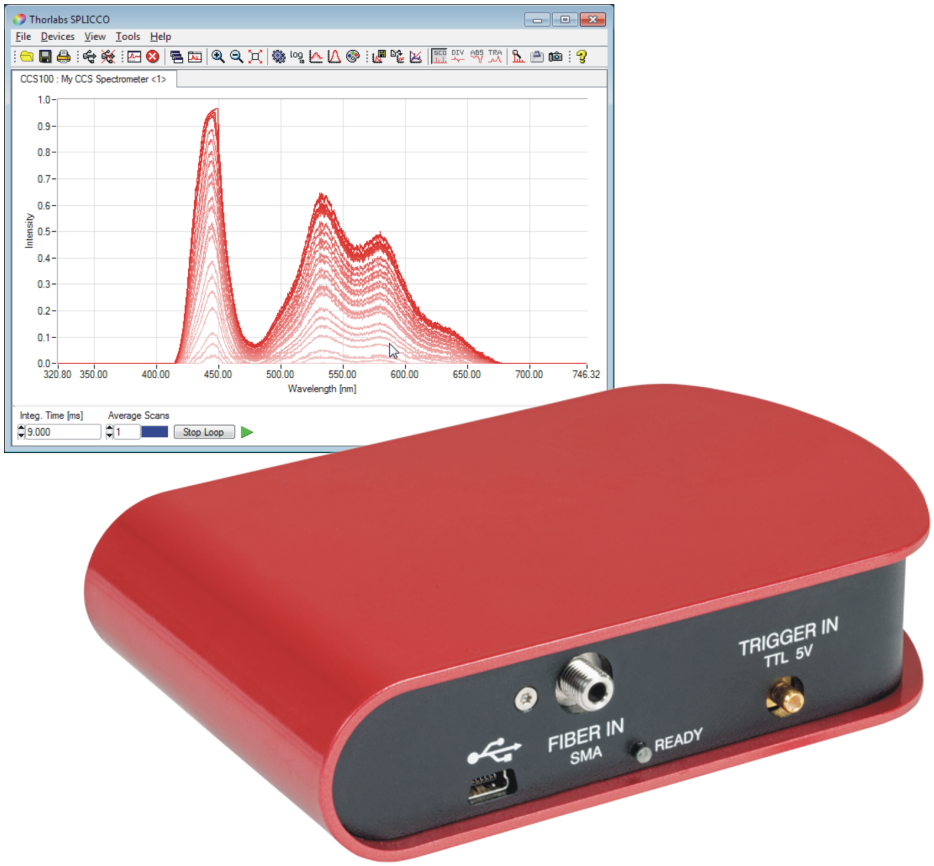
THORLABS

Spectrometer

CCS Series
Operation Manual



2012

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Contents

We aim to develop and produce the best solution for your application in the field of optical measurement technique. To help us to live up to your expectations and improve our products permanently we need your ideas and suggestions. Therefore, please let us know about possible criticism or ideas. We and our international partners are looking forward to hearing from you.

Thorlabs GmbH

Warning

Sections marked by this symbol explain dangers that might result in personal injury or death. Always read the associated information carefully, before performing the indicated procedure.

Attention

Paragraphs preceeded by this symbol explain hazards that could damage the instrument and the connected equipment or may cause loss of data.

Note

This manual also contains "NOTES" and "HINTS" written in this form.

Please read these advices carefully!

1 General Information

The CCS Spectrometer Series is designed for general laboratory use. Integrated routines allows averaging, smoothing, peak indexing, as well as saving and recalling data sets.

The initial setup is simple to complete. Following installation of the software, the CSS spectrometer is ready to use. Simply plug it into a USB 2.0 port and run the application software SPLICCO. The remainder of this manual is devoted to the setup procedure and features of the fiber spectrometer. A troubleshooting section and detailed specifications of the various components are provided to further assist. The description of the instrument driver commands can be found in the VXIpnp VISA instrument driver package.

Application software SPLICCO

SPLICCO is an acronym for "**SP**ectrometer and **LI**ne **C**amera **CO**ntrol". This software can be used for acquiring direct, transmittance and absorbance measurements in conjunction with Thorlabs line cameras and spectrometers.

After the installation the software is able to communicate with all Thorlabs CCS spectrometers. Additionally, two virtual devices are included: a line camera and a spectrometer, to demonstrate the functionality of SPLICCO.

1.1 Safety

Attention

All statements regarding safety of operation and technical data in this instruction manual will only apply when the unit is operated correctly as it was designed for.
All modules must only be operated with proper shielded connection cables.
Only with written consent from *Thorlabs* may changes to single components be carried out or components not supplied by *Thorlabs* be used.
This precision device is only serviceable if properly packed into the complete original packaging including the plastic foam sleeves. If necessary, ask for a replacement package.

1.2 Ordering codes and accessories

Ordering code	Short description
CCS100	CCS spectrometer, 350 - 700 nm
CCS150	CCS spectrometer, 200 - 400 nm
CCS175	CCS spectrometer, 500 - 1000 nm
CCS200	CCS spectrometer, 200 - 1000nm
M14L01	1 m SMA MMF Patch Cable, 50µm/0.22NA (to CCS100 and CCS175)
BFH22-200-030-SMA-1M	1 m SMA MMF Patch cable, 200µm/0.22 NA, High OH (to CCS150 and CCS200)
CVH100; CVH100/M	Cuvette holder (imperial and metric versions)

1.3 Requirements

Hardware Requirements:

CPU: 1 GHz or higher

RAM: 256 MB

Graphic card with at least 32 MB memory

Hard disc with at least 100 MB free storage space

free USB2.0 port

USB cable according the USB 2.0 specification

Software Requirements:

Windows ® XP (32-bit) SP3,

Windows ® Vista (32-bit, 64-bit),

Windows ® 7 (32-bit, 64-bit)

VISA runtime (version 5.1 or higher)

2 Installation

2.1 Parts List

Inspect the packaging for damage. If the shipping container seems to be damaged, keep it until you have inspected the contents and you have inspected the CCS Spectrometer mechanically and electrically.

Please verify that you have received the following items:

1x CCS Spectrometer

1x CCS Spectrometer User Manual

1x CD-ROM with application software SPLICCO and drivers

1x USB 2.0 A-B mini cable, 1.5 meters

1x Optical Fiber, SMA to SMA, 50µm / 0.22NA, 1 meter (CCS100, CCS175)
Quartz Fiber, SMA to SMA, 200µm /0.22NA, 1 meter (CCS150, CCS200)

1x Trigger Input cable SMB to BNC

CCS Spectrometer *with all user relevant ports and signal LEDs*

(1) USB port

(2) Fiber input (SMA connector)

(3) Status LED

(4) Trigger Input (SMB connector)

2.2 Getting started

The CCS spectrometer must **NOT** be connected to your PC while the software is being installed.

Once the software has been installed, please connect the USB cable to the USB 2.0 port on your PC and the USB B mini connector to the CCS spectrometer . You will be prompted to allow the automatic installation of the drivers. After completing, run the application program SPLICCO.

2.2.1 USB requirements

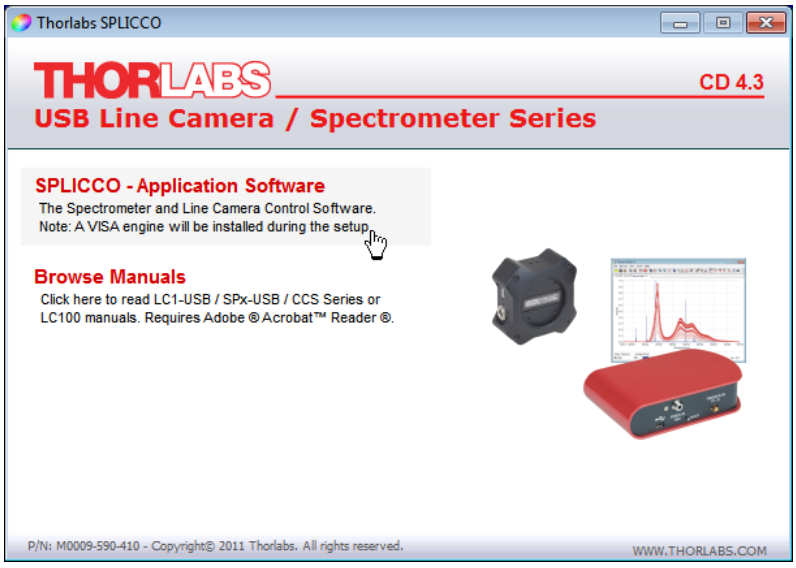
To achieve the maximum performance benefit from your CCS spectrometer, you must have a dedicated USB 2.0 port available on your PC (a built-in USB 2.0 port is recommended).

2.3 Installing Software

2.3.1 The installation menu

Before installing SPLICCO, please make sure that no CCS spectrometer is connected. After you inserted the SPLICCO installation CD an autorun menu will appear, see figure below. If autorun is disabled on your system you have to browse the installation CD and run

"[CD-Drive]:\Autorun\Autorun.exe".



Note

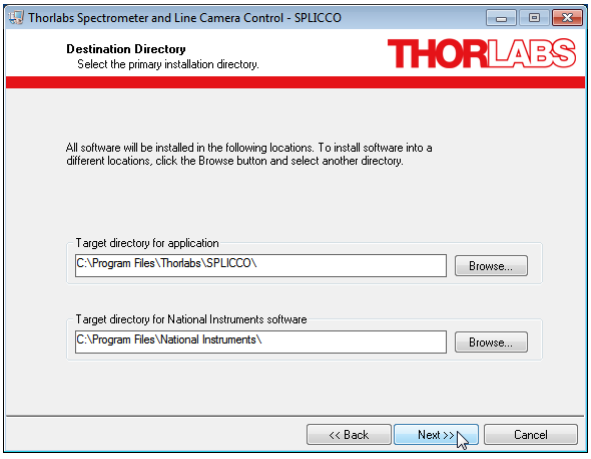
Please be aware that SPLICCO software requires the NI VISA runtime engine V5.1 or above installed on your system. The installer checks for installed VISA software and, if necessary, will install the NI VISA automatically. You will be notified accordingly:

Administrator privileges are required for installation. Please contact your system administrator, if you get an appropriate error message.

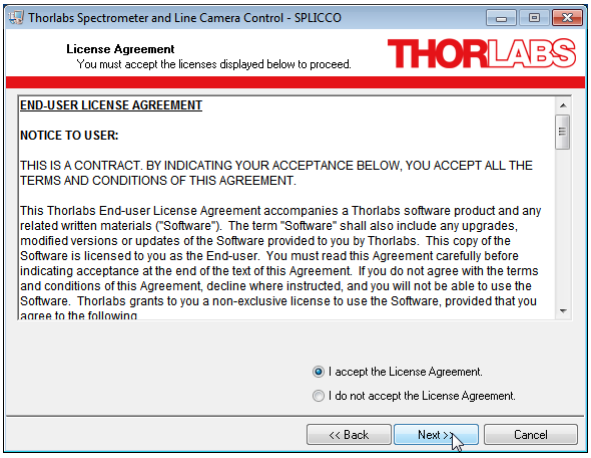
In the following section are shown in detail the installation steps for an installation on a Windows 7© operating system.

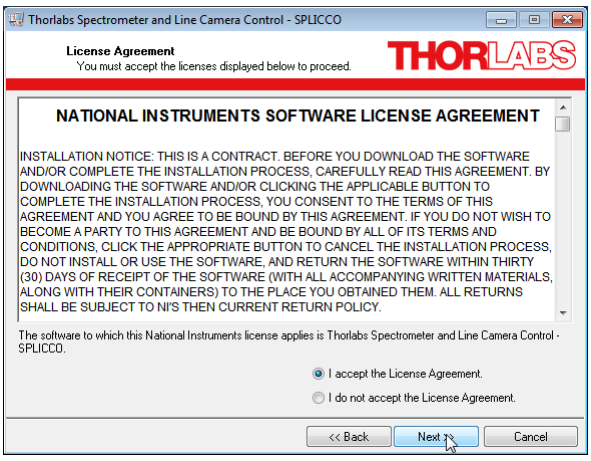
2.3.2 Installing SPLICCO

Select "SPLICCO - Application software" from the installation menu to start the installation wizard. You will be prompted to specify the installation path. Confirm with "Next" when you selected the installation path of your choice.

