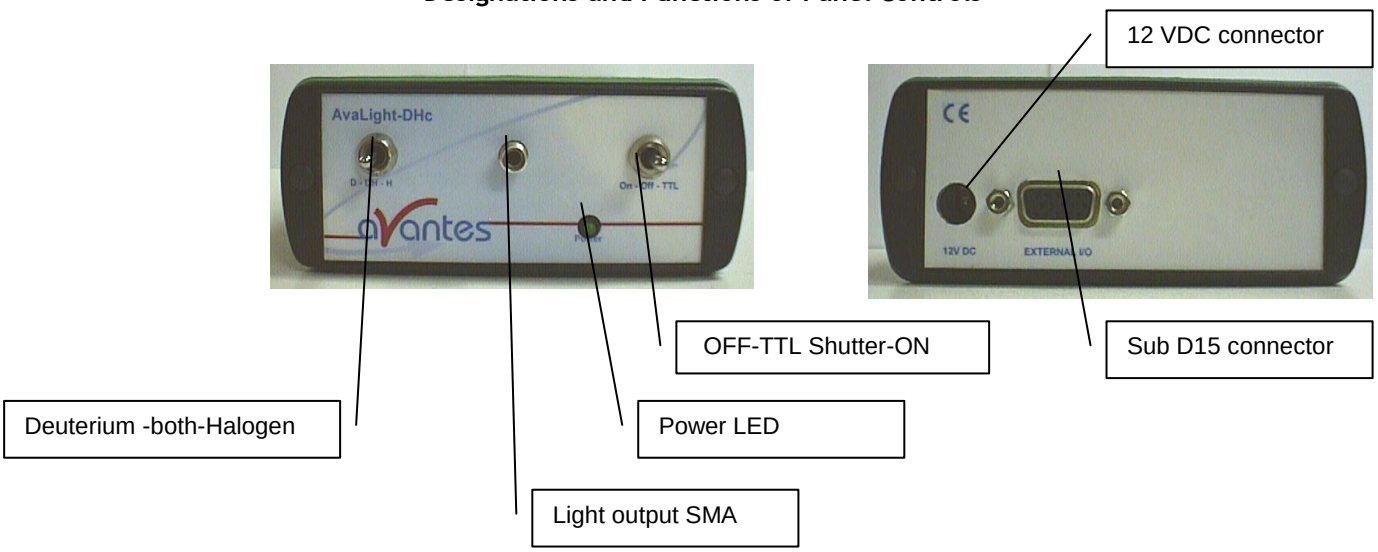
Object and Liquid Entry
Care should be taken that objects do not fall, or liquids spilled into the enclosure through openings.

Caution:



This lamp produces ultra violet radiation that can be harmful to the eyes. DO NOT LOOK INTO THE LIGHT BEAM. THIS CAN CAUSE PERMANENT EYE DAMAGE - WEAR PROTECTIVE EYE WEAR - CALL YOUR LOCAL LAB SUPPLY HOUSE FOR GLASSES OR GOGGLES.

Designations and Functions of Panel Controls



Front Panel

SMA-Connector / Protection Cap
The protection cap is only to avoid that the user could not unintentional look directly into the fiber optic connector. The connector is for use only with SMA-Fiber connectors. **Connect your Fiber optic Cable first before starting the Deuterium Lamp. Please be sure to avoid direct radiation of skin and eyes at the other fiber end.**

Caution: This lamp produces ultra violet radiation, which can be harmful to the eyes. Lamps must not be viewed directly without suitable approved eye protection being used.

OFF-TTL Shutter -Open
This switch is used to switch the lightsource on and operate TTL activated shutter (Normally closed)

Position switch	Lightsource power	Shutter
OFF	OFF	Closed
TTL	ON	Closed or TTL activated the through backside DB-15 connector TTL signal, Pin 13 (High = Open, Low = Close)
ON	ON	Open

Deuterium -both-Halogen
This switch is used to turn the deuterium and halogen light on.

Position switch	Deuterium	Halogen
Left	ON	OFF
Middle	ON	ON
Right	OFF	ON

Power LED

When the 12V power supply is connected to the unit and the power switch is ON, the LED indicator is lighted.

Rear Panel

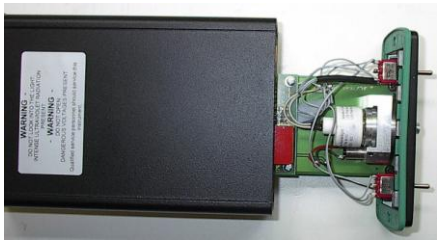
Power Input Connector
Insert the 12VDC-power supply plug of the adapter into the unit Polarity on the plug is +inside, GND outside.

Table of DB-15 connector

Pin	Description
10	GND
13	Shutter Open/Close (High = Open, Low = Close)

Replacement of Lamps

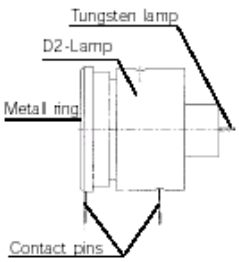
The lamp unit consists of a deuterium lamp and a tungsten lamp, which are both installed in a shell made of polytetrafluoroethylene (PTFE). If the deuterium lamp or the tungsten lamp fails or has reached the end of its service life, the complete lamp unit has to be replaced.
If the lamp fails or has reached the end of its service life, the complete lamp unit can be easily exchanged by the user and replaced by a new one.
For the replacement of the lamp unit (Replacement Lamp) the customer should follow the below listed instructions:

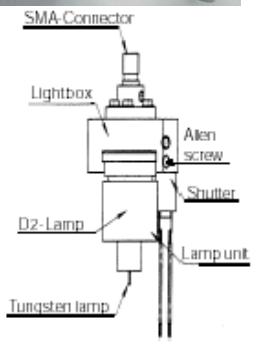


1. Disconnect power supply from the unit
2. Open the housing by unscrewing 2 screws at front panel
3. Take out the lamp unit
4. Unscrew the allen screw (1.5 mm) in lamp box.
5. Pull out the PTFE-housing upwards (do not tilt the housing)
6. Remove the black plug from the tungsten lamp.

Replacement Lamp build-in

1. Connect black plug onto tungsten lamp.
2. Insert replacement lamp into the lamp box.
3. Pay attention, that the contact pins on the bottom of the PTFE-body are upright and do glide into the contact sockets on the board.
4. Tighten the allen screw again.
5. Slide lamp back in outer box housing and connect screws at front panel





Technical Data

	Deuterium Light Source	Halogen Light Source
Wavelength Range	200 - 400 nm	400 - 2000 nm
Stability	< 1 mAU	<1 mAU
Warm-up time	8 min	1 min
Drift	<0.25%/hrs	<0.25%/hrs
Optical Power in 600µm fiber	0.2 µWatt	7 µWatt
Lamp Lifetime	1000 hours	2000 hours
Temperature Range	5°C - 35°C	
Power Requirements	12VDC(+inside, GND outside) / 450mA	
Dimensions / Weight	175 x 111 x 44 mm	

Warranty

Each AvaLight-DHc compact UV-VIS light source has been carefully checked before dispatch and complies with the specifications listed in this manual section. Avantes BV gives a one year (12 months) warranty on all circuit boards, valid from the date of purchase. Such warranty is restricted to the free-of-charge repair or replacement of the AvaLight-DHc compact UV-VIS light source if Avantes BV is clearly responsible for the fault. Faults caused by inappropriate use or changes to the circuit board are not covered by our warranty.
We give a warranty of **1000 operational hours** on the inbuilt **deuterium lamp**.
We give a warranty of **2000 operational hours** on the inbuilt **tungsten lamp**.

The conditions for lamp replacement within the stated warranty time are:
1. Light intensity is less than 50 % of the initial intensity on delivery (250 nm).
2. The deuterium lamp fails to ignite.
3. The factory pre-set voltages and currents on the circuit board have not been changed.
4. The circuit board and the light box show no mechanical damage.

Ordering Information

AvaLight-DHc	Compact Deuterium Halogen Light Source with TTL Shutter
IC-DB15-2	Interface cable AvaSpec-USB1 platform to AvaLight-DHc-TTL-shutter
IC-DB26-2	Interface cable AvaSpec-USB2 platform to AvaLight-DHc-TTL-shutter
AvaLight-DHc-RM	Rackmount Compact Deuterium Halogen Light Source with TTL Shutter
AvaLight-DHc-B	Compact Deuterium Halogen Replacement Bulb
CUV-DHc	Direct attach cuvette holder for AvaLight-DHc
PS-12V/1.0A	Power supply 100-240VAC/12VDC, 1.0A for AvaLight-DHc

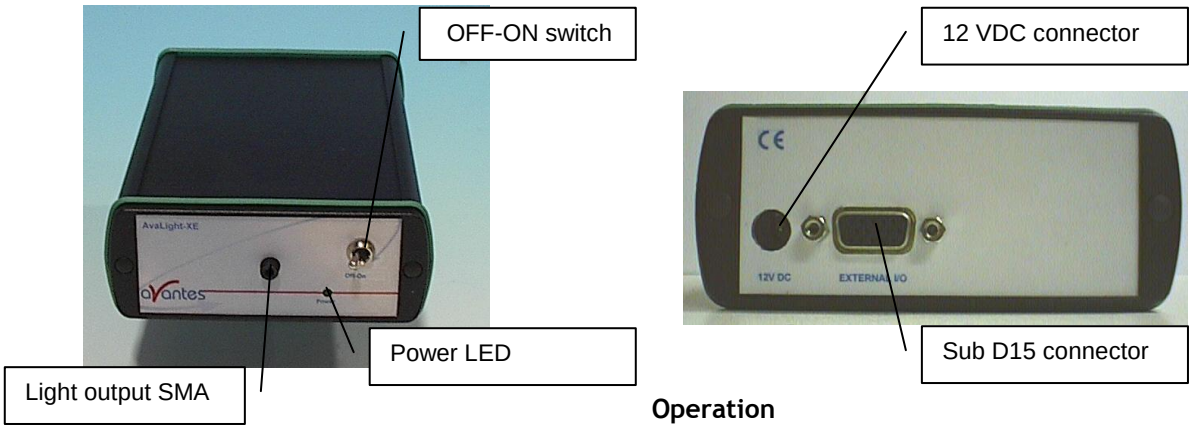
4.6 AvaLight-XE Xenon Pulsed Light source

The **AvaLight-XE Pulsed Xenon Lamp** is a high flash rate, short-arc xenon lamp for applications requiring absorbance, reflection, fluorescence and phosphorescence measurements. The AvaLight-XE operates at speeds up to 100 Hz and offers critical pulse-to-pulse stability.

Parts Included

1. AvaLight-XE Pulsed Xenon Lamp
2. The AvaLight-XE Operating manual
3. IC-DB15-2 or IC-DB26-2 15-pin cable for connecting the AvaLight-XE to the AvaSpec spectrometer (should have been ordered separately).
4. PS-12V/1.0A 100-240VAC power supply (should have been ordered separately)

Caution! UV Radiation and High Voltage!
Never look directly into the light source. The ultraviolet radiation coming from the light source is capable of causing serious eye injury.
The AvaLight-XE uses high voltages. Never operate the AvaLight-XE without it's housing intact.
The SMA connector will get HOT during operation. Handle with care



Operation

The lamp is triggered with TTL pulses delivered through the 15-pin connector located at the rear of the unit. These pulses are supplied by our AvaSpec spectrometers and AvaSoft software, or any other source of TTL signals. The lamp is powered by a 12V DC transformer, or from a 12V battery if field use is desired.

1. Plug the 12 VDC wall transformer. Plug the other end of the cord into the jack at the rear of the AvaLight-XE.
2. Install the IC-DB15-2 or IC-DB26-2 cable into the rear of the AvaLight-XE. Connect the other end to the AvaSpec spectrometer. Connect an optical fiber to the SMA-terminated fiber optic port on the front panel.
3. Turn the power switch located at the front of the source to the "ON" position.
4. AvaSoft software automatically operates the AvaLight-XE and gives one flash or multiple flashes per scan. The flash should fire with a clearly audible "ping."