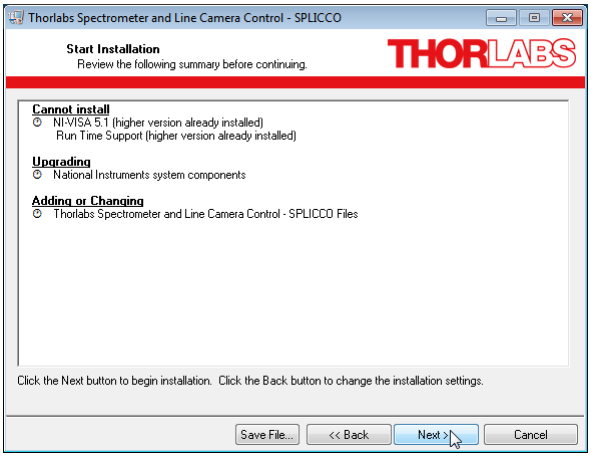


Please read the end user agreement carefully, choose "I accept the License Agreement(s)" if you do so and press "Next" in the following two screens:

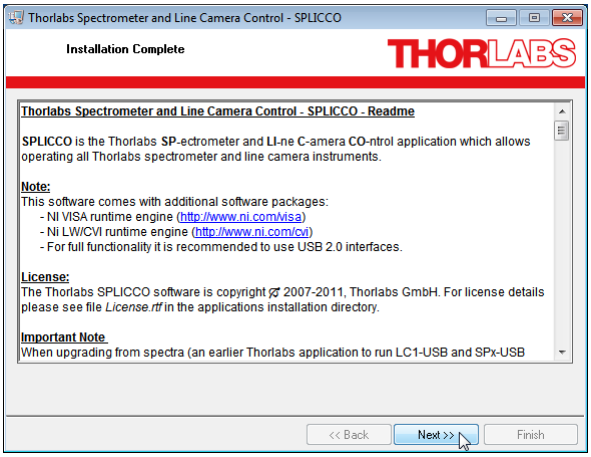




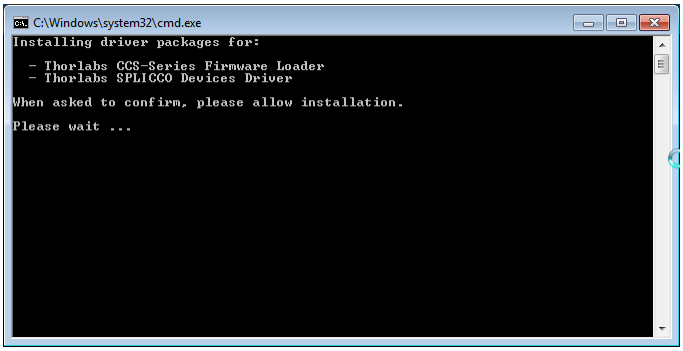
The following window states the next installation steps and notifies, which software will be installed. Click the "Next" button to begin installation or click the "Back" button to change the installation settings.



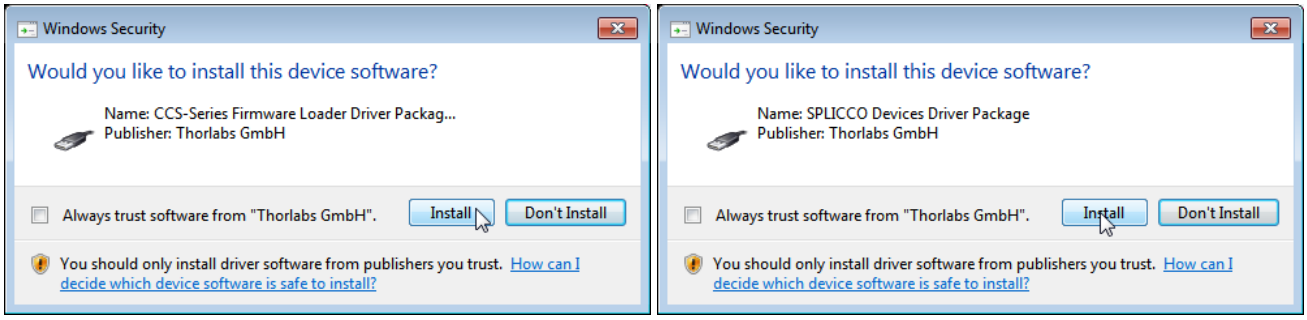
After the installation was successful you will see a window containing information about a log file (change log) and other notes. Press "Next" to finish installation.



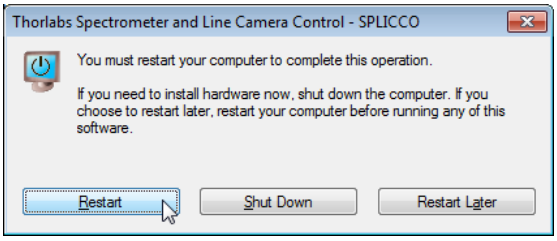
Now the device drivers will be copied into the system folders. This might take a few moments and a command prompt window will pop up, which will start the driver installation routine of windows.



Windows Security system will notify you about device driver installation. You may check the box "Always trust software from "Thorlabs GmbH" prior to click the Install button. A firmware and driver package for all supported devices will be installed as SPLICCO software is designed to control several hardware devices.



Finally, you will be prompted to restart you computer in order make changes effective:



2.3.3 Driver Installation

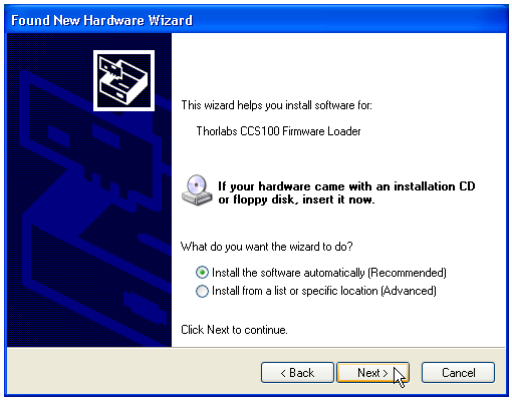
Upon first connect of a CCS-100 Series Spectrometer Windows recognizes a new hardware and starts the driver installation.

Using Windows XP©

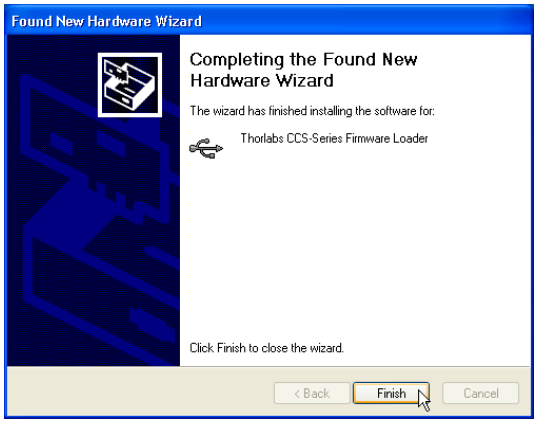
Windows installs first a firmware loader, followed by the CCS100 driver installation. A popup in the left bottom corner appears, displaying the name of the device.

The "Found New Hardware Wizard" starts to install the new device. Depending on the configuration of your system, you may be asked if you want to connect to "Windows Update to search for software" shown in the following figure.

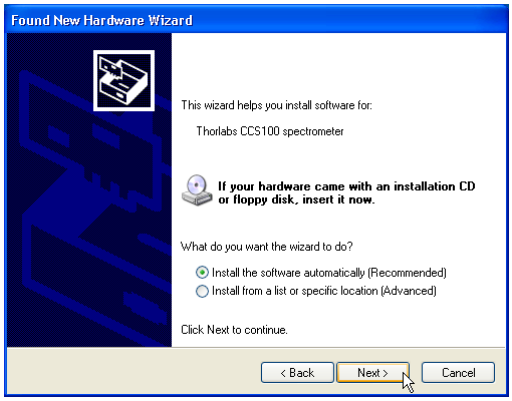
Please select "No, not this time" and click "Next" to continue.

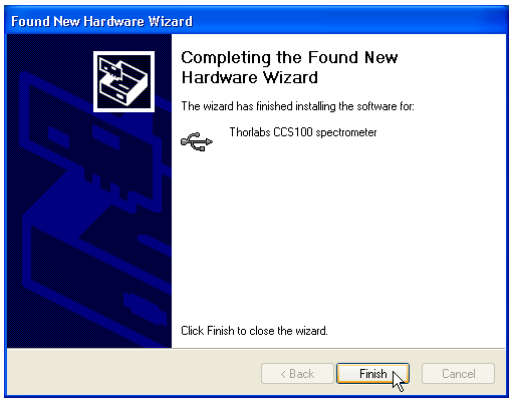


Select "Install the software automatically" and click "Next" to continue. Windows XP will notify you that Windows Logo Testing for this software has failed - please click to "Continue anyway".



Finalize the installation by clicking "Finish". As the next step, the CCS100 instrument driver will be installed. Please follow the screenshots below.

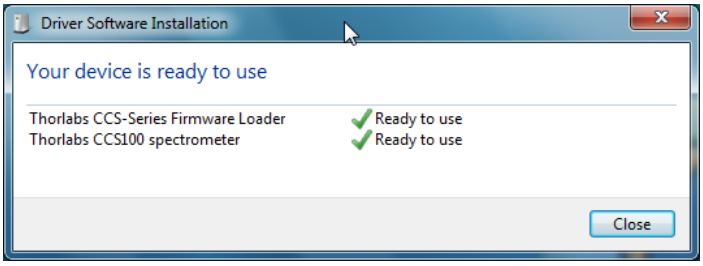




The green status LED lights up, the device is installed and ready for use with SPLICCO.

Using Windows 7©:

Connect your CCS spectrometer. Windows recognizes the connected device and automatically installs first the CCS-Series Firmware loader and then the driver software:



The green status LED lights up, the device is installed and ready for use with SPLICCO.

2.3.4 Start the GUI

To start SPLICCO click on the desktop icon 

or select 'Programs' via the START button in the Windows task bar and navigate to 'All Programs / Thorlabs / SPLICCO / SPLICCO'.

3 Operating Instruction CCS Spectrometer Series

Note

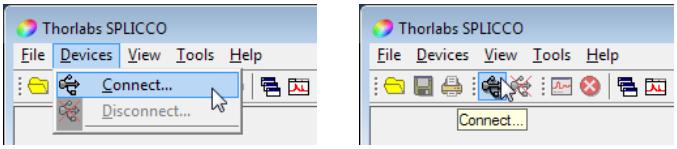
If you are using a CCS200 broadband spectrometer and a continuous spectrum (e.g. of a white light lamp) shall be measured, please note the following recommendation:

Your CCS200 was delivered with a BFH22-200 multi mode fiber, SMA connectorized. Due to eccentricity between the fiber core and the ferrule and the geometry of the input slit of the spectrometer, the displayed spectral intensity may vary when the SMA connector of the fiber is rotated within the input receptacle of the CCS200.

Please find the maximum intensity by rotation and then fix the fiber connector with the lock bush. This ensures best measurement results.

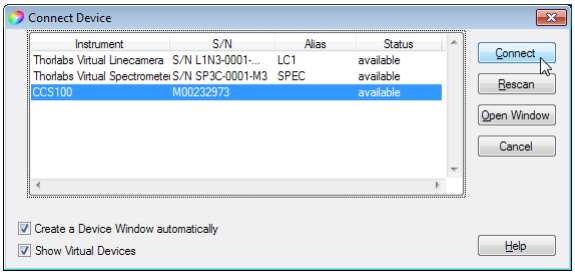
3.1 Connecting a Device

1. To start a measurement with a CCS spectrometer connect it to a USB port of your PC with the supplied cable.
2. The SPLICCO connects automatically to all detected devices.
3. A device can be connected manually: Select 'Connect...' from the **Devices** menu or click to the Connect icon from the tool bar.



The following window appears and shows all connected devices and additionally two virtual devices. Now you can select a device to be used. A panel will be created according to your selection by default. If the "Create a device window automatically" option is not checked, please use the according panel icon from the main interface.

Press "Cancel" to leave this dialog and "Rescan" to scan the system again for new devices.



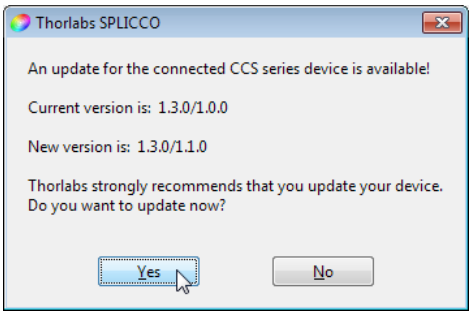
Every device can only be opened once. Devices already opened by SPLICCO are marked with the "running" status and are grayed out in the device selection dialog. Devices used by another application than SPLICCO are marked with the "locked" status.
Press "Open Window" to switch to the "Open Window" dialog to connect a window to an already running device.

Furthermore, you can start a virtual spectrometer, which can simulate a spectrum. Through this feature you can familiarize yourself with SPLICCO, without the need of a light source or signal. You can select to display or hide those virtual devices by checking or unchecking the "Show virtual devices" box.

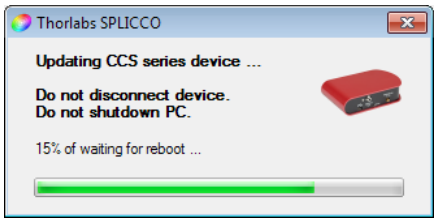
For a detailed description about the virtual devices refer to section Virtual devices 52.