15 pin dB Connector Pinout AvaLight-XE

Pin	Description
1	Strobe fire
10	GND

Specifications

Power requirement	12 VDC/550 mA (+inside, GND outside) (6 W)
Total Optical Power output (max.)	39 µJ per pulse, 3.9 mW(average)
Optical power in 600 µm fiber	1.8 µJ per pulse, 180µW(average)
Synchronization Input	15 pin sub D connector, TTL level
Pulse Duration	5 µsec (at 1/3 height)
Pulse duration	6 µsec
Pulse rate (max.)	100 Hz
Bulb Life	min. 10^9 pulses
Spectral Output	200 nm to 1000 nm
Connector	SMA-905 connector
Dimensions	175 x 110 x 44 mm

Ordering Information

AvaLight-XE	Xenon Light Source (200-1000nm), needs interface cable and power supply
AvaLight-XE-DUV	Xenon Light Source for DUV (160-1000nm), needs interface cable and power supply
AvaLight-XE-B	Spare bulb for the AvaLight-XE (200-1000nm)
AvaLight-XE-B-DUV	Spare bulb for the AvaLight-XE-DUV (160-1000nm)
IC-DB15-2	Interface cable AvaSpec-USB1 platform to AvaLight-XE
IC-DB26-2	Interface cable AvaSpec-USB2 platform to AvaLight-XE
CUV-XE	Direct attach cuvette holder for AvaLight-XE
PS-12V/1.0A	Power supply 100-240VAC/12VDC, 1.0A for AvaLight-XE

4.7 AvaLight-D(H)S(-BAL) (Balanced) Deuterium Halogen Light Source

Safety Instructions

Warning: All warnings on the unit and in the operating instructions should be adhered to.

Unpacking Instructions:

Your package should contain:
1 – AvaLight- D(H)S-(BAL) (Balanced) Deuterium-Halogen light source
1 - Power Cord
1 - This manual
1 – Safety goggles

1) Unpack your deuterium lamp carefully. Although the deuterium lamp is rigidly mounted dropping this instrument can cause permanent damage.

2) Inspect the outside of the instrument and make sure that there is no damage to your unit. In case of damage contact the dealer immediately and DO NOT USE THE INSTRUMENT!

3) Use this instrument in a clean laboratory environment.

Moisture
The unit is designed for operation in dry rooms only.

Ventilation
The unit should be situated so that its location or position does not interfere with its proper ventilation.

Heat
The unit should be situated away from radiators, hot bodies, ovens or other heat sources and direct sun radiation.

Power Sources
The unit should be connected to a power supply only of the type as marked on the unit.

Object and Liquid Entry
Care should be taken that objects do not fall, or liquids spilled into the enclosure through openings.

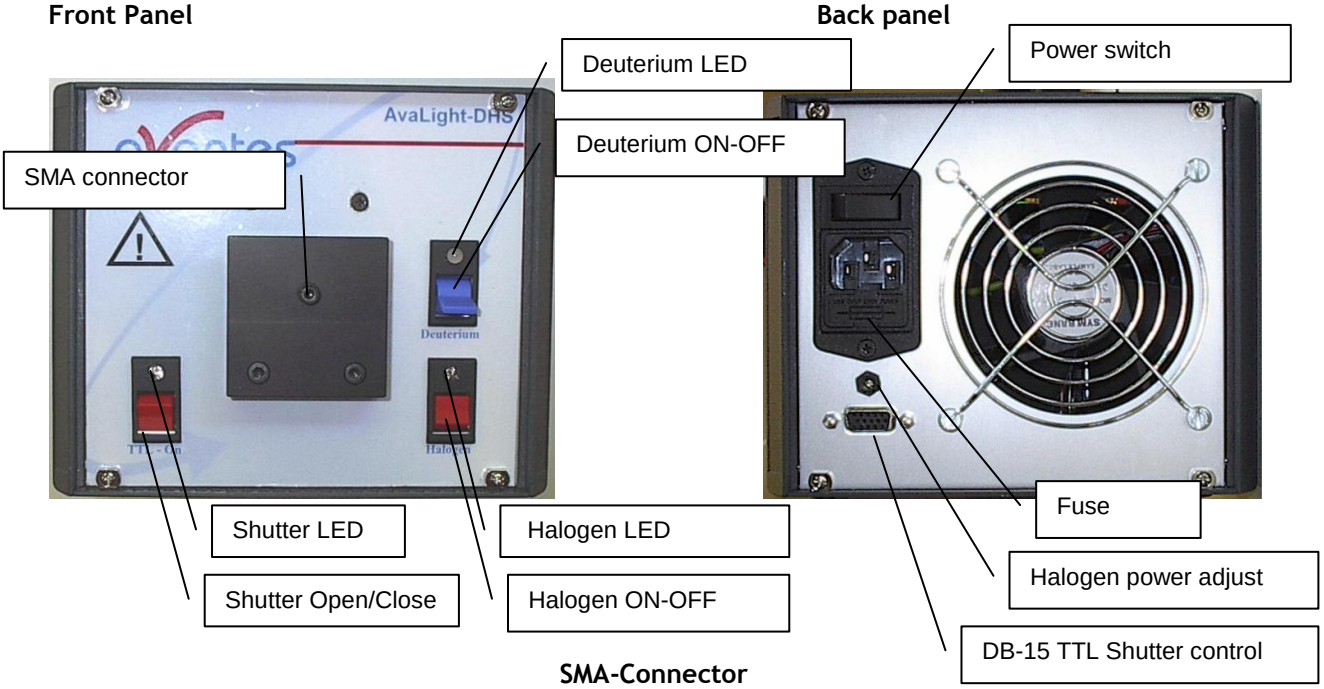
Caution:
This lamp produces ultra violet radiation, which can be harmful to the eyes. DO NOT LOOK INTO THE LIGHT BEAM. THIS CAN CAUSE PERMANENT EYE DAMAGE - WEAR PROTECTIVE EYE WEAR - USE THE SUPPLIED SAFETY GOGGLES. Do not use this device in clinical situations.



Disconnect power before opening housing or replace Fuse.
The installation category for this equipment is Class 2, it is not permitted to connect equipment to the AvaLight-DHS with a power supply without SELV or class II qualification.

Designations and Functions of Panel Controls

Front Panel **Back panel**



SMA-Connector

The connector is for use only with SMA-Fiber connectors. **Connect your Fiber optic Cable first before starting the Deuterium Lamp. Please be sure to avoid direct radiation of skin and eyes at the other fiber end.**

Caution: This lamp produces ultra violet radiation that can be harmful to the eyes. Lamps must not be viewed directly without suitable approved eye protection being used.

Deuterium Light

By switching the Deuterium switch downwards to ON the Deuterium lamp is preheated. After a warm-up time of 10-20 sec. (green LED flashes) the Deuterium lamp will ignite automatically.
After successful ignition the Deuterium LED lights up green and indicates that the Deuterium lamp is in operation. Should the Deuterium lamp not ignite the Deuterium LED lights up red. This indicates a malfunction of the lamp. See section “Trouble shooting”. Switch to OFF to reset the Error LED.
Switching the Deuterium switch to upwards to OFF the Deuterium lamp switches off.

Halogen Light

Switching the Halogen switch downwards to ON, the Halogen lamp switches on. The Halogen LED indicates the operation mode.
Switching the Halogen switch upwards to OFF, the Halogen lamp switches off.

TTL Shutter –Open

This switch is used to open and close the shutter either manually or by TTL pulse (generated by AvaSpec spectrometers in AvaSoft-FULL, IC-DB15-2 or IC-DB-26-2 interface cable needed).
The LED indicated if the shutter open (LED on) or closed.

Position switch	Shutter
Up	Closed or TTL activated the through backside DB-15 connector TTL signal, Pin 13 (High = Open, Low = Close)
Down	Open

Rear Panel- Power Switch ON/OFF

When the power switch is turned ON, power is supplied to the unit. The unit automatically switches to the basic operating mode and the cooling on the backside operates.

Rear Panel- Halogen light power adjustment

The halogen light, that is focused through the Deuterium Lamp 0,5 mm aperture, can be regulated in the optical power to match the Deuterium output. In order to obtain a more " balanced" spectrum, the multiturn potentiometer in the backside of the lightsource can be turned to regulate the halogen power.

Rear Panel – DB-15 connector

The DB-15 rear panel connector is available to connect an interface cable IC-DB15-2 or IC-DB-26-2 to the AvaSpec spectrometer, so the TTL shutter can be controlled from the AvaSoft software for auto-save dark.

Table of DB-15 connector

Pin	Description
10	GND
13	Shutter Open/Close (High = Open, Low = Close)

Fuse

This compartment contains the 2 fuses to protect the unit against overload.
Type: Miniature fuse 5 x 20 mm, 1 Amp slow blow

Input Terminal for Power Cord

Input voltages AC 100..240V, 50/60 Hz

Type Sign
Information about:
- Type
- Version
- Serial-No.
- Mains connection
- Warnings
- CE-Marking

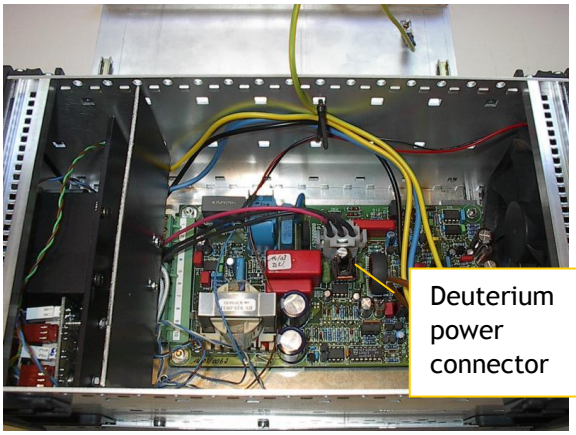
Replacement of Deuterium or Halogen Lamp

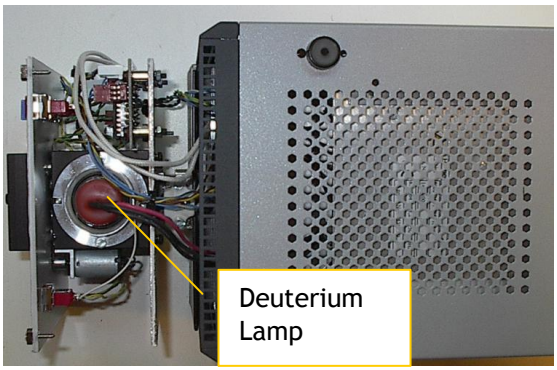
Disconnect power before opening housing or replace Fuse.
The installation category for this equipment is Class 2, it is not permitted to connect equipment to the AvaLight-DHS with a power supply without SELV or class II qualification.

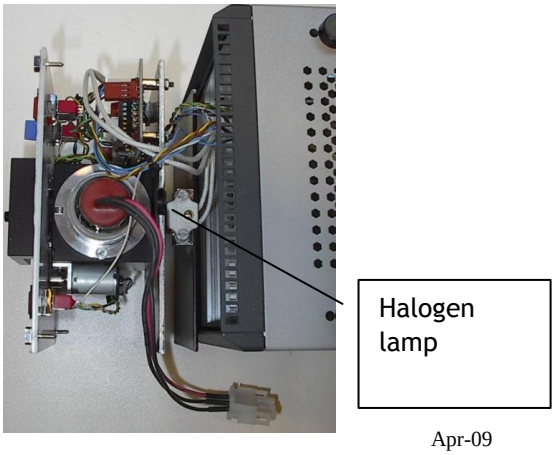
Warning: Disconnection of the power cord to the Deuterium Lamp MUST only be done when the power switch is turned OFF. As the output of the power supply is not galvanically separated from the line voltage the connecting lead for the Deuterium lamp can carry a voltage >42 V when the power switch is turned ON.
Warning: During operation the lamp envelope reaches a temperature of approx. 250°C. Should you intend to change the lamp please wait for at least 20 minutes for cooling before touching the lamp. The lamp envelope (quartz glass) should not be touched with bare fingers, otherwise lifetime is severely reduced.

Please follow these instructions for bulb replacement:

1. Disconnect the unit from the mains power supply.
2. Remove both side covers by unclicking.
3. unscrew a total of 4 screws to remove top cover
4. Disconnect the deuterium power connector
5. Dismount the front panel by unscrewing the 4 front screws.
6. Turn the lightsource upside down and carefully slide out the front panel
7. Unscrew the 2 screws holding the metal ring around the Deuterium Lamp
8. Take out the Deuterium Lamp, **carefull - may be hot!**
9. Replace with new Deuterium Lamp, carefull not to touch lamp glass with your fingers.
10. Tighten 2 screws around aluminum fixture.
11. Put connector back on board socket.
12. For halogen bulb replacement disconnect 2 screws of halogen lamp fitting.
13. Take out the halogen bulb
14. Replace the halogen bulb with new 5W bulb, carefull not to touch lamp glass with your fingers.
15. Tighten 2 screws for halogen lamp fixture.
16. Carefully slide back front panel, take care of wires not getting pinched.
17. Tigthen 4 screws of front panel
18. turn housing around and put back top cover
19. Tigthen 4 screws of top cover
20. Put back and click in the 2 side panels.
21. Connect mains power supply.







Specifications / Parts List

	Deep UV Deuterium	Deuterium Lamp	Halogen Lamp
Wavelength Range	190-400nm	215-400nm	360-1500nm
Warm-up Time	30 min.	30 min.	20 min.
Lamp Power	78W / 0.75A	78W / 0.75A	5W /0.2A
Lamp Lifetime	1000 hrs	1000 hrs	1000 hrs
Noise (AU)	2.10^{-4}	2.10^{-4}	10^{-4}
Max. drift	± 0.5%/hrs	± 0.5%/hrs	± 0.5%/hrs
Color Temperature	-	-	3000 K
Optical Power in 200µm fiber	11 µW	7 µW	43 µW
Optical Power in 600µm fiber	72 µW	61 µW	239 µW
Optical Power in 1000µm fiber	206 µW	166 µW	354 µW
Power consumption	90 Watt (190Watt for heating D-Lamp 4-5 sec.)		
Power Requirements	100-240VAC 50/60 Hz		
Dimensions / Weight	315 x 165 x 140 mm / ca 5 kg.		

Trouble Shooting
Deuterium Lamp Only

If the power supply or lamp does not seem to functioning properly, check the following:

FAULT	POSSIBLE CAUSE	REMEDY
Power switch on, fan not working, nor one of the LED's or lights	Line power not present	Check line voltage
	Fuse(s) defective	Check /replace fuse(s)
Deuterium Lamp does not ignite. The Two-Color-LED of deuterium lights up red (ERROR)	Deuterium Lamp too hot	Allow Deuterium Lamp to cool down. Swich to OFF to reset the Deuterium lamp, then switch to ON to restart.
	Lifetime of Deuterium Lamp has expired	Replace Deuterium Lamp
	Deuterium Lamp internal connection plug is not connected right	Disconnect power, Open Unit and connect connector plug
Deuterium Lamp extinguishes	When this fault appears always switch off the deuterium power	

during operation	and then - after cool down - restart

Halogen Lamp Only

FAULT	POSSIBLE CAUSE	REMEDY
Halogen Lamp does not work after switching on	Halogen Lamp defective	Replace Halogen Lamp
HalogenLED does not light up after switching on Halogen lamp	Internal Power Supply is defective	Disconnect the unit from mains power and inform your dealer

Ordering Information

AvaLight-D-S	Deuterium light source, 215-400 nm, incl. TTL shutter, -SR fibers needed
AvaLight-D-S-BAL	Balanced Deuterium light source, 215-400 nm, incl. TTL shutter, -SR fibers needed
AvaLight-DH-S	Deuterium-Halogen light source, 215-2500 nm, incl. TTL shutter, -SR fibers needed
AvaLight-DH-S-BAL	Balanced Deuterium-Halogen light source, 215-2500 nm, incl. TTL shutter, -SR fibers needed
AvaLight-D-S-DUV	Deep UV deuterium light source, 190-400 nm, incl. TTL shutter, -SR fibers needed!
AvaLight-DH-S-DUV	Deep UV deuterium-halogen light source, 190-2500 nm, incl. TTL shutter, -SR fibers needed!
IC-DB15-2	Interface cable AvaSpec-USB1 platform to AvaLight-D(H)S
IC-DB26-2	Interface cable AvaSpec-USB2 platform to AvaLight-D(H)S
AvaLight-D-B	Replacement deuterium bulb for AvaLight-D/AvaLight DH light source
AvaLight-D-B-DUV	Replacement deep UV deuterium bulb for AvaLight-D/AvaLight DH light source
AvaLight-DH-B	Replacement halogen bulb for AvaLight-DH light source
CUV-DHS	Direct attach cuvette holder for AvaLight-D(H)S
DH-S-BAL upgrade	Upgrade existing AvaLight-DHS to an AvaLight-DHS-BAL balanced light source

4.8 AvaLight-DH-CAL UV/VIS calibrated light source

The AvaLight-DH-CAL is a calibrated light source for the UV/VIS/NIR spectral range (200-1099nm). Optionally an extended calibration for the NIR spectral range (1100-2500 nm) can be ordered. This NIST-traceable calibrated light source is developed for use with all AvaSpec spectrometers to be used in measuring absolute spectral intensity.

The AvaLight-DH-CAL comes with a cosine corrector with SMA adapter. The software includes two calibration files, both valid for calibration with the cosine corrector. One calibration file can be used for irradiance calibration over the full range (200-1099nm). In that case the Deuterium and Halogen light need to be switched on during the calibration. The other calibration file can be used for irradiance calibration over the VIS/NIR range (350-1095nm). In that case only the Halogen light needs to be switched on which gives a more smooth and stable output at the higher wavelengths. Optionally an extended calibration for the NIR spectral range (1100-2500 nm) can be supplied.

The calibration files can be imported in the AvaSoft-IRRAD application software, developed to make your spectrometer system a spectroradiometer.

Changing of the bulb

Since the light source is calibrated, the bulb exchange and recalibration can only be done in our calibration lab.

N.B. The AvaLight-DH-CAL cannot be used as a light source for standard reflection/absorption spectroscopy.

How to take absolute irradiance measurements with AvaSoft 7-IRRAD

1. Start the AvaSoft 7 software, and click the Start button in the main window.
2. Connect a fiber to the Spectrometer input port.
3. Start the Absolute Irradiance Application software by clicking the menu option: Application/Absolute Irradiance. Click the “Perform Intensity Calibration” button.
4. Select the spectrometer channel that will be calibrated, the calibration lamp file and enter the diameter of the fiber/cosine corrector or integrating sphere sample port that is used.
5. Turn on the reference light source (e.g. AvaLight-DH-CAL or AvaLight-DH-CAL-ISP). If a cosine corrector is used at the end of the fiber, mount it directly on the reference light source. If an integrating sphere is used at the end of the fiber, put the integrating sphere sample port over the light output port.
6. Verify that the calibration lamp is ON for at least 15 minutes, and click the “Start Intensity Calibration” button. Try to adjust the integration time while looking at the reference light, such that the maximum count over the wavelength range is around 14000 counts. It’s also possible to let AvaSoft search for an optimal integration time by clicking the ‘∫AC’ button.
7. Adjust the Smoothing Parameter to optimize smoothing for the Fiber/Slit diameter that is used.
8. If a good reference signal is displayed, click the white “Save Reference” button. A white line will mark the reference spectrum. Then switch off the calibration lamp, wait until the spectrum becomes flat, near the bottom of the scale, and click the black button to save a dark spectrum. A black line will mark the dark spectrum.
9. Click the “Save Intensity Calibration” button. A dialog shows up in which the current settings in this intensity calibration are shown. If the calibration has been performed with diffuser,

the intensity calibration data will be saved to an ASCII file with extension *.dfr, with bare fiber this extension will be *.fbr. The name of the intensity calibration file can be entered after clicking the "Save As" button.

10. Switch to the Irradiance Chart TAB to enter the hardware setup and select the colorimetric, radiometric, photometric and/or peak parameters of interest. Then click OK.
11. Measure the output parameters in the experiment. If needed, change the integration time, such that the maximum in Scope Mode is around 14000 A/D Counts . Block the light path to the spectrometer, and save a dark spectrum. If the (ir)radiance of the light to be measured needs to be displayed against time, click the time measurement TAB in the settings dialog.
12. The intensity calibration as performed under point 9 can be loaded in future experiments by selecting the option "Load Intensity Calibration", as described below under Quick Start (2). After loading an intensity calibration, a dark spectrum needs to be saved before switching to Irradiance mode.

Technical Data

Wavelength Range	200-1099 / 1100-2500nm
Calibration Accuracy Repeatability	± 1 %
Calibration Relative Uncertainty to NIST standard	± 10 % (200-400nm) ± 9 % (240-350nm) ± 10% (350-400nm) ± 9.5% (400-1100nm)
Calibration valid for	60 hrs
Time to stabilize	Ca. 30 Min.
Bulb Output (CC-UV/VIS)	Ca. 80µW/cm^{2}nm (@215nm) Ca. 5µW/cm^{2}nm (@800nm)
Power requirement	100-240VAC
Dimensions (mm)	315x165x140

Ordering Information

AvaLight-DH-CAL	NIST traceable UV/VIS Deuterium/Halogen Lamp with CC-UV/VIS-CAL diffuser, -SR fibers recommended
AvaLight-DH-CAL-ISP30	NIST traceable UV/VIS Deuterium/Halogen Lamp for use with AvaSphere-30-IRRAD, -SR fibers recommended
AvaLight-DH-CAL-ISP50	NIST traceable UV/VIS Deuterium/Halogen Lamp for use with AvaSphere-50-IRRAD, -SR fibers recommended
AvaLight-DH-CAL-ISP80	NIST traceable UV/VIS Deuterium/Halogen Lamp for use with AvaSphere-80-IRRAD, -SR fibers recommended
DH-Recal	AvaLight-DH-CAL recalibration service 200-1099nm
DH-Recal-NIR	AvaLight-DH-CAL extended or recalibration service 1100-2500nm

4.9 AvaLight-CAL Spectral Calibration Light Source

Parts included

1. AvaLight-CAL
2. The AvaLight-CAL Operating manual (or this manual)
3. PS-12V/1.0A 100-240VAC power supply (should have been ordered separately)

Safety Instructions

Instructions: All the safety and operating instructions should be read before the unit is operated. Before using the power supply for the first time check for transport damage.

Warning: All warnings on the unit and in the operating instructions should be adhered to.

Unpacking Instructions:

1) Unpack your lamp assembly carefully. Although the lamp is rigidly mounted dropping this instrument can cause permanent damage.

2) Inspect the outside of the instrument and make sure that there is no damage to your unit. In case of damage contact the dealer immediately and DO NOT USE THE INSTRUMENT!

3) Use this instrument in a clean laboratory environment.

Moisture
The unit is designed for operation in dry rooms only.

Ventilation
The unit should be situated so that its location or position does not interfere with its proper ventilation.

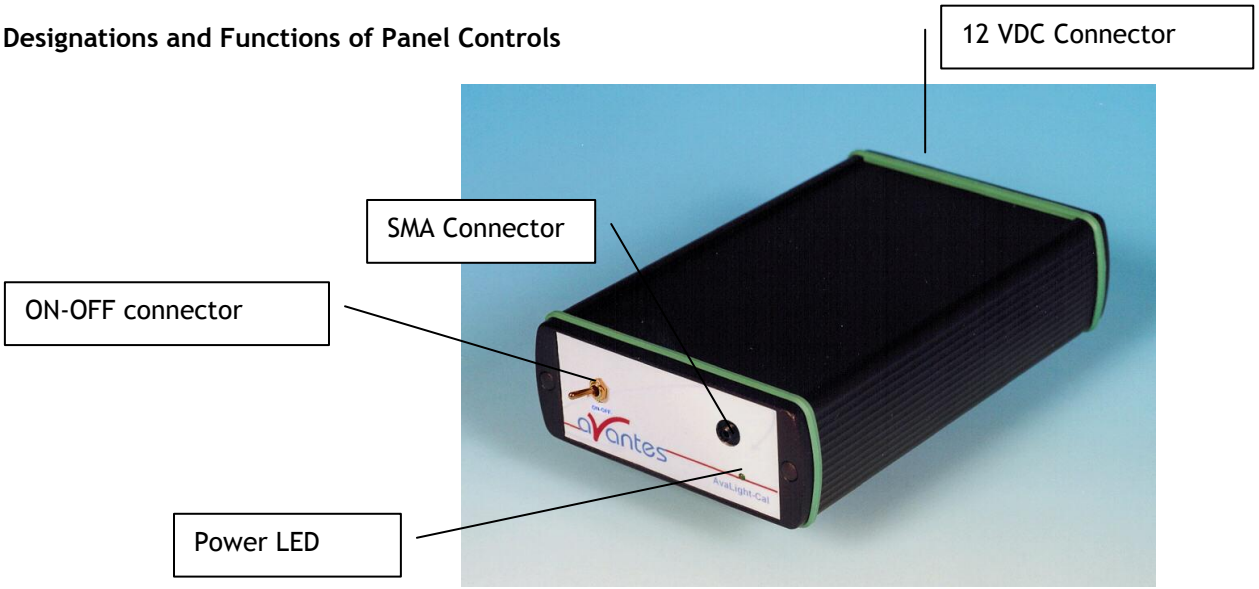
Heat
The unit should be situated away from radiators, hot bodies, ovens or other heat sources.