3.2 CCS xxx Software upgrade

The SPLICCO software comes with a driver update function. The CCS spectrometers have an internal software, it's versions are being checked upon connecting a device by SPLICCO software. In case that the installed SPLICCO version requires a firmware update, the following warning appears:



Click "Yes" to update. Several message windows appear:



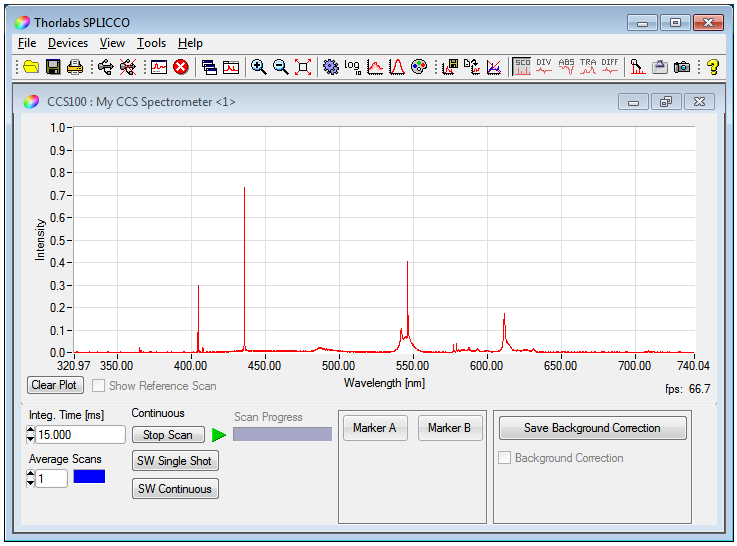
After successful installation, the spectrometer is being connected automatically.

If you decline the CCSxxx update, the spectrometer might not work properly with the current SPLICCO version.

Note

The content of the spectrometer's internal memory (EEPROM), i.e., the device label is not being overwritten.

3.3 Integration time



The integration time represents how long the CCD interacts with incoming light. CCD pixels act like light buckets, gathering photons. The integration time displays the duration for which the bucket is open. For very bright sources, low integration times are required, whereas for weak sources, longer integration times should be used. As in the light bucket analogy, CCD pixels can be overfilled ("blooming"). This is called saturation and will cause the output to be misleading.

Note

If no intensities are displayed, please enter the shortest integration time and increase it continuously until an intensity curve is displayed. As mentioned above, CCDs are very sensitive, and if over-exposure occurs, no intensity can be displayed.

Also, please make sure the background correction is disabled (see section Background Correction 39)

Integration time can be set via the control on the lower left corner of the device window. The supported range is defined by the CCS Spectrometer and ranges from 10 µs to 60 seconds. The integration time input window uses milliseconds, therefore the values of 0.01 ms - 60000 ms have to be used to cover the range. A window, which only shows a loaded from a file spectrum does not offer those controls in the left bottom corner.

For integration time values below 1000 ms, in the lower right corner is displayed the actual frame rate ("fps" = frames per second). When exceed 1s integration time, the according parameter is changing to "sec per frame".

A change of the integration time affects all windows connected to this device, which are then updated to show the same integration time.

Higher integration times results in higher peaks in the measurement data.

Note

For CCS Series, a the integration is specified up to 10 s. The reason is that at longer integration time, the intensities of hot pixels and noise may increase essentially and reach, depending on the individual CCD, 100% intensity.

3.4 Program Navigation

SPLICCO can be operated by using the menu or the toolbar.

Menu

File menu

The 'File' menu contains all functions for saving, loading, importing and exporting measurement data, printing and saving and loading of device configurations.

Devices menu

In the 'Devices' menu you find all functions regarding your actual connected devices. You can connect / disconnect devices as well as set the properties of the devices.

View menu

The 'View' menu contains all functions to configure the display windows. All active windows are listed here. Windows can be opened/closed/zoomed or you can switch between the released and tabbed view.

Tools menu

All functions to calculate with reference curves like transmittance can be found here. Furthermore there are tools like taking snapshots from the actual window, copying the current measurement data to the clipboard, finding a peak and sequential recording.

Help menu

You will find the online help in this menu. Furthermore, there is a link to the Thorlabs web page to check for the latest drivers or software version. You can check the current version by selecting 'About...'.

Toolbar

The toolbar offers quick access to important functions.

 Opens an existing file (*.jdx)

 Saves the current measurement in a file (*.jdx)

 Prints the current window with user's comment and timestamp

 Connect a device

 Disconnect a device

 Creates and connects a new window to a device

 Closes the actual window

 Switches to released windows view

 Switches to tabbed windows view

 Zooms in by factor 2

 Zooms out by factor 2

 Resets the zoom to full scale

 Opens the Devices Settings Panel

 Switches between logarithmic and normal y scale

 Opens a dialog to configure persistence

 Opens a dialog to configure Gaussian transformation

 Opens a dialog to configure colors


Stores the actual measurement plot as reference plot


Loads a reference plot out of a JCAMP-DX file


Deletes the actual windows reference curve

Switches to scope view

Switches to division view

Switches to absorbance view

Switches to transmittance view

Switches to difference view


Opens the peak finder dialog for the actual window


Copies actual measurement data values to clipboard


Makes a snapshot from the actual window


Opens the windows help for SPLICCO

3.5 Save and Export Data

SPLICCO can save data either in JCAMP-DX or CSV format.

JCAMP-DX:

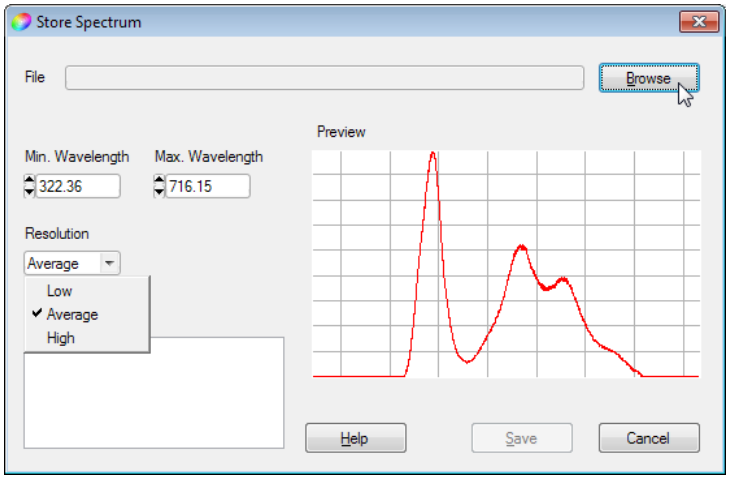
- stores data and comments
- visit "http://www.jcamp-dx.org/" for more information

CSV:

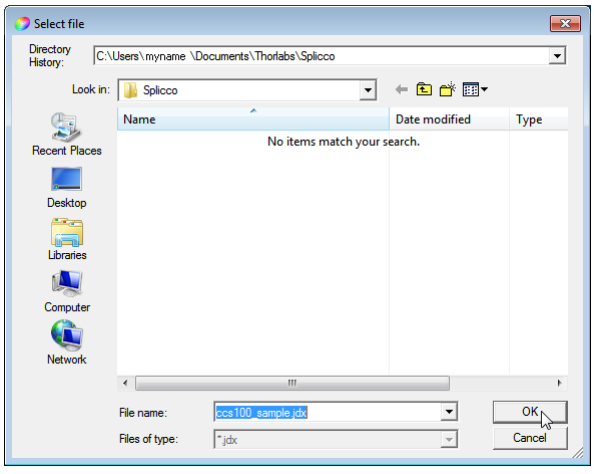
- comma separated values
- later use with third party software like Microsoft Excel™ or Mathlab™
- human readable

Save measurement data

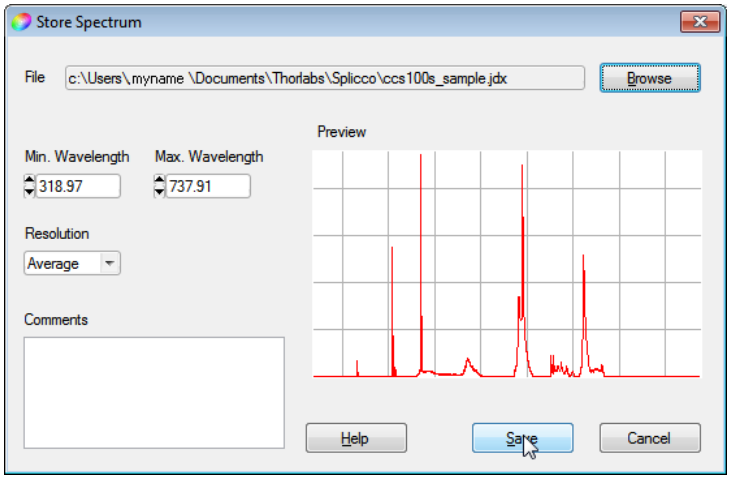
To save the measurement data to a JCAMP-DX file select 'Save As ...' from the **File** menu or click the button from the toolbar. A file dialog window appears and you can choose the filename and directory.



Click to "Browse" to define the location of the file to be saved to:



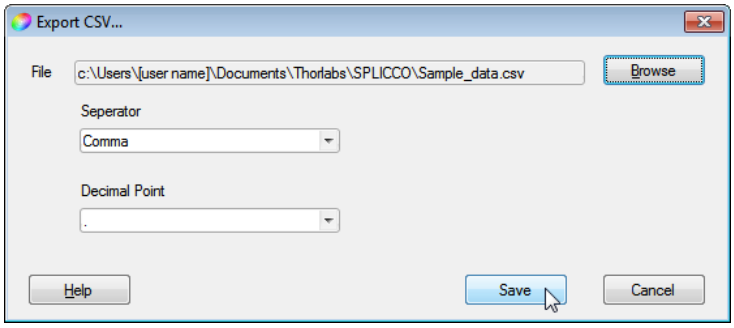
The file extension of this file is *.jdx. Additionally you can choose the range to store and the resolution, which defines how many values are interpolated and saved to file. "High" means factor 2, "Low" means factor 0.5 and "Average" means factor 1. Text entered in the "Comments" field will be stored together with the data.



Export Data

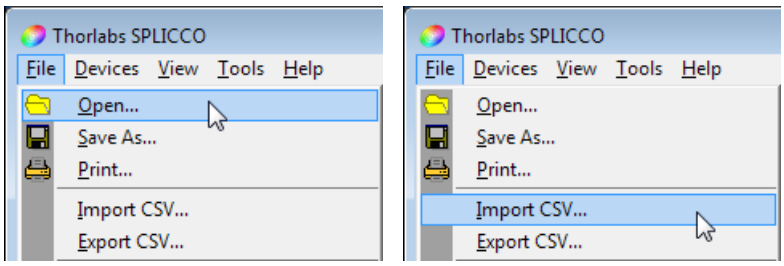
Measurement data can be exported to a *.csv file for use with e.g. Microsoft Excel™ or MathLab™. To export the current measurement data to a *.csv file select 'Export CSV...' from the **File** menu. A popup panel appears to choose the target directory, filename and the characters for "**Separator**" and "**Decimal Point**".

Reference data can be handled in the same way.



3.6 Load and Import Data

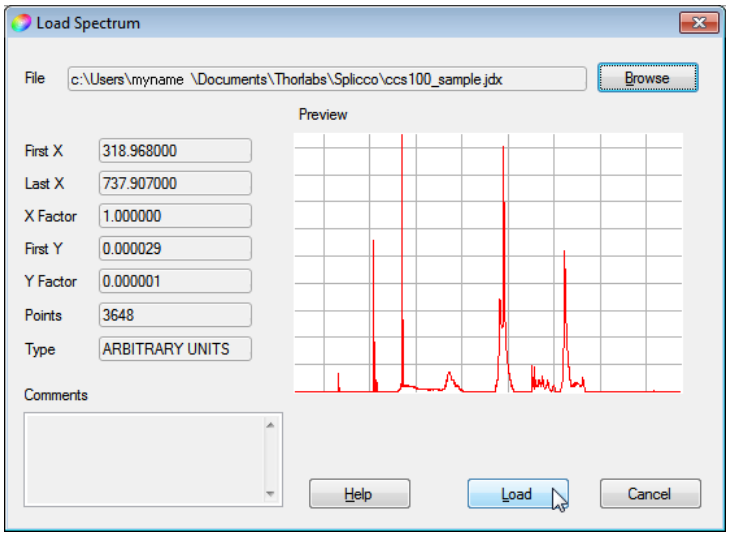
Previously captured and saved measurement scans can be reopened with SPLICCO without connecting a device. This can be done from the **File** menu by selecting "Open..." (icon) or "Import CSV..." .



Opening a file

SPLICCO can load most JCAMP-DX 18 files with file extension *.jdx either as a reference 44 to use with the live measurement data or in an individual window to show formerly saved data.

To open a *.jdx file, choose "Open" or click to the icon. Choose the appropriate file using the Browse button, the selected file is shown in the preview window. Eventually saved comments are shown in the "Comments" field.