Power Sources
The unit should be connected to a power supply only of the type described in the operating instructions or as marked on the unit. 12 VDC 1000mA analog regulated (Code: PS-12VDC/1.0A)

Object and Liquid Entry
Care should be taken that objects do not fall, or liquids spilled into the enclosure through openings.

Caution:
This lamp produces ultra violet radiation, which can be harmful to the eyes. DO NOT LOOK INTO THE LIGHT BEAM. THIS CAN CAUSE PERMANENT EYE DAMAGE - WEAR PROTECTIVE EYE WEAR - CALL YOUR LOCAL DISTRIBUTOR FOR GLASSES OR GOGGLES. This unit is supplied with a mechanical safety device - Before removing this Safety Device be sure that the power is off, and screw in the fiber optic cable first before starting the instrument.

Designations and Functions of Panel Controls

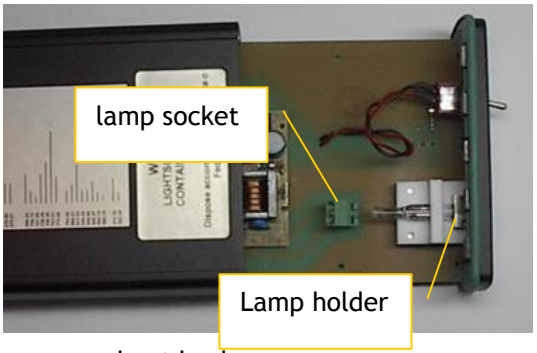


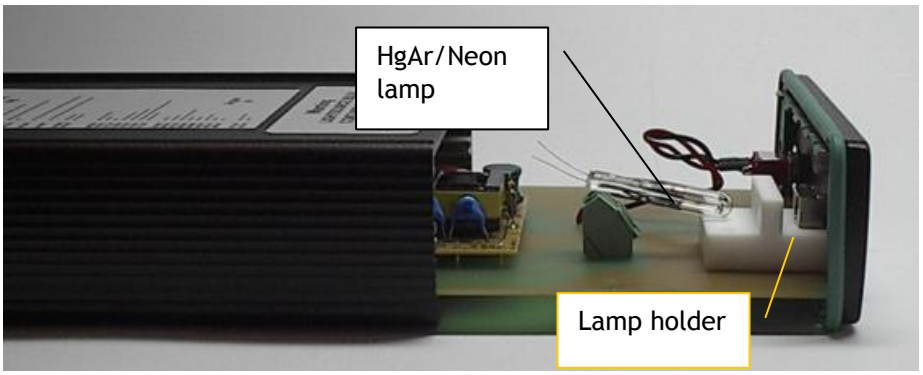
1) Front side: Fiber optic Connector SMA 905 compatible
LED shows ON/OFF Status of Lamp
ON/OFF-Switch

2) Backside: Power Input 12VDC, Inside +12VDC, outside GND

HgAr or Neon Lamp replacement

1. Plug out the power connector from the socket.
2. Remove screw protection caps on the frontside
3. Loosen 2 screws with philips screwdriver
4. take out the frontplate and electronics board
5. untighten 2 screws from HgAr socket
6. slightly bend the electrical wires out of lamp socket
7. take out the HgAr/Neon Lamp from Lamp holder
8. replace by new Lamp, make sure the lamp legs make no short circuit.
9. Slide back electronics board and front plate, tighten screws and put back screw





Technical Data

Lamp	HgAr	Neon	Ar
Output	Hg and Ar lines from 254 nm to 965 nm	340-1100nm	696-1704 nm
Power requirement	12VDC supply (+inside, GND outside), 240 mA		
Optical power in 600µm fiber	1.6 mW		
Connector	SMA 905 connector		
Internal Voltage	1200 Volts AC at 30 kHz, 10 mA		
Warm up	1 minute for vapor stabilization		
Dimensions	175 x 110 x 44 mm		

Ordering Information

AvaLight-CAL	Mercury-Argon Spectral Calibration Source
AvaLight-CAL-NEON	Neon Calibration source needs extra PS-12V/1.0A power supply, SMA
AvaLight-CAL-AR	Argon Calibration source needs extra PS-12V/1.0A power supply, SMA
AvaLight-CAL-RM	Rack mounted version of Mercury-Argon Spectral Calibration Source
AvaLight-CAL-B	Replacement bulb, Mercury-Argon
AvaLight-CAL-NEON-B	Replacement bulb, Neon
AvaLight-CAL-AR-B	Replacement bulb, Argon
PS-12V/1.0A	Power supply 100-240VAC/12VDC, 1.0A for AvaLight-CAL

5 Fiber optics

General Information

Core

For existing sensor applications, generally, **multi-mode step index silica fibers** are used. These range in core thickness from 50 microns to 1 mm. The core is made out of pure silica. Other fiber cores with much higher absorption are made out of certain glass types or plastics. These are not offered in this catalog.

First a distinction is made between silica with high or low OH content. Silica fibers with high OH (600-1000 PPM) are used in the UV/VIS wavelength range because of the low absorption in the UV. They are referred to as **UV/VIS fibers.** For Deep-UV applications special solarization resistant fibers can be used.

The OH content causes strong absorption peaks in the NIR wavelength range. In order to get good fibers for the NIR range, the "water" is removed from the silica. This results in low OH fibers (<2 PPM) with low absorption in the NIR. They are referred to as **VIS/NIR fibers**.

Cladding

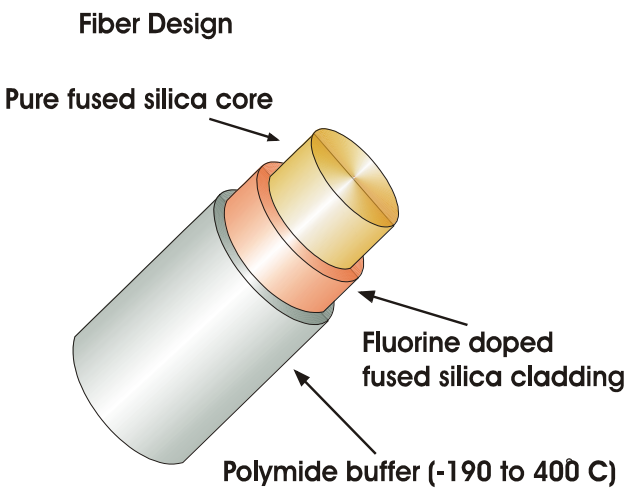
In order to get the light guiding effect the core is cladded with a lower index of refraction material. For the highest quality fibers with the lowest absorption this is a fluorine-doped silica, the so-called **silica-silica or all-silica fibers** with a numerical aperture (NA) of 0.22.

Buffers

Without further protection fibers would easily break, because of small scratches or other irregularities on the surface. Therefore a next layer, the buffer, is added. This buffer also determines under what circumstances the fiber can be used. Temperature range, radiation, vacuum, chemical environment and bending are factors to be considered.

Polyimide buffers offer a wide temperature range (-100 to 400 °C) and superior solvent resistance. Also, this material is non-flammable. Drawbacks are sensitivity to micro bending and the difficulty to remove it.

For extreme temperatures (-190 to 750 °C) a **gold buffer** is used. Gold-coated fibers are virtually inert to all environments and make hermetically sealed high pressure feed trough's possible. (See: pressure feed troughs). The same is true for **aluminum buffers** for temperatures from -190 up to about 500°C. Low out gassing makes them also excellent for use in vacuum.

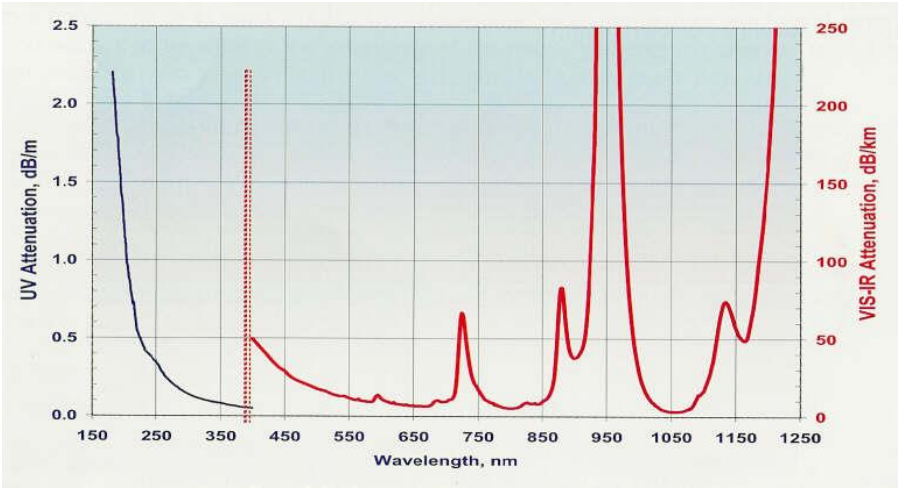


Properties

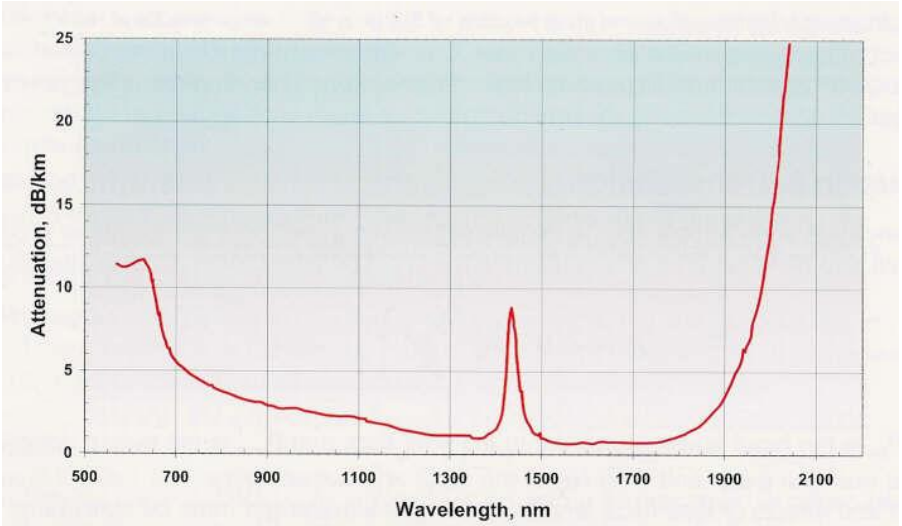
- Step index profile
- Pure silica core
- Numerical aperture: 0,22 ± 0,02
- Laser damage resistant core transmits 1,3 kW/mm^2 CW at 1060 nm, up to 10 J, pulsed
- Bend radius: momentary 100 x clad radius, long term 600 x clad radius
- Polyimide's high NA (1,78) strips cladding modes

Standard proof test: 70 kpsi

UV/VIS Fiber attenuation



VIS/NIR Fiber Attenuation



Solarization Resistant Fibers for Deep UV applications

Most spectroscopic applications with fiber optics have been restricted to wavelength ranges above 230nm, because standard silica fibers with an undoped core and fluorine doped cladding are frequently damaged by exposure to deep-UV light (below 230nm). This solarization effect is induced by the formation of "color centers" with an absorbance band of 214 nm. These color centers are formed when impurities (like Cl) exist in the core fiber material and form unbound electron pairs on the Si atom, which are affected by the deep UV radiation.

Not long ago, solarization resistant fibers, which were hydrogen loaded, were developed (UVI). The disadvantage for these fibers is the limitation on smaller fiber diameters and limited lifetime, caused by the H_2 outgass from the fiber.

Recently, with the availability of a modified core preform, a new fiber became available (UVM). This fiber provides long-term stability at 30-40% transmission (for 215nm). All fiber optic probes, cables and bundles with core diameters of 100µm, 200¤ m, 400¤ m and 600µm can be delivered with solarization resistant fibers. All assemblies, made by us, are pre-solarized for an 8-hrs period, to have a constant transmission of 30-40% @ 215nm.

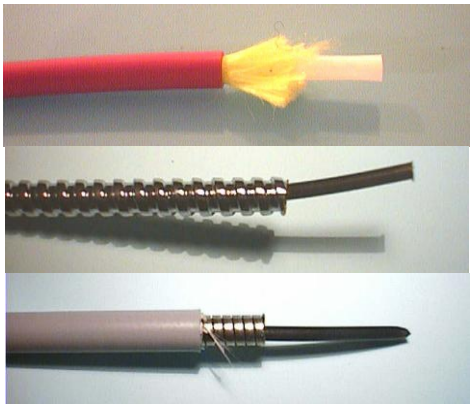
5.1 Sleeving material

For different applications we can offer different sleeving material. Standard all of our fiber optic cables and bifurcated cables are protected by a Kevlar reinforced polypropylene inner tubing with PVC red outer jacket. All of our reflection probes are standard protected by a flexible chrome-plated brass outer tube, with hooked profile for optimal strain relief with silicon or PTFE inner tubing. For waterproof and some medical applications stainless steel spiral tubing with glassilk and gray outer silicon rubber coating can be provided. Inside this tubing silicon or PTFE inner tubing is used as well. Especially for small, flexible, endoscopic probes we use a PVC rubber sleeving. Some specifics on the sleevings can be found in the following technical information.

Standard - Kevlar reinforced PVC

ME - Chrome plated brass

MS - Silicon coated stainless steel



Technical Data

Sleeve material	Kevlar reinforced PVC	Chrome plated brass	Silicon coated stainless steel	PVC
Inner Tubing	Polypropylene	Silicon/PTFE	Silicon/PTFE	n.a.
Outer dimensions	3,8 mm	5,0 mm	5,8 mm	2,0 mm
Temperature Range	-20˚C to +65˚C	-65˚C to +250˚C (Silicon/PTFE)	-60˚C to +180˚C (Silicon/PTFE)	-20˚C to +65˚C
Tensile Strength	150 N	350 N	70 N	n.a.
Application	Standard	Heavy Industrial	Waterproof IP67	Medical

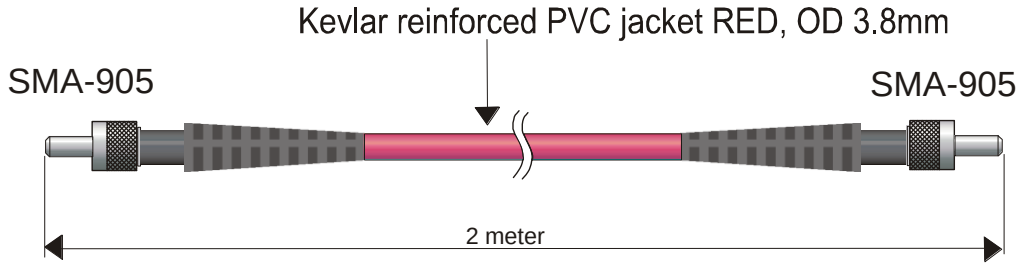
5.2 Fiber optic cables

Fiber optic cables can be made in different lengths with different type of connectors, like SMA905, ST or FC-PC connectors. The fibers are also available in different wavelength regions, like Deep UV solarization resistant fibers, UV/VIS fibers and VIS/NIR fibers.
We offer different shielding, like Kevlar reinforced PVC sleeving with PTFE inner tubing (standard) or metal shielding with silicon or PTFE inner tubing for higher temperature and more industrial applications.
Depending on the intended wavelength range a UV/VIS (200-750 nm) or a VIS/NIR (500-1000 nm) fiber is used. In the following table replace xx by respectively UV or IR. For deep UV use specify –SR (solarization resistant).

5.2.1 Patch cords

Patch cords are standard delivered in 2m length with SMA-905 terminations. One side of each patch cord fiber has an extended ferrule in order to allow easily connecting into the AvaSpec spectrometers optical bench.
Please follow the next rules:

1. Gently remove the plastic protection caps from the fiber SMA connectors.
2. Inspect the fibers if light is transmitted, note that for small fiber diameters the transmitted light energy may be low, so it is hard to see.
3. Do not bend the fiber too tightly, the minimum recommended bending radius of a fiber is 600 times the core/cladding diameter (i.e. 12 cm for a 200µm fiber), further bending may induce losses in optical transmittance. Bending the fiber below a radius of 200 times the fiber diameter may cause irreversible damage.
4. Keep connectors and tips protected by the plastic caps when not in use.
5. When necessary the fiber end can be cleaned with soft tissue and alcohol or acetone, avoid scratching.
6. Do not exceed temperature specifications.



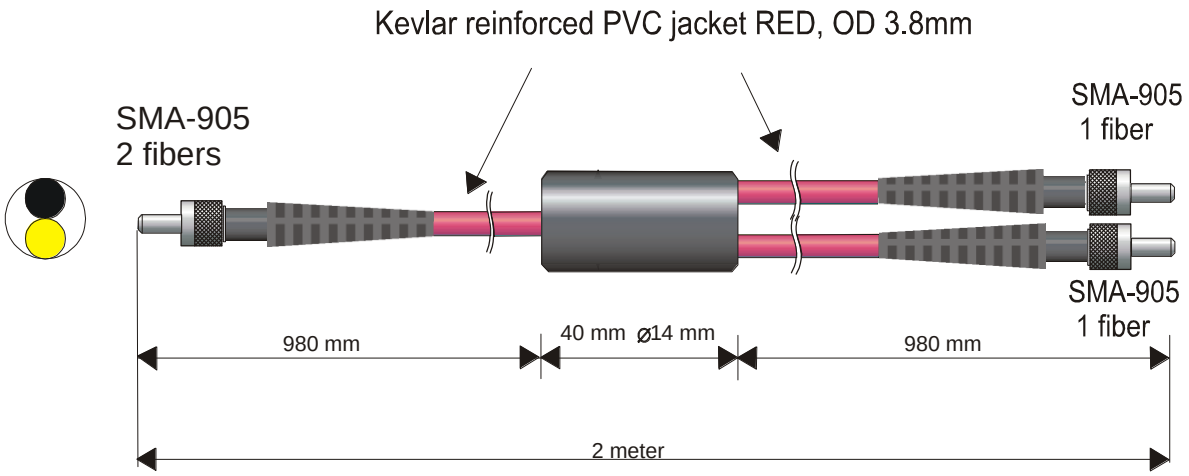
In our standard quality assurance procedure, each fiber optic assembly is labeled with a serial nr, and some standard test are being carried out with a spectrometer and AvaLight-CAL Line source and registered:

1. Spectral attenuation at 253 nm for UV/VIS fibers, spectral attenuation at 763 nm for VIS/NIR fibers.
2. Symmetries of the connector for both sides; the maximal peak value is allowed to move as many nm as the registered resolution of the fiber / spectrometer.
3. Optical inspection of scratches on the surface.
4. A Deep-UV burn-in of 8 hours to pre-solarize the -SR assemblies, the attenuation at 215nm is registered.
5. There is always a label attached to the fiber optic cable or assembly that will tell you the serial nr, so the QA data can be retraced.

5.2.2 Bifurcated cables

Typically bifurcated fibers will have 2m length with the splitting point in the middle (1m) of the assembly.
Note that for the bifurcated fibers the light is entered into 2 different fibers that split up into the 2 different legs, the fibers are located next to each other.
Please follow the next rules:

1. Gently remove the plastic protection caps from the fiber SMA connectors.
2. Inspect the fibers if light is transmitted, note that for small fiber diameters the transmitted light energy may be low, so it is hard to see.
3. Do not bend the fiber too tightly, the minimum recommended bending radius of a fiber is 600 times the core/cladding diameter (i.e. 12 cm for a 200µm fiber), further bending may induce losses in optical transmittance. Bending the fiber below a radius of 200 times the fiber diameter may cause irreversible damage.
4. Keep connectors and tips protected by the plastic caps when not in use.
5. When necessary the fiber end can be cleaned with soft tissue and alcohol or acetone, avoid scratching.
6. Do not exceed temperature specifications.



In our standard quality assurance procedure, each fiber optic assembly is labeled with a serial nr, and some standard test are being carried out with a spectrometer and AvaLight-CAL Line source and registered:

1. Spectral attenuation at 253 nm for UV/VIS fibers, spectral attenuation at 763 nm for VIS/NIR fibers.
2. Symmetries of the connector for both sides; the maximal peak value is allowed to move as many nm as the registered resolution of the fiber / spectrometer.
3. Optical inspection of scratches on the surface.
4. A Deep-UV burn-in of 8 hours to pre-solarize the -SR assemblies, the attenuation at 215nm is registered.

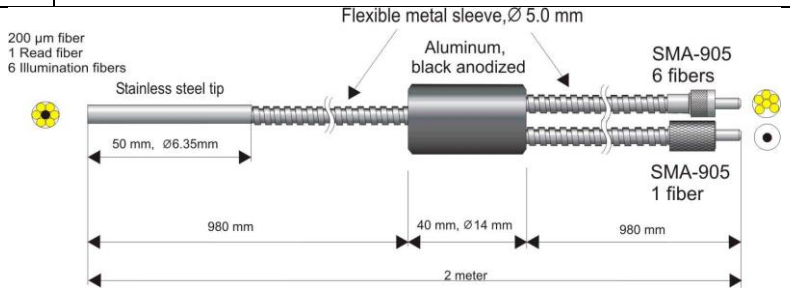
There is always a label attached to the fiber optic cable or assembly that will tell you the serial nr, so the QA data can be retraced.

5.3 Fiber optic Reflection probes

We can make almost any type of arrangement as fiber optic reflectance probe. The standard configuration is a 6 illumination around 1 read fiber, which is 2 meters long. All probes can be delivered with UV/VIS or VIS/NIR fibers.

Technical data

Fibers	7 or 19 fibers 200 µm or 400 µm core, 6 or 17 light-fibers, 1 or 2 read fiber, n.a.= 0,22. Standard 2m length, splitting point in the middle.
Wavelength range	200-800 nm (UV/VIS) or 350-2000 nm(VIS/NIR)
Connectors	Standard SMA905 connectors (2x)
Probe end	Stainless steel cylinder, 50 mm long x 6,35 mm diameter.
Tubing	The optical fibers are protected by a PVC inner tube and a flexible chrome plated brass outer tubing. The tubing also gives stress relief. OD: 5.0 mm
Temperature	-30 °C to 100 °C. (High Temperature Probes available on request)
Bending	Minimum bend radius: Short term (few seconds) 20 mm, long term: 60 mm



Please follow the next rules:

1. Gently remove the plastic protection caps from the fiber SMA connectors.
2. Inspect the fibers if light is transmitted, note that for small fiber diameters the transmitted light energy may be low, so it is hard to see.
3. Do not bend the fiber too tightly, the minimum recommended bending radius of a fiber is 600 times the core/cladding diameter (i.e. 12 cm for a 200µm fiber), further bending may induce losses in optical transmittance. Bending the fiber below a radius of 200 times the fiber diameter may cause irreversible damage.
4. Keep connectors and tips protected by the plastic caps when not in use.
5. When necessary the fiber end can be cleaned with soft tissue and alcohol or acetone, avoid scratching.
6. Do not exceed temperature specifications.

In our standard quality assurance procedure, each fiber optic assembly is labeled with a serial nr, and some standard test are being carried out with a spectrometer and AvaLight-CAL Line source and registered:

1. Spectral attenuation at 253 nm for UV/VIS fibers, spectral atten. at 763 nm for VIS/NIR fibers.
2. Symmetries of the connector for both sides; the maximal peak value is allowed to move as many nm as the registered resolution of the fiber / spectrometer.
3. Optical inspection of scratches on the surface.
4. A Deep-UV burn-in of 8 hours to pre-solarize the -SR assemblies, the atten at 215nm is registered.

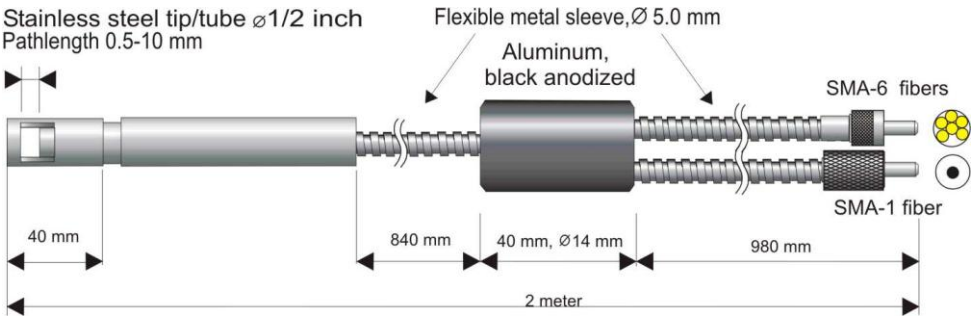
There is always a label attached to the fiber optic cable or assembly that will tell you the serial nr, so the QA data can be retraced.