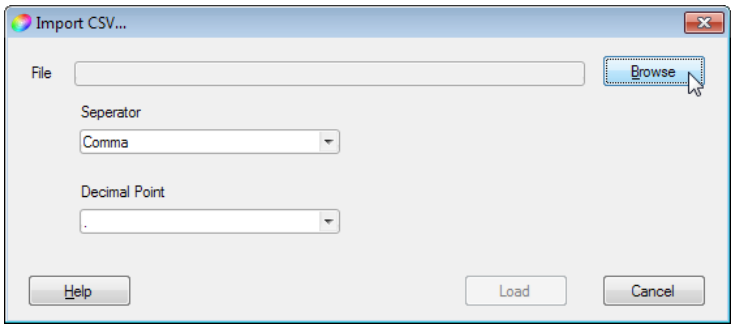
X and **Y Factors** represent the resolution. The resolution of the X axis is 1 pixel, the resolution of Y axis results from the resolution when the file was saved. By pressing **Load** the curve is opened in a new window.

Note

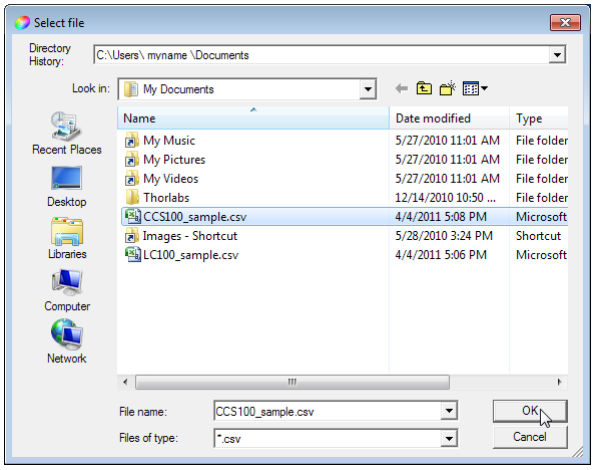
The **Load** function is used also for loading a reference scan to the current live window. Details are explained in section References 44.

Import data

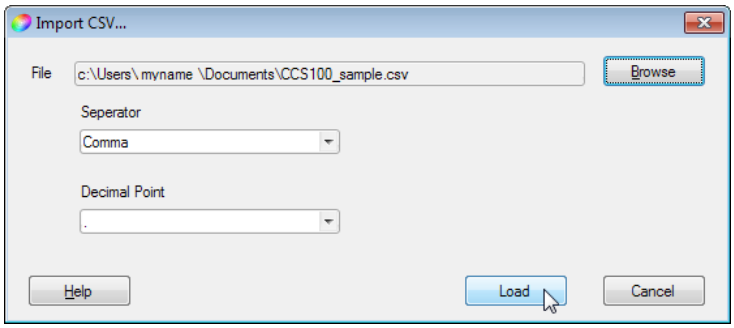
To import measurement data from a *.csv file select 'File -> Import CSV...' from the menu.



Please specify the character separating the x & y columns and choose which character marks the decimal position in the appearing window. Then click to **Browse** to select the required file:



Click OK to confirm:



Clicking to **Load** imports the data to a new window.

Note

The Y axis will be displayed only for values between the min and the max intensity; scaling factor as for *.jdx is not available.

3.7 Save and Load Device Settings

SPLICCO allows to save device settings to and load them from a configuration file in xml format.

The advantage is that you can exactly reproduce your measurement conditions say, next day or even in a different lab. The only condition is that the type of device (e.g. CCS175) must match.

The following parameters are saved:

- Device type and Device Label 38
- Serial number
- Trigger mode 34
- Integration time 14
- Display mode 37
- Smoothing mode and settings 36
- Averaging mode 35 and settings
- Persistence and settings 43
- Gaussian transformation and settings 44
- Flip / Revert Picture 37
- Scaling 31 Y axis (intensity) and X axis (pixel # or wavelength)
- Progress indicator 37 on/off

Additionally, an individual comment can be entered.

Sample of a configuration file:

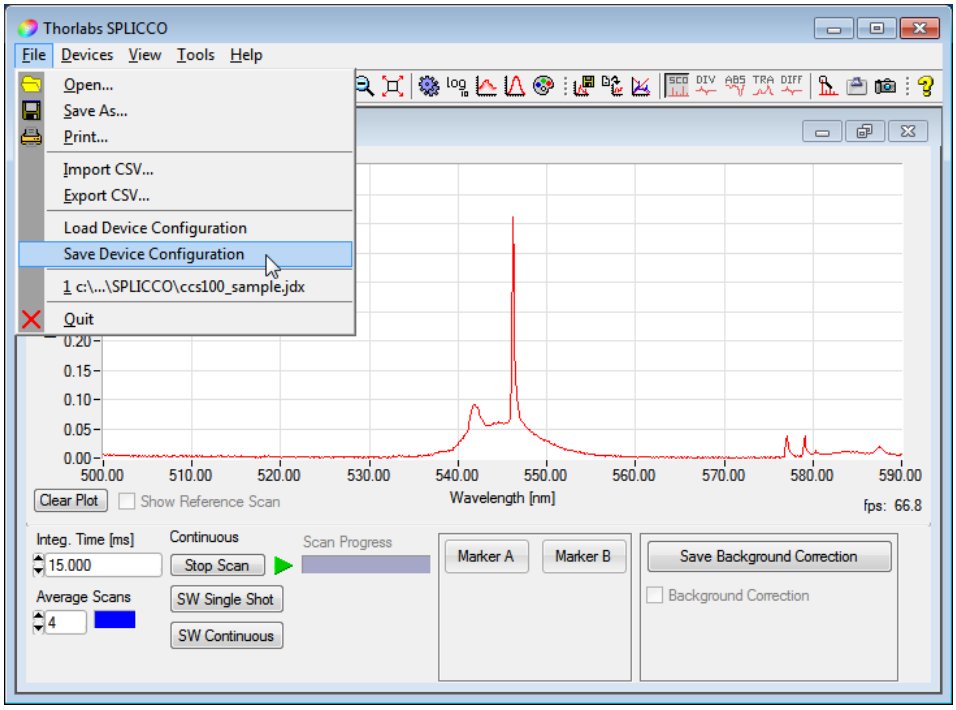
```
<?xml version="1.0" ?>
- <device_config>
  - <general>
      <devicetype>Spectrometer</devicetype>
      <DLL>Splicco_CCS_Series.dll</DLL>
      <comment>Example comment</comment>
      <userlbl>CCS100 : My CCS Spectrometer</userlbl>
      <sernr>M00232148</sernr>
      <rsrc>USB0::0x1313::0x8081::M00232148::RAW</rsrc>
      <trgsrc>0</trgsrc>
      <trgmode>0</trgmode>
      <dispmode>1</dispmode>
      <smoothmode>0</smoothmode>
      <smoothwidth>0</smoothwidth>
      <averaging>0</averaging>
      <averagescans>4</averagescans>
      <persistance>0</persistance>
      <persistancetime>0</persistancetime>
      <persistanceintens>10.000000</persistanceintens>
      <flipped>0</flipped>
      <reverted>0</reverted>
      <progressbar>0</progressbar>
      <logyscale>0</logyscale>
      <gauss>0</gauss>
      <gausssmooth>15</gausssmooth>
      <gausssignificance>0.001000</gausssignificance>
      <integrationtime>15.000000</integrationtime>
      <xmin>500.000000</xmin>
      <xmax>590.000000</xmax>
      <ymin>0.000000</ymin>
      <ymax>0.500000</ymax>
    </general>
  </device_config>
```

The background correction is ***NOT*** being saved!

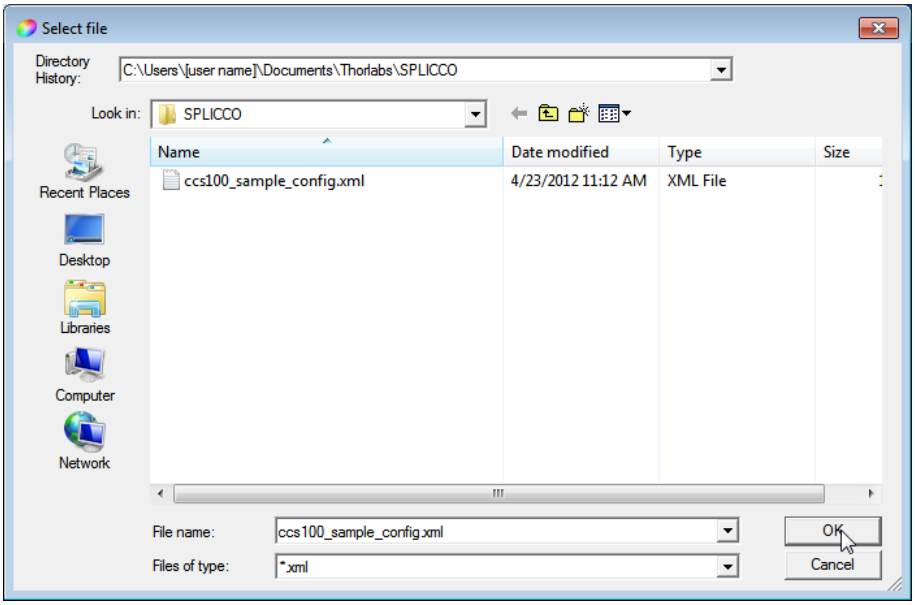
Also, settings of the graphic user interface, like color settings, released or tabbed view of multiple windows, cannot be saved to the device configuration file.

3.7.1 Save Settings

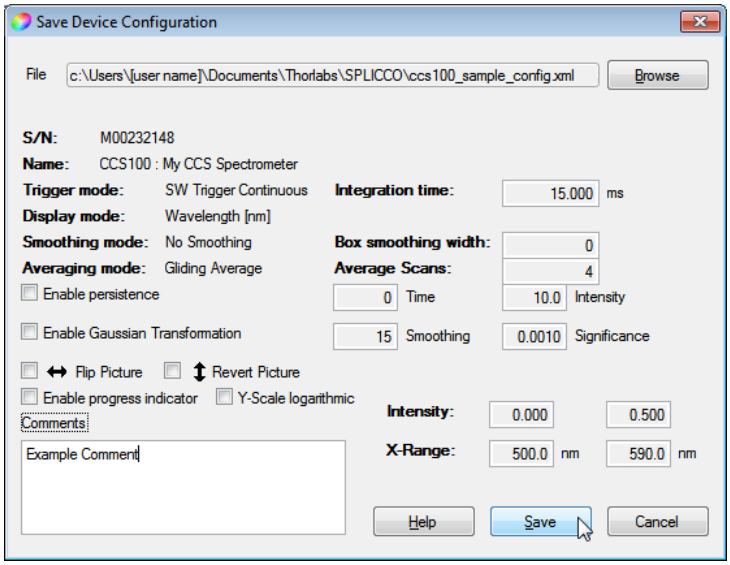
Open from the File menu the topic "Save Device Configuration":



Select a file name and destination for the configuration file.

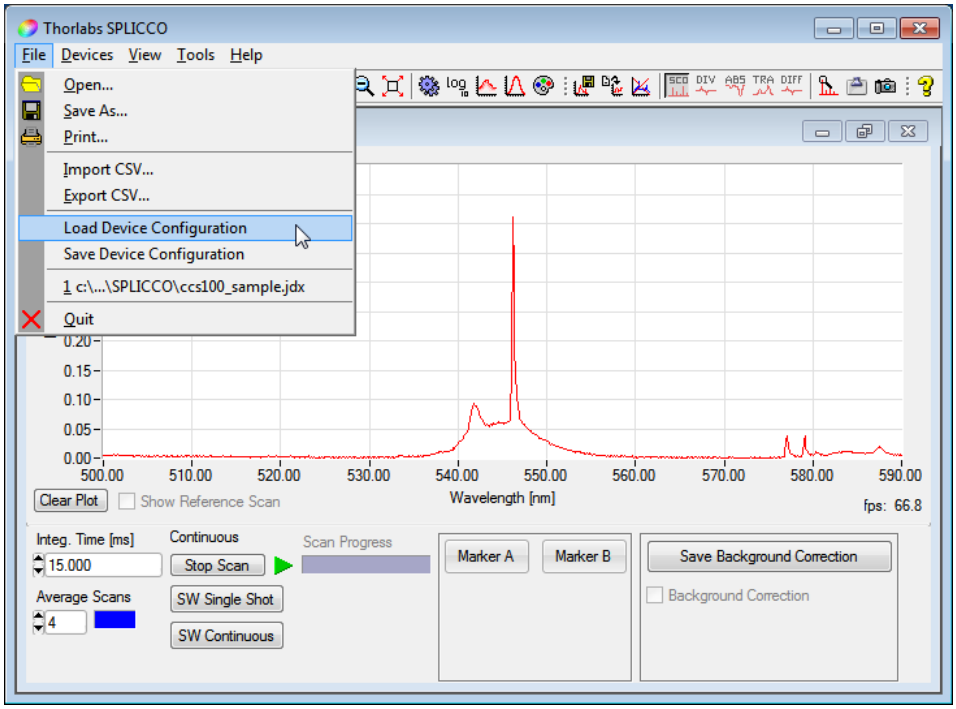


and click "Save".