5.4 Fiber optic Transmission Dip probes

For in-line absorption measurement as fiber optic transmission dip probe is used. The transmission dip probes come with either fixed path length or variable path length. The standard configuration is a 6 illumination around 1 read fiber, which is 2 meters long. All probes can be delivered with UV/VIS or VIS/NIR fibers.

Technical data

Fibers	7 fibers 200 µm core, 6 light-fibers, 1 read fiber, n.a.= 0.22.
Wavelength range	200-800 nm (UV/VIS) or 350-2000 (VIS/NIR)
Connectors	Standard SMA905 connectors (2x)
Optical Path	0.25 - 10 mm spacing, i.e. an optical path of 0.5-20 mm
Probe end	Stainless steel or PEEK cylinder , 140-160 mm long x 12,7 mm (1/2") diameter. Waterproof
Tubing	The optical fibers are protected by a PVC inner tube and a flexible chrome plated brass outer tubing. The tubing also gives stress relief. OD: 5.0 mm Optionally a waterproof, steel reinforced, silicon tubing can be provided
Temperature	-30 ºC to 100 ºC. (High Temperature Probes available on request)
Bending	Minimum bend radius: Short term (few seconds) 20 mm, long term: 60 mm



Please follow the next rules:

1. Gently remove the plastic protection caps from the fiber SMA connectors.
2. Inspect the fibers if light is transmitted, note that for small fiber diameters the transmitted light energy may be low, so it is hard to see.
3. Do not bend the fiber too tightly, the minimum recommended bending radius of a fiber is 600 times the core/cladding diameter (i.e. 12 cm for a 200µm fiber), further bending may induce losses in optical transmittance. Bending the fiber below a radius of 200 times the fiber diameter may cause irreversible damage.
4. Keep connectors and tips protected by the plastic caps when not in use.
5. When necessary the fiber end can be cleaned with soft tissue and alcohol or acetone, avoid scratching.
6. With the probe a 1,5mm wrench allyn key is delivered, so the setscrew of the variable path can be loosened, before changing the path length. Afterwards the setscrew needs to be tightened.
7. Since the optical reflector at the end of the probe is a diffuse reflecting material, a calibration of absorption values versus concentration needs to be done for all the chosen path lengths.
8. Do not exceed temperature specifications.

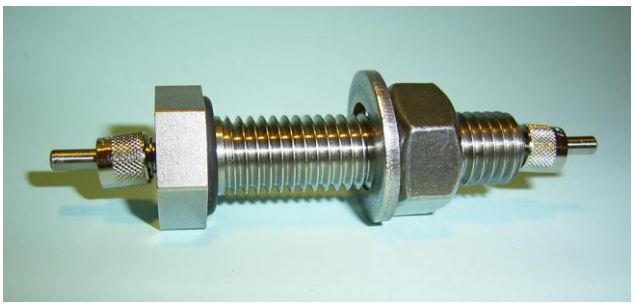
In our standard quality assurance procedure, each fiber optic assembly is labeled with a serial nr, and some standard test are being carried out with a spectrometer and AvaLight-CAL Line source and registered:

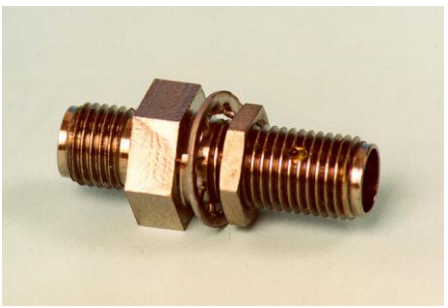
1. Spectral attenuation at 253 nm for UV/VIS fibers, spectral attenuation at 763 nm for VIS/NIR fibers.
2. Symmetries of the connector for both sides; the maximal peak value is allowed to move as many nm as the registered resolution of the fiber / spectrometer.
3. Optical inspection of scratches on the surface.
4. A Deep-UV burn-in of 8 hours to pre-solarize the -SR assemblies, the attenuation at 215nm is registered.

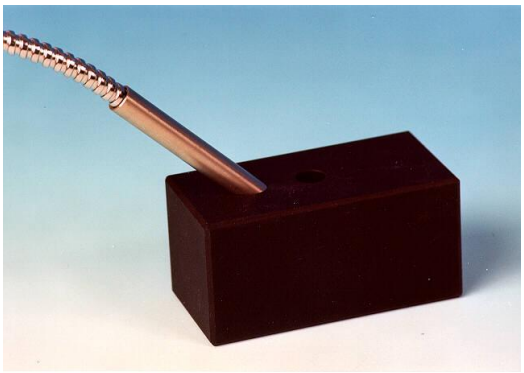
There is always a label attached to the fiber optic Dip probe that will tell you the serial nr, so the QA data can be retraced.

5.5 Fiber optic accessories

All fiber optic accessories are delivered with SMA905 connectors to allow easy coupling to our fiber optic cables and probes.









5.5.1 Collimating lenses

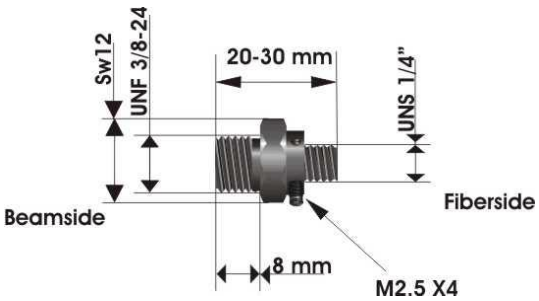
The COL-UV/VIS collimating lenses screw onto the end of an SMA fiber and convert the divergent beam of radiation light into a parallel beam. Collimating lenses can be used in any optical setup that requires parallel beams of light at the illumination source or at the entrance optics or at both sides. The COL-UV/VIS-90 is used to focus the exit light under 90 °.
Standard optical fibers have a n.a. of 0.22, which is an acceptance angle of 25°. The collimating lenses are adjustable, providing an acceptance angle of near 0° to about 3°.
The FCR-COL is used to collimate the light of a standard ¼" ferrule reflection probe, the FCR-COL also has an adjustable focus.
Please follow the below instructions to adjust the focus of your collimating lens:

1. Connect the fiber between the collimating lens and the light source.
2. Turn on the light source and focus the light in a white paper in ca. 100 mm distance.
3. Loosen the setscrew with the Allen Wrench key 1.27 mm on the barrel and slide the inner barrel until you see a sharp focused spot without light intensity and color variations across the beam spot.
4. Tighten the setscrew with the Allen Wrench key 1.27 mm.

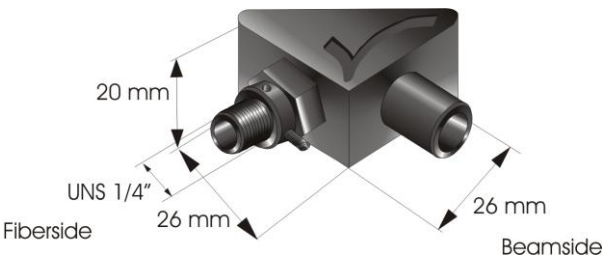
Technical Data

	COL-UV/VIS	COL-UV/VIS-90
Lens Diameter	6 mm	
Lens confocal length	8.7 mm	
Lens Material	Fused Silica	
Wavelength range	200-2500nm	
Fiber connection	SMA 905, UNS 1/4", FC/PC also possible	
Mirror reflectivity	n.a.	>90% (200-1100nm)
Housing Material	Aluminum black anodized	
Thread	UNF 3/8"-24	

Drawing COL-UV/VIS



Drawing COL-UV/VIS-90



5.5.2 Cosine corrector

The cosine correctors are spectro radiometric sampling optics, designed to collect radiation (light) over 180°, thus eliminating optical interface problems associated with the light collection sampling geometry inherent to other sampling devices.

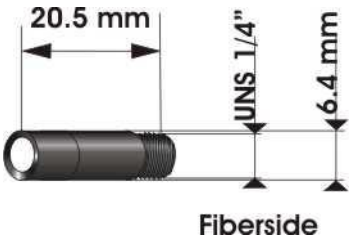
The CC-UV/VIS cosine corrector has teflon diffusing material and is optimized for applications from 200-1100 nm. For the VIS/NIR range (350-2500nm) a Radin material is available in the CC-VIS/NIR. Both cosine correctors screws onto the end of any SMA-terminated optical fiber. When coupled to a miniature fiber optic spectrometer, these cosine correctors can be used to measure UV-A and UV-B solar radiation, environmental light, lamps and other emission sources.

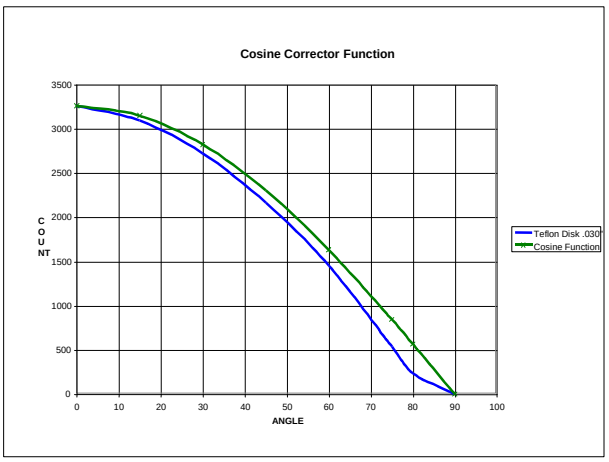
The Cosine Correctors have a 0.25" O.D. barrel with a smooth yet rugged black oxyde finish. The diffusing material is a thin disk that fits at the end of the barrel. The cosine corrector has an SMA 905 connector for convenient coupling to optical fibers.

Technical specifications

	CC-UV/VIS	CC-VIS/NIR
Diffusing material	Teflon (200-1100nm), ca 1 mm thick	Radin Quartz (350-2500 nm), ca. 1.5mm thick
Barrel dimension	0.25" O.D.	
Sampling geometry	accepts light at/from 180° FOV	
Connector	SMA 905	

Drawing CC-UV/VIS



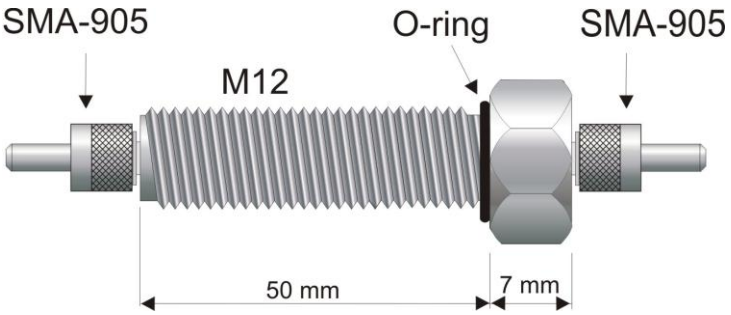


5.5.3 Vacuum feed through

The FC-VFT vacuum feed troughs are designed for use of fiber optics in vacuum chambers, such as for plasma monitoring. The vacuum feed through consists of an M12 housing with Viton® O-ring and needs 2 extra SMA fiber optic interconnects to allow easily coupling to fiber optic cables and probes. The vacuum feed through can be delivered for all fiber diameters, such as 50µm, 100µm, 200µm, 400µm, 600µm, 800µm and 1000µm for UV/VIS as well as for VIS/NIR.

Technical Data

Fibers	1 fiber, diameter 50 /100/200/ 400/600/800/1000µm
Wavelength range	200-800 nm (UV/VIS) or 350-1100 (VIS/NIR)
Connectors	Standard SMA905 connectors (2x)
Wall thickness of vacuum chamber	5-40 mm
Vacuum	Max. 10^{-7}mbar
Temperature	-40 ºC to 100 ºC. (High Temperatures available on request)



5.5.4 Fiber optic interconnect

The ME-FI-SM-MM fiber interconnect and ME-SM-BC are accessories for SMA-terminated optical fibers. Each connector consists of ¼"-36 outside-thread female adapter for easy connection to any SMA-terminated optical fiber. The ME-FI-SM-MM fiber interconnect may be useful for coupling patch cords to fiber optic probes and other devices, or for any multiple-fiber application where coupling of standard optical fibers and accessories is preferable to creating costly and complex fiber optic assemblies.

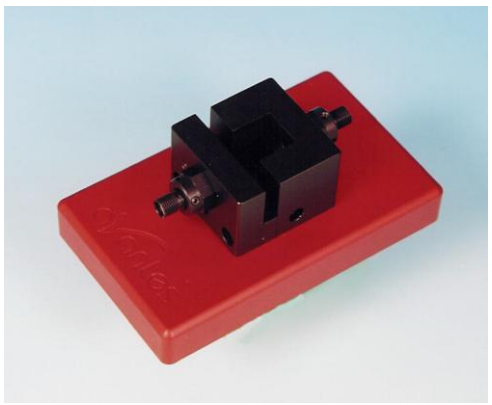
5.5.5 Reflection probe Holder

The Reflection probe holder is to fix a FCR standard reflection probe under an angle of 90 or 45 degrees, the holes have a 6,5 mm diameter and contain a setscrew to fix the probe in its position. The RPH measures 60 x 30 x 30 mm.
The reflection probe holder was developed for 2 types of reflection, specular and diffuse:

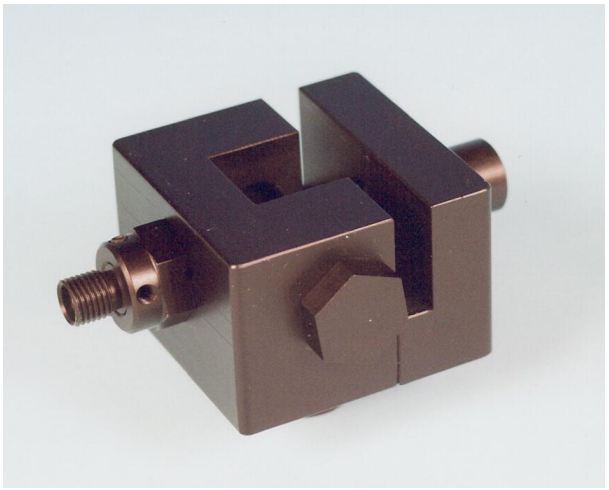
1. Specular reflection: Put the probe in the 90° aperture, adjust the distance from the measurement surface and tighten the setscrew with the 1.5 mm Allyn Wrench. Connect the 6-fiber leg to the light source and the read fiber to the spectrometer.
2. Diffuse reflection (for color measurements) : Put the probe in the 45° aperture, adjust the distance from the measurement surface and tighten the setscrew with the 1.5 mm Allyn Wrench. Connect the 6-fiber leg to the light source and the read fiber to the spectrometer.

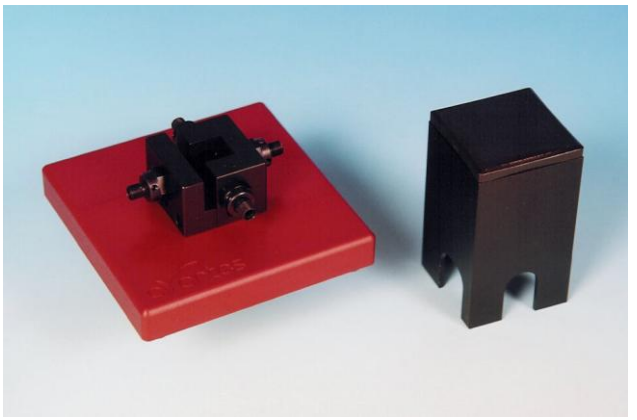
6 Accessories

A complete program for fiber optic SMA 905 coupled sampling accessories is available, such as batterypacks, integrating spheres, cuvette holders, filter holders, shutters, attenuators, integrated sampling systems and flow cells.







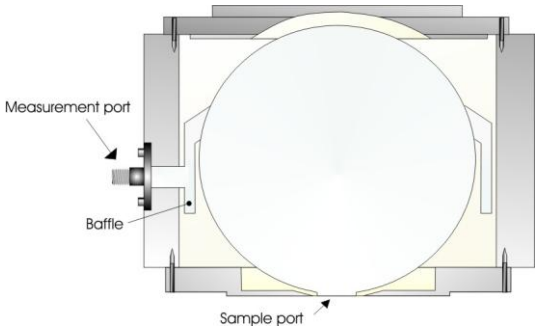


6.1 Integrating spheres

The AvaSphere integrating sphere family can be delivered with an active diameter of 30, 50 or 80 mm (XX means the active diameter) and an SMA port at 90 degrees for both irradiance and reflection measurements, the reflection sphere has an additional SMA- connector port at 8 degrees. Both versions have a sample port diameter of 6 mm for the 30 mm diameter sphere, 10 mm for the 50 mm diameter sphere and 15 mm for the 80 mm diameter sphere. The irradiance version of the integrating sphere can be used to measure light sources (Laser, LED, and Halogen Lamps). The reflection version is used to measure reflective surfaces, as well as for color measurement and fluorescence spectroscopy. A light source may be connected to SMA-connector port through a fiber optic bundle to make the integrating sphere an ideal uniform light source. The integrating sphere is made out of highly reflective diffuse material, its surface is reflecting the light diffuse with more then 95% in the spectral range from 250-2500 nm.

Operating instructions for the irradiance spheres

1. Connect an optical fiber between the SMA terminated measurement port of the sphere and the spectrometer.
2. Insert your emission source (Laser, LED, and Halogen Lamps, or light fiber) into the sphere sample port .
3. To collect diffuse radiation (light) from a 180° field of view, eliminating direct light collection by the detection fiber a baffle is installed in the sphere.
4. Measurements should be done in AvaSoft's relative or absolute irradiance mode, see the appropriate documentation.

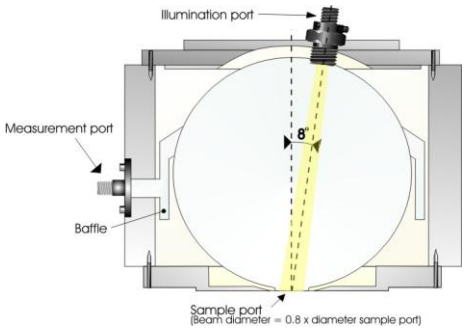


Operating instructions for the reflection spheres

Since the reflection sphere has 2 SMA ports, one under 8° and one under 90°, the sphere can be connected for reflection measurements in 2 ways:
1. Direct illumination, indirect measurement or
2. Indirect illumination and direct measurement

We always recommend to use the first method of directly illuminating and indirect measurement. This method has the advantage that the white light of the source directly illuminates the object. The diffuse and specular reflection is indirectly measured by the sample port. In the second method the illumination is indirect and therefore the object surface becomes a part of the sphere, so the illumination of the object is actually not white light anymore, depending on the color of the object. Such method requires a second spectrometer channel to measure the illumination in the sphere. The operating instructions refer to the first method of direct illumination and indirect measurement:

1. Connect an optical read fiber between the SMA terminated measurement port on the side of the sphere and the spectrometer.
2. Connect an optical illumination fiber or bundle between the SMA terminated illumination port on the top of the sphere and the light source. We recommend a 600um fiber or a bundle of 7 fibers of 200um. A bigger bundle will result in a collimated measurement spot, which is bigger than the sample port and will therefore make the measurement less accurate.
3. Loosen the set screw of the collimating lens with the Allen Wrench key 1,27 mm on the barrel and slide the inner barrel until you see a sharp focused spot without light intensity and color variations across the beam spot. Focus the illumination spot on the sample port, the optimal focusing point diameter is ca. 80% of the sample port diameter. The best way to see the spot is to put a white paper on the sample port and hold the sphere upside down.
4. Now you can put your AvaSphere on the object you would like to measure, do not forget to take dark and reference (on a WS-2 white tile) first.
5. The maximum angle of diffuse reflection is 120° field of view.
6. Measurements should be done in AvaSoft's reflectance or color parameter mode, see the appropriate documentation.



Technical Data

	AvaSphere-30	AvaSphere-50	AvaSphere-80
Internal diameter (mm)	30	50	80
Sample port diameter (mm)	6	10	15
External Housing dimensions	59.5 mm diameter 40 mm height	69.5 mm diameter 60 mm height	109 mm diameter 95 mm height

Ordering info for accessories

AvaSphere-LED-Adapter	Cylindrical Adapter to hold 3, 5, 8 mm LED's inside the AvaSphere-50-IRRAD
AvaSphere-LED-ADR-80	Cylindrical Adapter to hold 3, 5, 8 mm LED's inside the AvaSphere-80-IRRAD
AvaSphere-GT50	Optional Gloss Trap for AvaSphere-50-REFL, coated with black absorbing material. Only in combination with AvaSphere-50-REFL.
AvaSphere-GT50-W	Gloss Trap coated with white material to include specular reflection
AvaSphere-50-HOLD	WS-2-GEM Tile holder for AvaSphere-50-REFL for gemmology applications

6.2 Cuvette Holders

All types cuvette sample holders are designed for transmission/fluorescence measurements using a 10 x 10 mm cuvette. They feature adjustable clamping to hold non-uniform cuvettes at a repeatable location. All cuvette sample holders have 5 mm wide slit for filters.
In the following paragraphs the operation instructions for the different cuvette holders are given.

6.2.1 CUV-UV/VIS

The CUV-UV/VIS comes with 2 COL-UV/VIS focusing collimating lenses to maximize the light throughput. It also comes with a cover to prevent ambient light entering the light path.
Operating instructions:

1. Attach an SMA terminated optical fiber between the cuvette holder and the light source
2. Attach an SMA terminated optical fiber between the cuvette holder and the spectrometer
3. Optionally install a filter by loosening the filter screw and insert the filter into the filter slot, max filter size is 5 mm.
4. The cuvette holders are designed to hold 10 mm cuvettes, 2 ball plunger screws can be adjusted to secure an optimal reproducible cuvette position
5. Focusing of the 2 lenses: Loosen the set screw of the collimating lens with the Allen Wrench key 1,27 mm on the barrel and slide the inner barrel until you see the optimal signal for your spectrometer in raw data intensity counts.
6. Place cover over sample to prevent ambient light entering the light path.

Technical Data

Cuvette Dimensions	10 x 10 mm
Fiber connection	2 x COL-UV/VIS, SMA
Filter slit	Max 5 mm wide
Overall dimensions	100 x 60 x 40 mm
Cover	Black anodized aluminum, 45 x 45 x 80 mm

6.2.2 CUV-FL-UV/VIS

The CUV-FL-UV/VIS has 2 focusing lenses, under 90 degrees for fluorescence measurements as well as 2 SiO2 coated mirrors.
Operating instructions:

1. Attach an SMA terminated optical fiber between the cuvette holder and the light source
2. Attach an SMA terminated optical fiber between the 90° port on the side of the cuvette holder and the spectrometer
3. Optionally install a filter by loosening the filter screw and insert the filter into the filter slot, max filter size is 5 mm.
4. The cuvette holders are designed to hold 10 mm cuvettes, 2 ball plunger screws can be adjusted to secure an optimal reproducible cuvette position
5. Focusing of the 2 lenses: Loosen the set screw of the collimating lens with the Allen Wrench key 1,27 mm on the barrel and slide the inner barrel until you see the optimal signal for your spectrometer in raw data intensity counts.
6. Place cover over sample to prevent ambient light entering the light path.

6.2.3 CUV-ALL-UV/VIS

The CUV-ALL-UV/VIS has 4 collimating lenses, 4 x COL-UV/VIS in 2 optical paths. The CUV-ALL can be used to do simultaneously measurements with a dual channel spectrometer, such as AvaSpec-2048-2.
Operating instructions:

1. Attach an SMA terminated optical fiber between the port of the cuvette holder and the light source.
2. Attach an SMA terminated optical fiber between the opposite port the cuvette holder and the spectrometer's master channel.
3. Attach an SMA terminated optical fiber between the other port of the cuvette holder and the light source.
4. Attach an SMA terminated optical fiber between the opposite port the cuvette holder and the spectrometer's slave channel.
5. Optionally install a filter by loosening the filter screw and insert the filter into the filter slot, max filter size is 5 mm.
6. The cuvette holders are designed to hold 10 mm cuvettes, 2 ball plunger screws can be adjusted to secure an optimal reproducible cuvette position. Focusing of the 2 lenses: Loosen the set screw of the collimating lens with the Allen Wrench key 1,27 mm on the barrel and slide the inner barrel until you see the optimal signal for your spectrometer in raw data intensity counts.

The CUV-ALL-UV/VIS can be used for fluorescence applications as well, for fluorescence follow these instructions:

1. Attach an SMA terminated optical fiber between the cuvette holder and the light source
2. Attach an SMA terminated optical fiber between the 90° port on the side of the cuvette holder and the spectrometer
3. Optionally install a filter by loosening the filter screw and insert the filter into the filter slot, max filter size is 5 mm.
4. The cuvette holders are designed to hold 10 mm cuvettes, 2 ball plunger screws can be adjusted to secure an optimal reproducible cuvette position
5. Focusing of the 2 lenses: Loosen the set screw of the collimating lens with the Allen Wrench key 1,27 mm on the barrel and slide the inner barrel until you see the optimal signal for your spectrometer in raw data intensity counts.