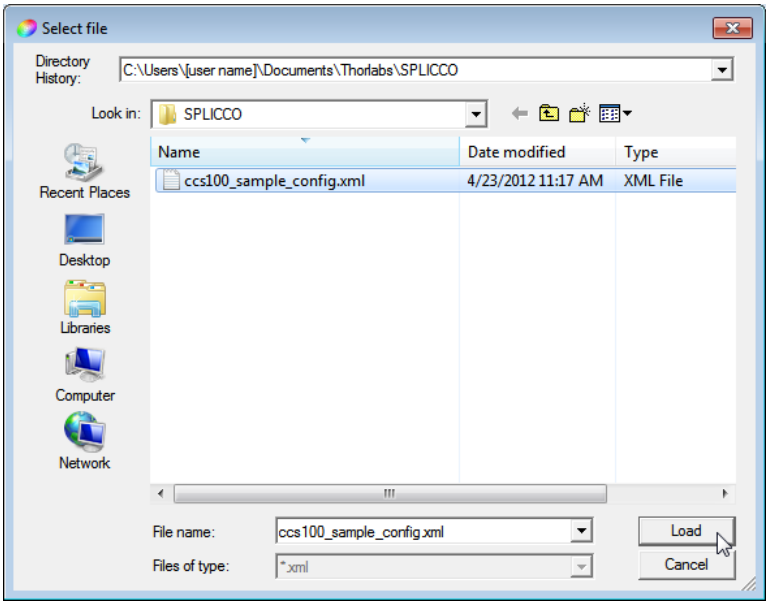


3.7.2 Load Settings

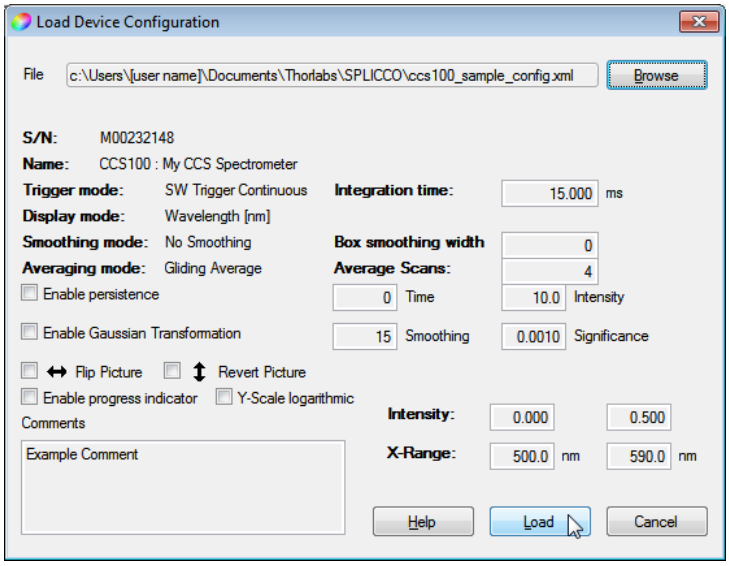
Open from the File menu the topic "Load configuration":



Select a file name of the configuration file

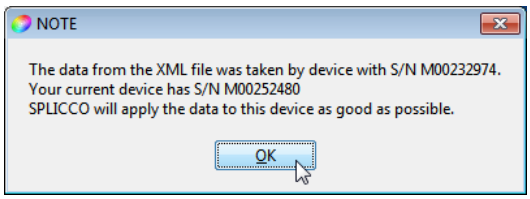


and click "Load". A preview pane comes up showing the settings saved to the selected configuration file:



Click "Load" to apply these settings.

In case the instrument's serial numbers do not match, you will be noticed about that:



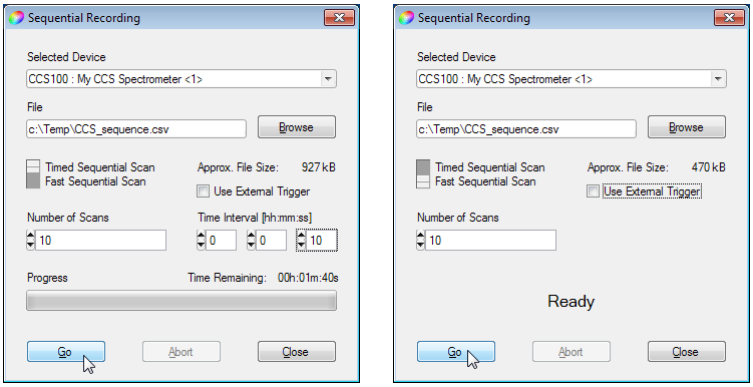
Click Ok to get back to the preview pane. You may choose then another configuration file ("Browse") or even load the mismatching file.

3.8 Sequential Recording

SPLICCO software allows a sequential recording of individual scans. The scan results are saved in *.csv file format 18. Importing sequential results to an appropriate software, e.g., Microsoft EXCEL©, scans can be displayed in a 3rd dimension - time. A maximum of 1000 scans can be recorded.

The **Sequential Recording** function can be reached via **Tools** menu.

There are 2 types of recording modes - Timed Sequential Scan and Fast Sequential Scan.



3.8.1 Timed Sequential Scan

Timed Sequential Scan

The Timed Sequential Scan mode is ideally used for long term monitoring. In this mode, a time interval between the start of 2 subsequent scans can be entered. The interval ranges from 1 sec to 8760h:59min:59sec. Alternatively, the scan can be triggered externally, using the hardware trigger input.

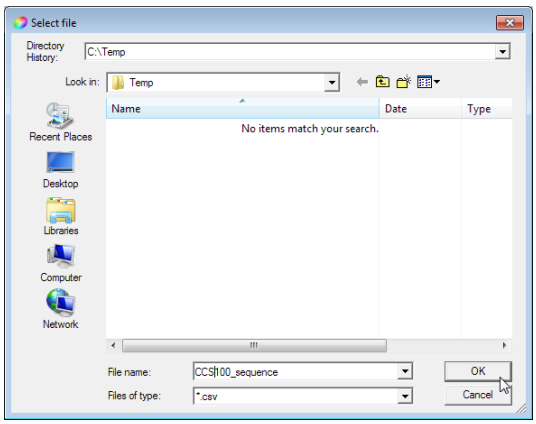
Each scan will be saved to a separate file. To the chosen file name (e.g. CCS_sequence.csv) a time stamp is being appended. The format of the time stamp is

_YYYYMMDD_xxhxxmxxsxxxms

(e.g., "_20110506_09h02m15s030ms" stands for May 06, 2011, 09h:02min:15sec:030ms.)

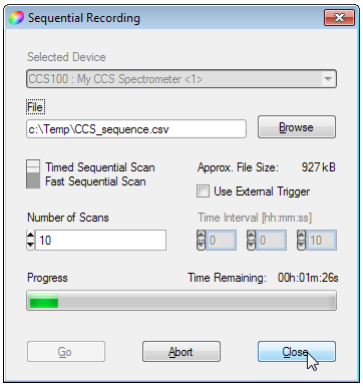
Example:

- Select the desired device
- Click **Browse** to open the dialog for selecting a file name

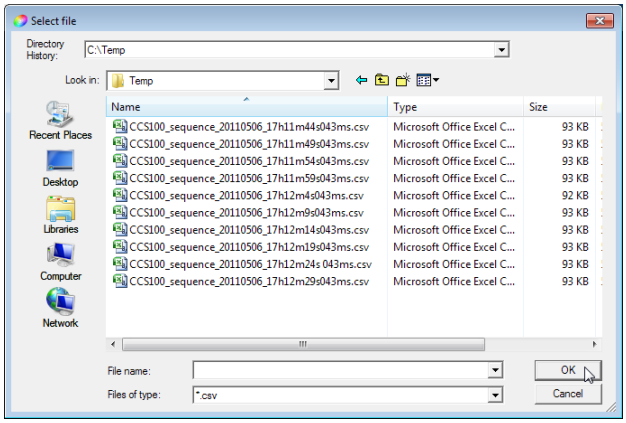


- Confirm the entered file name
- Define the number of scans to be recorded
- Define the time interval between scans - alternatively, choose "External trigger"

- Click Go; the progress will be shown in the bar and the remaining time will count down.



- After processing the entered number of scans the files will be saved and the window closed



- Each result file contains 2 columns - first column is the pixel number, second column states the intensity measured from the actual pixel. Small negative intensity values (below 0.01) are caused by CCD noise and/or ADC noise or background correction.

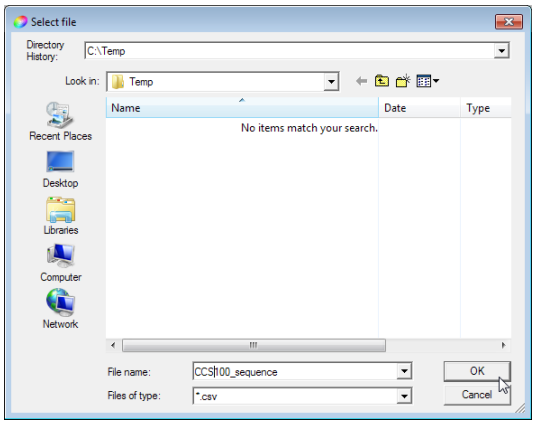
3.8.2 Fast Sequential Recording

Fast Sequential Recording

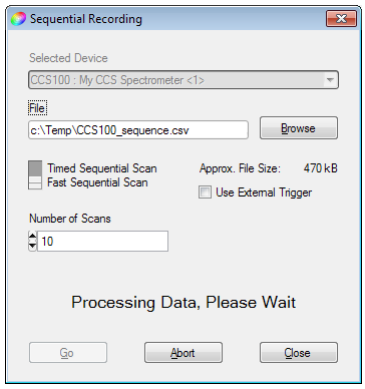
The Fast Sequential Recording mode allows to record fast changes. The time interval between two subsequently recorded scans depends on the integration time, if ≥ 10ms. For smaller integration time values it depends on system performance and CCD read-out time. Results are being saved to a single file.

Example:

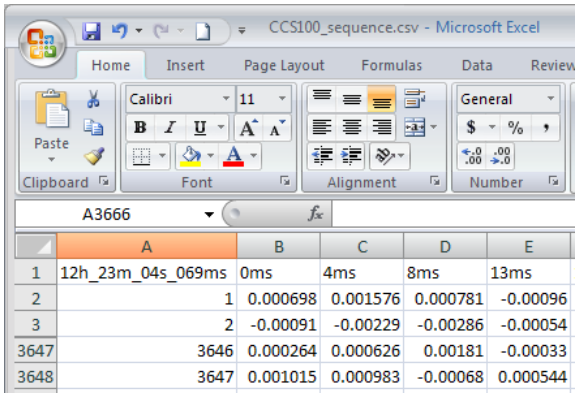
- Select the desired device
- Click Browse to open the dialog for selecting a file name



- Confirm the entered file name
- Define the number of scans to be recorded.
- For triggered recording, check the box "External trigger"
- Click **Go**; the recording starts. After finishing, the software needs to process data, which takes some time, depending on the number of scans to be recorded.



- During processing data, in above window header may appear "Sequential Recording (Not responding)", eventually the screen may gray out - this is just a reaction of the operating system to extended processing time and does not impact the function of SPLICCO software, so please ignore it.
- A sample result file is shown below:



	A	B	C	D	E
1	12h_23m_04s_069ms	0ms	4ms	8ms	13ms
2	1	0.000698	0.001576	0.000781	-0.00096
3	2	-0.00091	-0.00229	-0.00286	-0.00054
3647	3646	0.000264	0.000626	0.00181	-0.00033
3648	3647	0.001015	0.000983	-0.00068	0.000544

The 1st line of the file contains the time stamps: A1 is the scan start time with accuracy to 1ms, columns B1, C1, ... contain the start time delay between 1st and actual scan. If the scans were recorded free running, the delay between subsequent scans is equal to the integration time set value. The time stamp has a tolerance of ± 1ms.

Further, 1st column (A2, A3,...) states the pixel number and in the same line are recorded the intensities measured from the actual pixel during the scans. Small negative intensity values (below 0.01) are caused by CCD noise and/or ADC noise or background correction.

3.9 Print

SPLICCO allows to print out an actual scan to any printer installed on the operating system. The appropriate dialog can be opened via the menu **File** -> 'Print...' or by clicking to the icon in the menu bar.

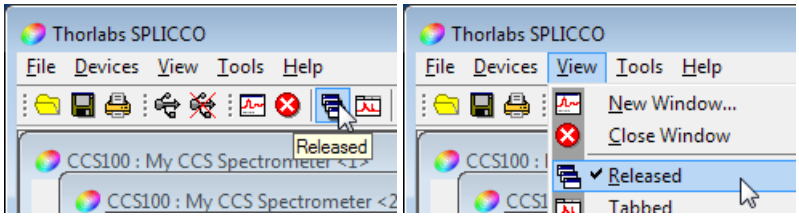
The print-out has a header with information on

- device type and device label 38
- date and time
- user name
- settings for integration time 14 and averaging counts 35

3.10 Device windows

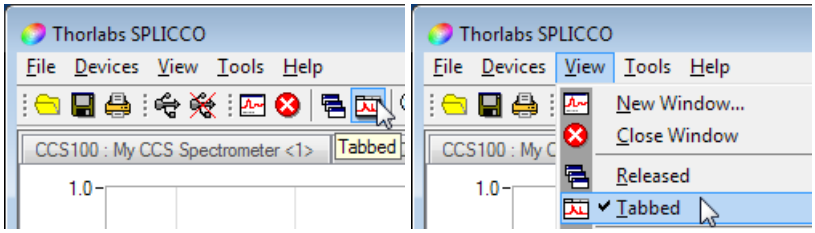
You can open up to 10 measurement windows for every device. Parameters like integration time, number of scans to be averaged and trigger control take effect on all of the device windows. All options, which are selected by right click mouse menus, influence only the active window, with the exception of "Properties" and "Color settings". There are several views for multiple windows.

Released view:



The child windows can be arranged tiled or cascaded.

Tabbed view:



The child windows are arranged in tabs.

3.11 Zooming and panning

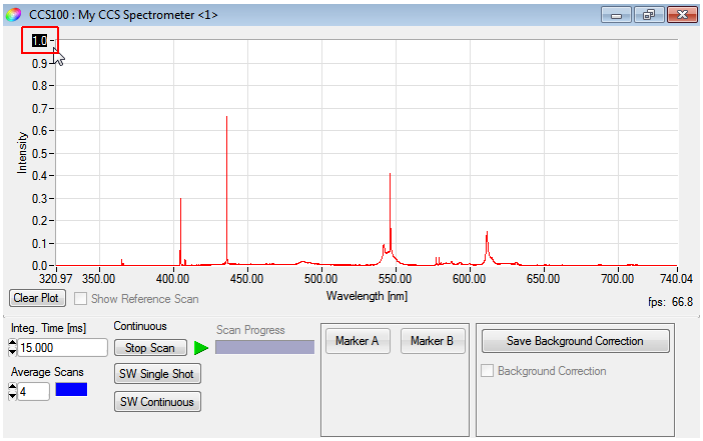
SPLICCO offers several possibilities to zoom/expand areas of interest.

In case the window is in "Zoom mode", you can box-in a region by pressing and holding the left mouse button.

By pressing the "Zoom in" () and the "Zoom out" () button in the toolbar you can step in or step out on the actual windows graph. Use the "Zoom home" () button in the toolbar to zoom to the original size. You can also zoom home by a right click on the graph and selecting "Zoom home" in the appearing menu.

The third option to zoom is the use of the editable graph axis. On each axis you can double click the minimum or maximum value for editing. The axis is rescaled after confirming the changes.

Another way to zoom is holding the CTRL key on the keyboard and left clicking on the graph to zoom in and right clicking to zoom out.



Note

The zoom is limited to 1% of the original size of each axis. Furthermore you cannot zoom out more than the original size.

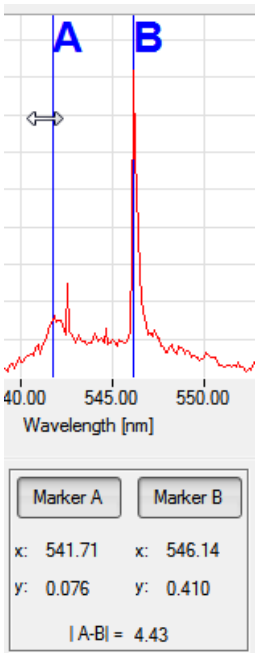
Panning

Press and hold the CTRL and SHIFT key on the keyboard to use the mouse to pan the actual graph.

Another option is to double click the left or right-most wavelength value and to type-in the range of interest via the keyboard. The same can be done for the intensity axis. This is especially useful for zooming or panning-in, in only one axis, while keeping the second one static.

3.12 Markers

SPLICCO provides two markers for instantaneous readout of wavelength and intensity.



The markers are being enabled by clicking to the appropriate button. Each marker appears as a vertical line named "A" or "B". These lines can be shifted along the X axis using the mouse (right click and hold).

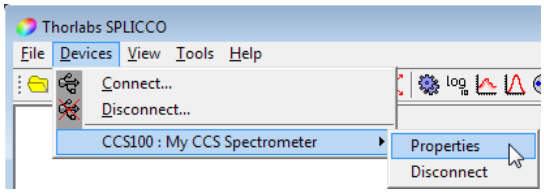
Below the buttons the actual X and Y values are displayed: X stands for wavelength or pixel number, depending on the setting, while Y stands for the relative intensity at position X.

If both markers were enabled, additionally the distance |A-B| on X axis is shown.

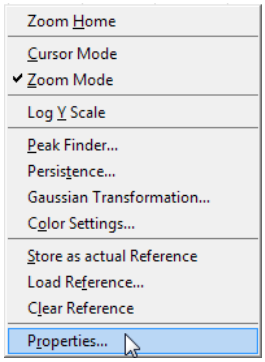
3.13 Device Settings

The Device settings dialog can be opened in different ways:

- Click to  icon in the toolbar
- From the **Device** menu:

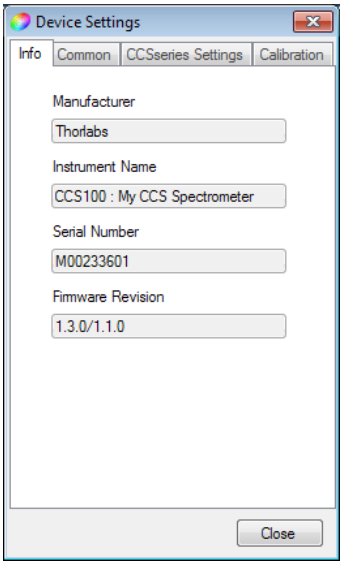


- By right-clicking to the diagram area and choosing "Properties":



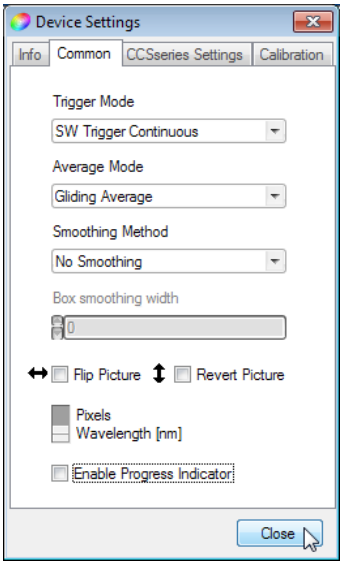
3.13.1 Tab Info

The tab Info contains information about manufacturer, device name, serial number and firmware revision:

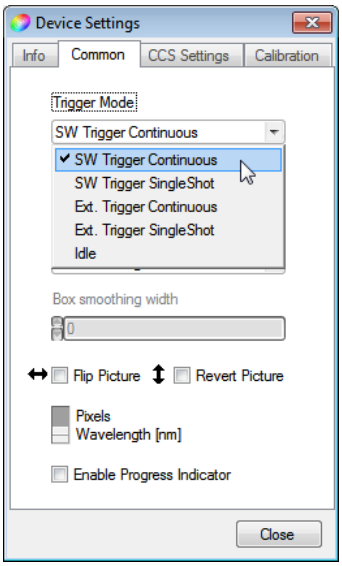


3.13.2 Tab Common

In this tab, trigger and averaging modes can be set, a smoothing can be enabled and the graphical display can be changed.



3.13.2.1 Trigger mode



SPLICCO is able to generate internal trigger signals (SW) or use external trigger signals to take readings at defined time intervals.

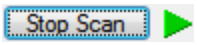
You can set the trigger mode in the **Device Settings**, tab 'Common':

The control offers five trigger modes: SW Trigger Continuous, SW Trigger Single Shot, External Trigger Continuous, External Trigger Single Shot and the Idle mode. According to the trigger mode the status symbol and the trigger button in the bottom of each device windows changes. The trigger buttons labels shows the possible option, e.g. "Stop Loop", "Scan 1x", "Arm Trigger" or "---".

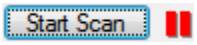
Software trigger

SW Trigger Continuous:

The default trigger mode. The software triggers as fast as possible for maximal data refresh rate. The figure below shows the status symbol and the trigger button.

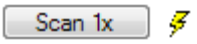


By pressing the "Stop Scan" button the data readout is stopped and the symbol changes to:



SW Trigger Single Shot:

In this mode for each click on the trigger button a data set is read out and shown. The status symbol and the trigger button will appear:



Hardware Trigger

Any model of the CCS spectrometer series is equipped with a hardware trigger input. This input will be enabled by selecting either the "Ext. Trigger Continuous" mode or the "Ext. Trigger Single Shot" mode.

Ext. Trigger Continuous:

This mode is similar to the "SW Trigger Continuous" mode, except that the data readout is triggered by an external signal. After each data readout the external trigger will be armed again.

The status symbol and the trigger button will look the same way as in the software continuous mode.

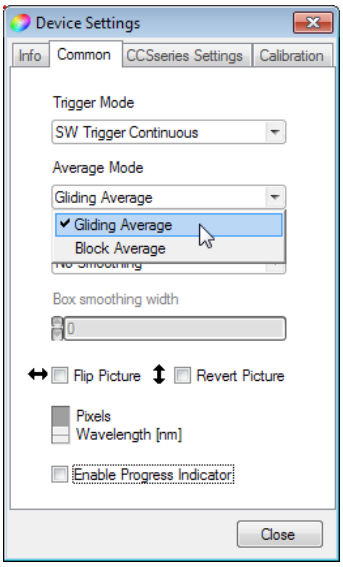
Ext. Trigger Single Shot:

You have to press the trigger button to arm the external trigger before you can readout data. While the software is waiting for an external trigger signal the status symbol changes; see the following two figures below.

Idle:

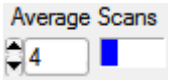
This mode causes the device to be idle. In this mode the device does not take any measurements.

3.13.2.2 Average Mode



Very noisy or weak signals can be amplified by adding several scans, which is known as averaging. SPLICCO provides two kinds of averaging - Gliding Average and Block Average. The averaging mode can be set in the Device Settings panel:

Click to  icon in the toolbar and open the 'Common' tab:The number of scans to average can be set in the bottom of the active panel:



To the right of the number of scans to be averaged a status box is displayed, indicating the fill level of the buffer used for averaging.

Gliding Average

This method averages over the most recent number of scans and is being updated with every new scan. The advantage is that the graph is being updated with every scan.

Example: The number of scans to be averaged is set to 10. After starting acquisition, the software calculates the average out of the first two data sets, then out of the first three sets and so on until the desired number (10) is reached. Then the first data set will be subtracted and the newest data set will be added to calculation of average. This can be seen also in the buffer fill level - it grows up to the max and stays there.

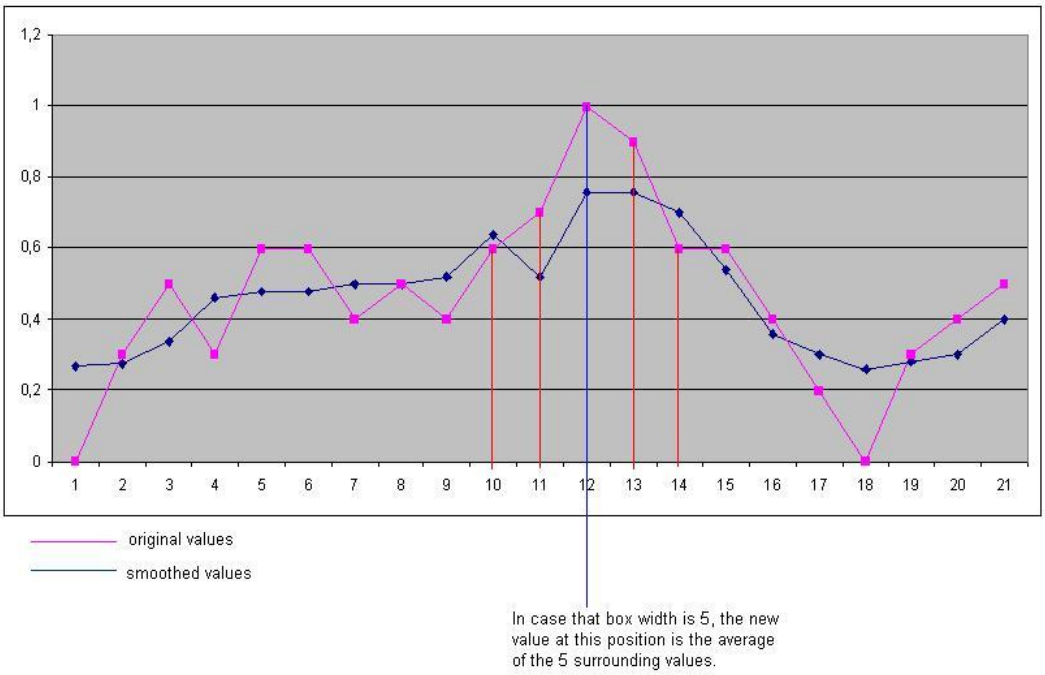
Block Average

This method accumulates a number of scans, after that calculates the average, displays it and starts the averaging process from beginning. The display is updated only after n scans.