6.2.4 Direct Attach Cuvette Holders

The CUV- direct attachment cuvette holders are available for all our fiber optic light sources, for the different models see technical data table. The direct attach cuvette holders can be used for absorbance and fluorescence measurements.

They come with two 90 degree and a 180 degree 3/8"-24 thread that allows the COL-UV/VIS collimating lens to be mounted for absorbance or fluorescence setups.

Two SiO_2 coated aluminum mirrors with 3/8"-24 thread screw are delivered with the direct attach cuvette holders to mount in the other thread, to make the fluorescence signal even stronger. The cuvette holders also have a 5 mm wide filter slot.

For most of the AvaLight light sources special direct attach cuvette holders are available (see table) that can be mounted directly on the front panel of the light source instead of the standard filter holder.

Technical Data

	CUV-DHc/XE/LED			CUV-DHS	CUV-HAL
Lightsource	AvaLight-DHc	AvaLight-XE	AvaLight-LED	AvaLight-DH-S	AvaLight-HAL
Wavelength range	200-2500nm				
Cuvette Dimensions	10 x 10 mm				
Light source connection	SMA thread incl col. lens			Mounting plate	Mounting plate
Fiber connection	1 x COL-UV/VIS, SMA 905 connectors				
Fluorescence mirrors	2 x SiO_2 coated aluminum mirrors				
Filter slit	Max 5 mm wide				
Dimensions	60 x 43 x 28 mm			60x 50 x 50mm	60x 35 x 35mm

The Direct Attach Cuvette Holders can be used for 2 types of applications, absorbance and fluorescence

For **absorbance measurements** follow these instructions:

1. Attach the cuvette holder directly to the SMA port of the light source
2. Attach an SMA terminated optical fiber between the cuvette holder 180-degree port and the spectrometer.
3. Optionally install a filter by loosening the filter screw and insert the filter into the filter slot, max filter size is 5 mm.
4. The cuvette holders are designed to hold 10 mm cuvettes, 2 ball plunger screws can be adjusted to secure an optimal reproducible cuvette position
5. Focusing of the lens: Loosen the set screw of the collimating lens with the Allen Wrench key 1,27 mm on the barrel and slide the inner barrel until you see the optimal signal for your spectrometer in raw data intensity counts.

The CUV-DA can be used for **fluorescence applications** as well, for fluorescence follow these instructions:

1. Attach the cuvette holder directly to the SMA port of the light source
2. Move the SMA connector from the 180° position to the 90° position and screw the aluminum mirror into the 180° position.
3. Attach an SMA terminated optical fiber between the 90° port on the side of the cuvette holder and the spectrometer

4. Optionally install a filter by loosening the filter screw and insert the filter into the filter slot, max filter size is 6 mm.
5. The cuvette holders are designed to hold 10 mm cuvettes, 2 ball plunger screws can be adjusted to secure an optimal reproducible cuvette position
6. Focusing of the 2 lenses: Loosen the set screw of the collimating lens with the Allen Wrench key 1,27 mm on the barrel and slide the inner barrel until you see the optimal signal for your spectrometer in raw data intensity counts.

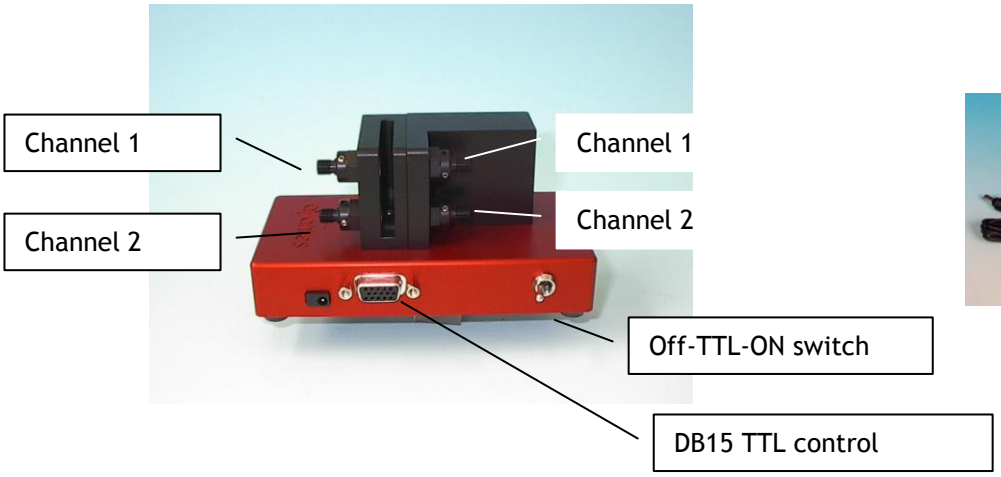
6.3 FOS-1/2-inline Fiber Optic Switch

Starting up

7. Plug in the PS-24V power supply .
8. Plug in the connector of the power supply into the socket of the FOS.
9. Connect the SMA-connectors of your fibers to the Fiber inputs Channel 1 and 2
10. FOS-1-inline only: For automatic TTL-shutter control insert interface cable IC-DB-15 or IC-DB-26-2 plug in connector and connect to AvaSpec spectrometer
11. Choose operating mode for the mode-switch: The active channel for the FOS-2-INLINE-UV/VIS can be selected manually or can be controlled by a signal at pin 15 of the DB15 connector. If there is no cable connected to the DB15 connector, the active channel of the FOS-2-INLINE-UV/VIS can be set by the position of the switch according to following table:

Switch position	TTL signal	Channel 1	Channel 2
OFF (left)	X	Undefined	Undefined
TTL (middle)	Not connected	CLOSE	OPEN
	High	OPEN	CLOSE
	Low	CLOSE	OPEN
ON	X	OPEN	CLOSE

12. For Automatic save-dark for FOS-1-inline use AvaSoft full
13. For Correct for long time drift with FOS-2-inline see application note with AvaSoft 7





PS-24VDC power supply

Adjustment of focusing in SMA fiber

The AvaLight is factory adjusted to optimally focus the output into a 200µm fiber. If lower optical power is recommended or a different fiber (bundle) diameter is used, the optical power can be adjusted.

9. Connect your fiber optic spectrometer or your optical power meter to a fiber to the Fiber input
10. Loosen blocking-screw with delivered Allen key (1,3mm).
11. By shifting the SMA socket you can optimize your optical power.
12. Secure position by tightening the blocking screw .

Application note

Correct for long term system drift with the FOS-2-INLINE-UV/VIS and AvaSoft 7 (see AvaSoft 7 manual)

Technical Data

Power requirement	24 VDC (+inside, GND outside)/ 100 mA
Filter slit	Max. 5 mm wide
Shutter frequency	Max. 40 Hz
Shutter delay	10 ms
IC-DB-15 connector	FOS-1-inline Pin 10 = GND Pin 13 = TTL input, high – shutter open, low shutter closed
	FOS-2-INLINE Pin 10 = GND Pin 15 = TTL input
Dimensions (mm)	130 x 65 x 65 mm

The following interface cables that can be used for the FOS are available at Avantes:

IC-DB15-2	Interface cable for AvaSpec-USB1 platform to FOS-1-inline, 2m long
IC-DB26-2	Interface cable for AvaSpec-USB2 platform to FOS-1-inline, 2m long
IC-DB15-FOS2-2	Interface Y-cable, AvaSpec-USB1 platform to FOS-2 and Avalight-S, 2m long
IC-DB26-FOS2-2	Interface Y-cable, AvaSpec-USB2 platform to FOS-2 and Avalight-S, 2m long

6.4 Flow cells

6.4.1 1”, 1/4" and 1/2" flow cells

The 1”, 1/4" and 1/2" flow cells are developed for in-line absorption measurements. The flow cells consist of a Swagelok union cross tube fittings and 2 UV/VIS/NIR collimating lenses with 5 mm, 10 mm or 20 mm optical path and SMA905 connectors for easy coupling to our comprehensive line of fiber optic cables and bundles.

Technical Data

Wavelength range	200-2000nm
Fiber connection	2 x SMA905 connectors
Collimating optics	Plano Convex, focal length 8,7 mm
Optical path	5 mm for 1/4", 10 mm for 1/2", 20 mm for 1”
Material	Stainless steel for the fitting, black anodized aluminum for the SMA905 connectors
Overall dimensions	55 x 45 x 15 mm

6.4.2 Micro flow cells

The micro flow cells are Z-cells that can be easily coupled by 1,5mm PTFE tubing with 0,5mm inner diameter for in-line absorption measurements and HPLC applications. For the micro HPLC cell a temperature control is possible through Peltier element via the RS-232 interface with the computer. The Z-flow cells can be coupled with 2 special fiber optic cables (see below) , the Micro HPLC directly by SMA adapters.

Technical Specifications

Flow Cell Type	Micro flow Z-cell	Micro HPLC cell
Wavelength Range	200-2200nm	250-2500 nm
Optical path length	1,5 mm / 10 mm	5 mm / 10 mm
Sample volume	3 µl / 18 µl	1 µl / 2 µl
Tubing OD connection	1.5mm (1/16")	1.5mm (1/16")
Pressure rating	10 bar	30 bar
Fiber optic coupling	1,6 mm ferrule	SMA connector
Temperature regulation	-	10-40°C ± 0,1°C
Dimensions / material	32 x 38 x 13 mm / PEEK	40 x 70 x 46 mm / Aluminum

6.5 WS-2 White reflective tile

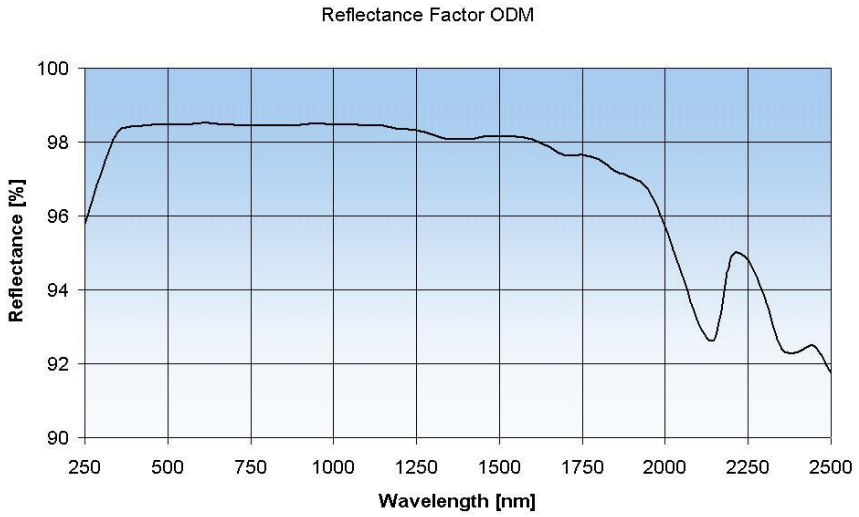
The WS-2 white reference tile is made out of a white diffuse plastic material, meeting the highest demands with regard to high grade diffuse reflectance, mostly used in colorimetry applications where a reference signal has to be obtained during a reflection measurement. Thanks to most accurate preparation of the PTFE and its processing to an amorphous structure, the tile reflects light from 350-1800 nm with ca 98% and from 250-2500nm more than 92%. The material offers along term stability, even in deep UV applications, the plastic is hydrophobic and chemically inert.
The material can be delivered as custom designed items, such as the WS-2-GEM with a 10 mm radius hole for nitrogen cooling of gemstones for gemology applications, contact us for more information.

General Care

WS-2 is an optical standard and should be handled in much the same way as other optical standards. Although the material is very durable, care should be taken to prevent contaminants such as finger oils from contacting the material's surface, because this causes a loss of reflectivity especially in the UV region. Always wear clean gloves when handling WS-2!

Cleaning Instructions

If the material is lightly soiled, it may be air brushed with a jet of clean dry air or nitrogen. DO NOT use Freon. For heavier soil, the material can be cleaned by using an ultrasonic bath with double distilled or deionized water for 2 hours at 40 to 60°C. After this dry the WS-2 piece at 60° C for a 12-hour period (If possible at a vacuum of 1 Torr or less, then purge the vacuum oven with clean dry air or nitrogen). Caution!! Never use soap-water, alcohol, and organic or any other cleaners for WS-2. This will cause a big loss of reflectivity in the UV reflectance.



Technical Specifications

Reflectivity (see curve)	>98% (350-1800nm) >92% (250-2500nm)
Max. temperature	280 °C
Dimensions tile	32mm diameter / 10mm thick
Housing	38 mm diameter, black anodized

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