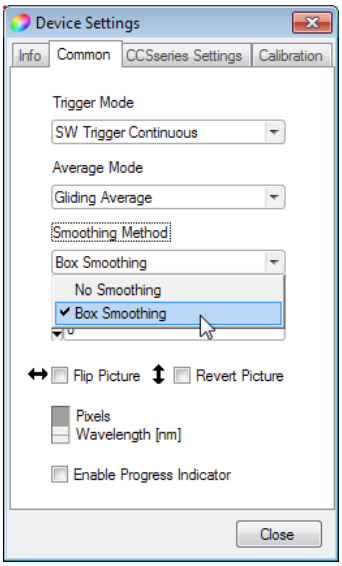
Example: The number of scans to be averaged is set to 10. The software accumulates 10 scans (can be seen from the buffer fill level), calculates the average over these 10 scans, displays the result and restarts acquisition. (It's obvious that block averaging decreases the frame rate.)

3.13.2.3 Smoothing Method

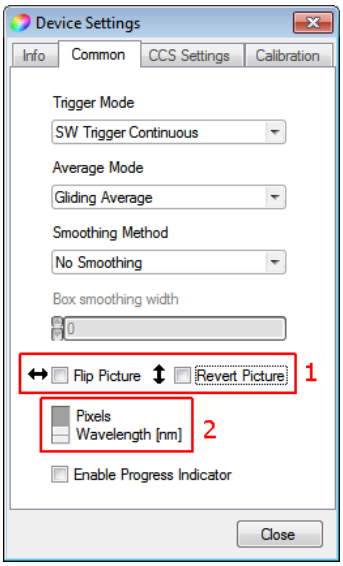
SPLICCO provides the standard smoothing method called "Moving Area Smoothing", also known as "Box Smoothing". This kind of smoothing is comparable to a low pass filter, suppressing the high frequent noise. This is the simplest form of smoothing. The only parameter needed is the box width, which indicates how many values are averaged. There is no weighting of those values.



Click to icon in the toolbar, open the 'Common' tab and enable "Box Smoothing". The smoothing box width can be set below this control. Zero means no smoothing at all. Any change will instantly affect the actual graph.



3.13.2.4 Display mode



Click to icon in the toolbar and open the 'Common' tab.

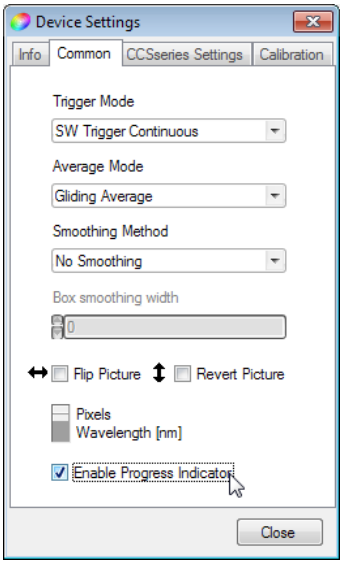
Flip and revert picture

SPLICCO provides the possibility to mirror the actual measurement data displayed vertically and/or horizontally in a window. Check boxes **1** to mirror the axes accordingl

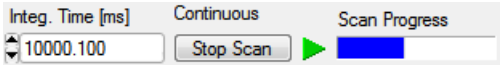
Switch between "Pixels" and "Wavelength"

CCS100 Series Spectrometers can use an internal wavelength calibration file to show the range in nanometers instead of pixels. SPLICCO supports two display modes regarding the scaling of the x axis - the x axis is shown in either nanometer or pixel. Flip the switch **2** to change between the display modes.

3.13.2.5 Progress Indicator



In case of long integration time, it can be useful to know the progress of the actual scan. Therefore, a progress bar can be enabled:



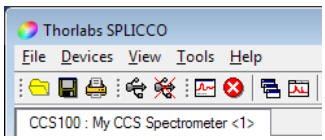
The scan progress is being indicated for integration time > 500ms.

3.13.3 Tab CCS Series Settings

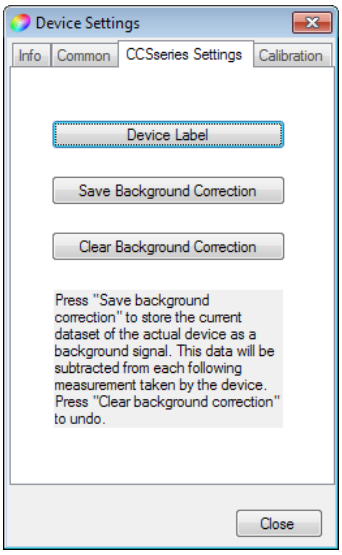
The CCS Series Settings tab allows to set a custom device label, save and clear background correction.

3.13.3.1 Device Label

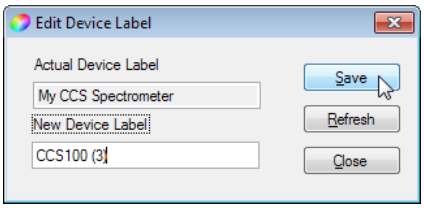
SPLICCO allows to assign an individual name to any connected device, called "Device Label". This device label is an identifier, which eases the operation of multiple connected devices; it can be found in the upper left corner of the measurement window:



Click to icon in the Toolbar and open the 'CCS series Settings' tab. The button "Device label" opens a dialog box:

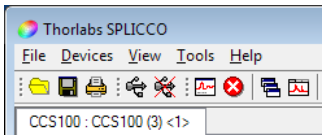


Enter a new device label name and press "Save"



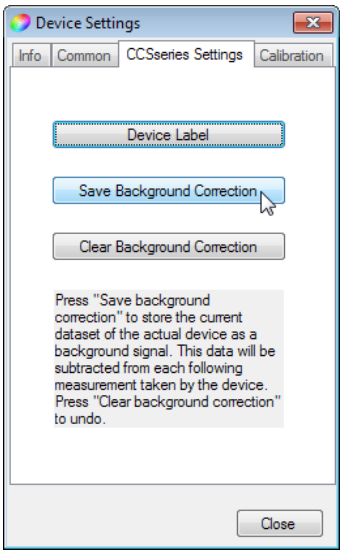
Reconnect the device to activate changes:

The new device label is displayed in the software:



3.13.3.2 Background Correction

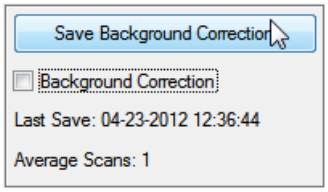
You can subtract a background reading to reduce noise from your ambient surrounding (for instance if your room light offsets your base line).



"Save Background Correction" overwrites the currently saved data and remains effective only during the current SPLICCO session. That means, the background correction will be cleared automatically, when SPLICCO software is terminated and/or a device is disconnected.

"Clear Background Correction" deletes the correction data immediately.

The background correction can be easily saved and turned on/off from the panel below the scan:



Note

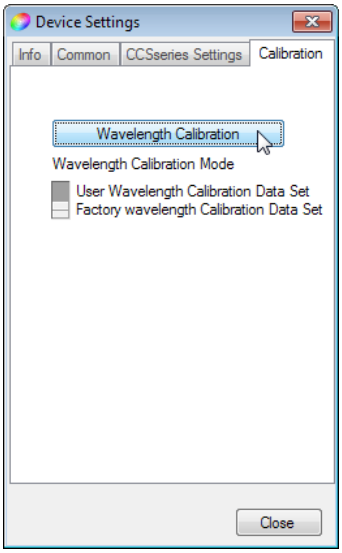
Any change of integration time clears background correction data.

3.13.4 Tab Calibration

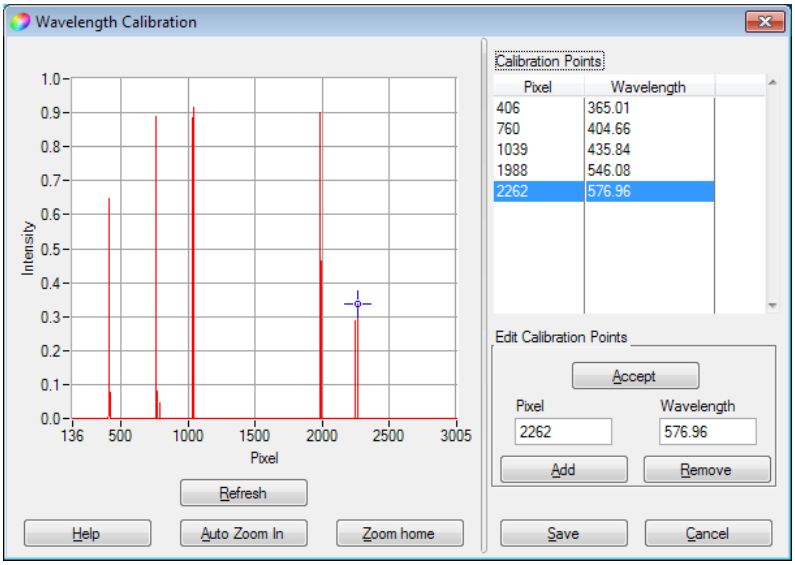
The CCS Spectrometer is delivered with calibration data pre-programmed on the device corresponding to the spectrometer optics mounted on the device ("Factory Wavelength Calibration Data Set"). This data set cannot be erased.

Every time a CCS spectrometer is connected the corresponding calibration data will be uploaded automatically and used to format each plot.

You have the possibility to use your own calibration data for setting the wavelength scale of the spectrometer. Click to icon in the toolbar and open the 'Calibration' tab:



The User Calibration can be be enabled by switching to "User Wavelength Calibration Data Set". In the case, that there are no User Calibration Data recognized, SPLICCO will notify on this. In this case, connect a light source with known spectrum to the spectrometer's input and start User Calibration by pressing the "Wavelength Calibration" button.



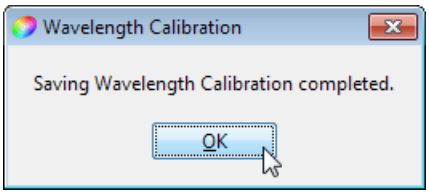
The wavelength calibration window is divided into two parts. The actual measurement is shown on the left side. You can zoom into the graph by holding the CTRL key and boxing-in a region of interest or pressing the "Auto Zoom In" button. It is always possible to zoom to the original window by pressing the "Zoom home" button or to refresh the graph by pressing the "Refresh" button. The blue cursor in the graph always snaps to a data point so that you can mark a peak graphically. The graphically marked point is shown in the "Edit Calibration Points" box.

A minimum of four and a maximum of ten calibration points are required for a valid calibration.

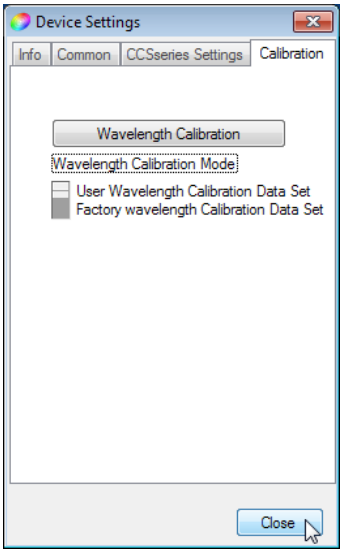
If you calibrated the instrument beforehand the "Calibration points" list on the right side of the window is filled with the former calibration points.

You can edit a calibration point by selecting it in the "Calibration Points" list. The point can be edited with the controls in the "Edit Calibration Points" box. Press "Accept" to make the changes valid. To add a new point press "Add" and a new point will be added to list and can be edited. To delete a selected point press "Remove" and the point will be removed from list.

Press "Save" to save the user calibration. SPLICCO will notify you in case the new calibration would lead to negative or other non valid wavelengths.



After clicking OK button, the user Calibration becomes effective:

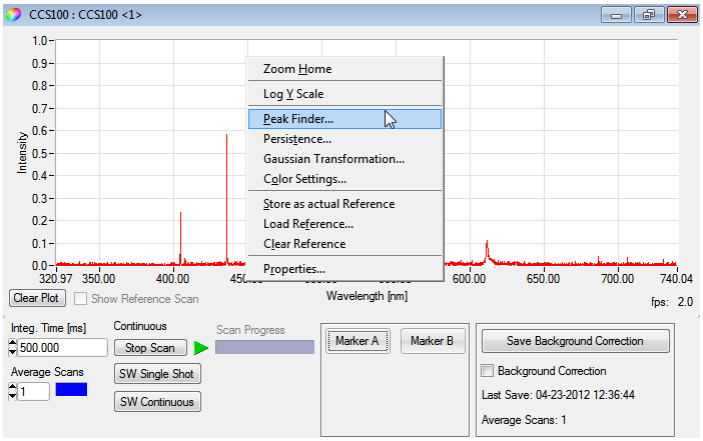


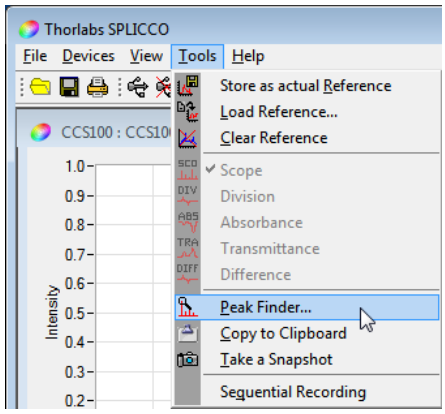
Note

SPLICCO uses a polynomial fitting routine to create the pixel-wavelength correlation array. Make sure that the calibration points are distributed over the whole pixel range.

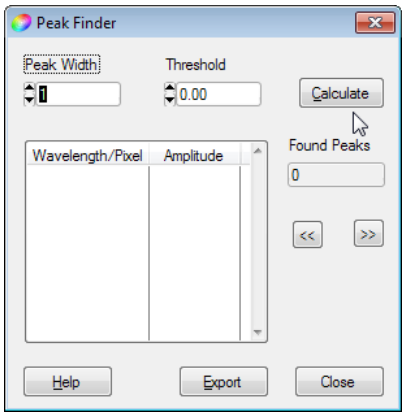
3.14 Peak finder

SPLICCO offers the possibility to find peaks in an actual measurement. The peak finder can be selected by right clicking on the actual window and selecting "Peak finder..." or from the **Tools** menu:



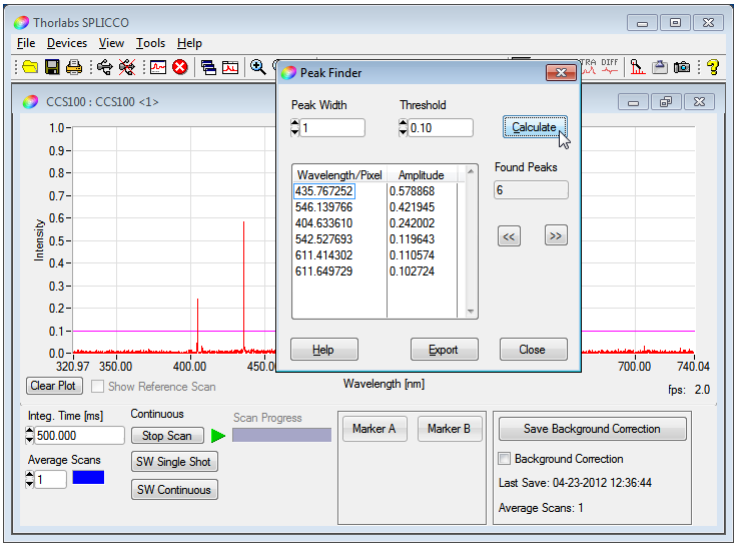


or just click the icon in the toolbar. The following wizard will appear:



In order to specify the relevant peaks, a peak width and a peak threshold can be set. A higher threshold and a higher peak width will reduce the found peaks.

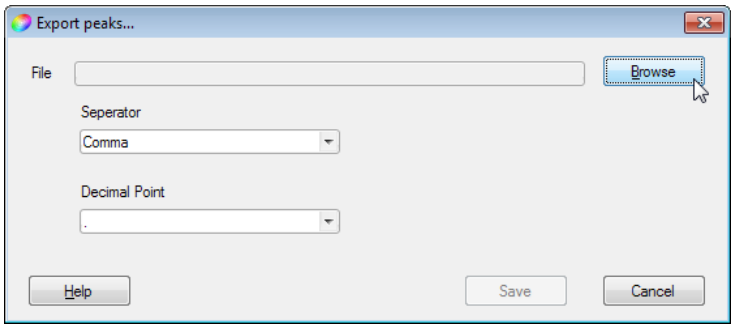
By pressing the "Calculate" button the peaks specified by those two parameters are calculated and the list is filled with the found peaks.



The found peaks can be sorted by their location ("Wavelength/Pixel") or by intensity ("Amplitude") - just click to the desired header - and can be iterated with the help of the arrow

buttons ("<<" and ">>").

Only one peak can be marked at the same time, but you can export the full list into a tab separated text file with the "Export" button.

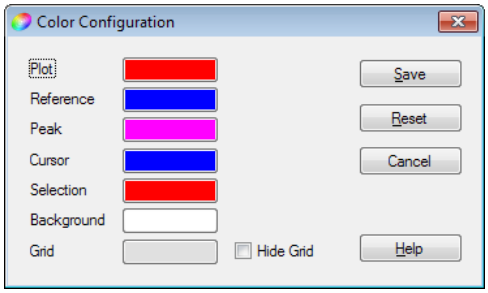


3.15 Logarithmic Y Scale

The intensity axis can be scaled linearly or logarithmical. Default display is linear, in order to switch to logarithmic just click the log icon in the toolbar. Alternatively, the **Log Y Scale** can be activated via the **View** menu or from the dialog after right clicking to the diagram area.

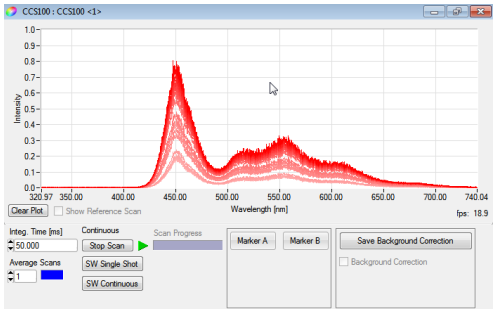
3.16 Color setup

The colors of the graph and its curves can be set by selecting 'Color settings...' from the **View** menu or from the right click dialog to the window area or simply by clicking the icon in the the toolbar. The following dialog appears and you can set the colors to the desired value. Furthermore you can select to hide the grid or not. If you click on the button 'Reset' the factory default will be restored. Click on 'Save' to confirm the setting.

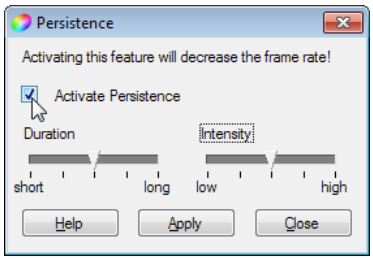


3.17 Persistence

SPLICCO offers the possibility to change the persistence attributes for each panel. Activated persistence leads to a fading out of previous scans. This function requires extra processing time and might influence the frame rate. The screenshot below illustrates persistence:



The persistence dialog can be reached either by clicking to the icon in the menu bar, by choosing **Persistence** from the **View** menu or from the right click to the diagram area dialog. It offers two sliders for duration and intensity of the persistence feature. After you have chosen the parameters, press "Apply" to make the changes effective. Press "Done" to leave the dialog.

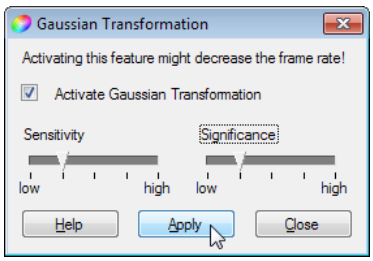


3.18 Gaussian Transformation

SPLICCO is able to display the measurement data as the best-fit Gaussian distribution. The Gauss Transformation dialog can be reached either by clicking to the icon in the menu bar, by choosing '**Gauss Transformation...**' from the **View** menu or from the right click to the diagram area dialog.

The appearing dialog offers two sliders for sensitivity and significance, which influences the Gaussian fit. As persistence, this might decrease the frame rate.

After you have chosen the parameters, press "Apply" to make the changes effective. Press "Done" to leave the dialog.



3.19 References

An actual scan can be stored as reference. This reference will appear in a different color (see Color Setup 43) and remains unchanged during the current SPLICCO session unless cleared.

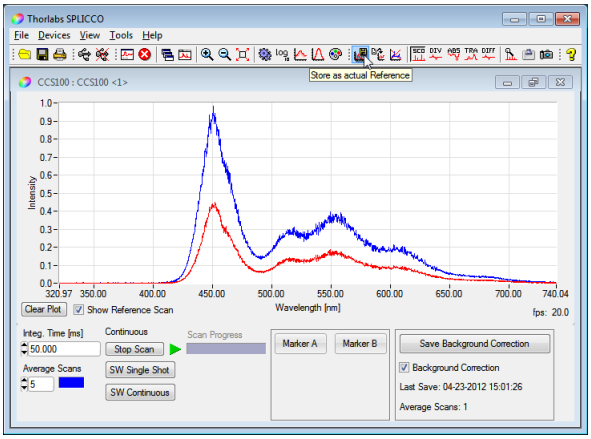
Click the icon in the toolbar, or select '**Store as actual Reference**' from either the **Tools** menu or from dialog, which appears after a right click on the diagram area.

Delete a reference by selecting '**Clear Reference**' or by clicking the icon.

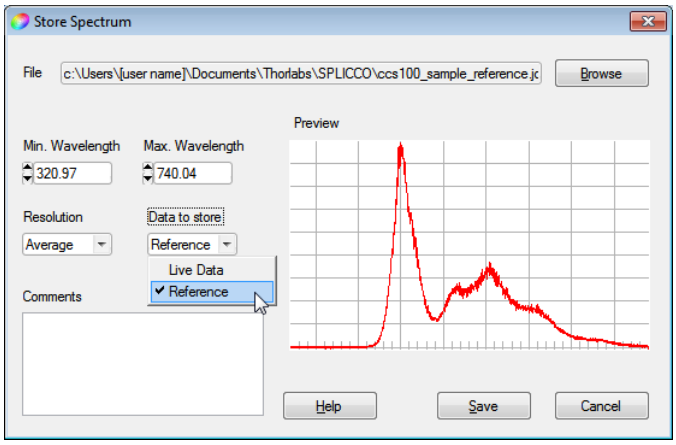
A scan can be saved as a *.jdx file for later use.

Save a reference

- Store the actual scan as reference. (**Note**: In order to distinguish the reference scan in the following screenshot, the integration time was changed after defining the reference. Actually, the actual scan and the reference are congruent)

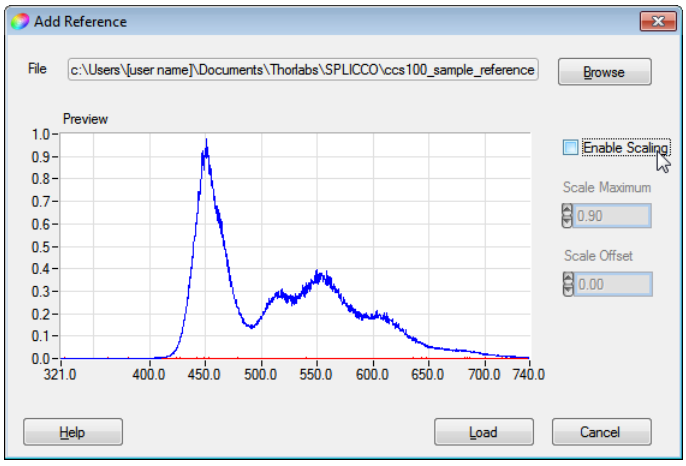


- Open the 'Save As...' menu, choose a location and file name, select '**Data to store: Reference**' and click **Save**



Load a reference

- Click the icon in the toolbar, or select **'Load Reference...'** from either the **Tools** menu or from dialog, which appears after right clicking the diagram area. A dialog box opens:



- Browse for the file location, select the desired reference file and click Load.
- The reference curve is copied into the actual window and can be used for future calculations.

Note

The reference can be scaled: check the "Enable Scaling" box - then the intensities can be scaled and an offset can be entered.

3.20 Calculations with references

SPLICCO offers the possibility to recalculate the live measurement with a reference curve. This reference curve can be a sampled live curve or a curve loaded from a JCAMP-DX file as long as the ranges are compatible to each other. It is possible to calculate with a reference curve that only partly matches the range of the live measurement. In this case only the matching range is calculated and shown.

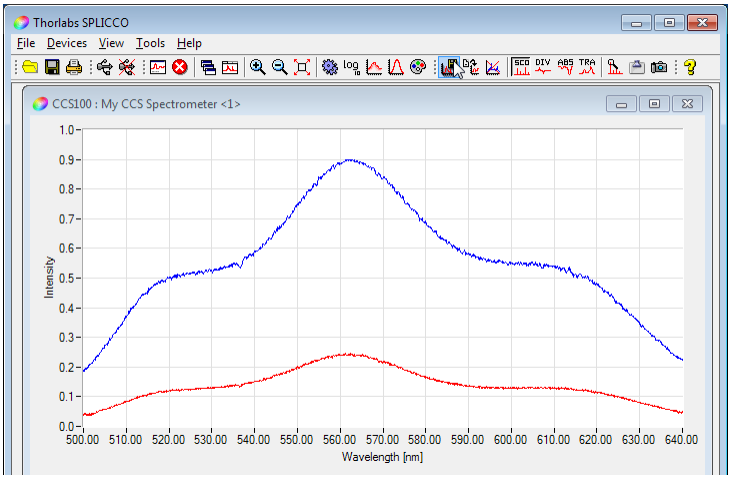
There are four modes available:

SCO (Scope)	Both actual and reference scans are displayed
DIV (Division)	The ratio between actual scan and reference
ABS (Absorbance)	The absorbance view
TRA (Transmittance)	The transmittance view
DIFF (Difference)	The difference between actual and reference intensities

An example shall illustrate that. As reference, a spectrum in the range from 400 to 600nm of a Thorlabs MCWHL2 mounted cold white LED was taken. Then, into the light path a Thorlabs NE06A neutral density filter (optical density ≈ 0.6, transmission ≈ 25%) was inserted.

Scope view

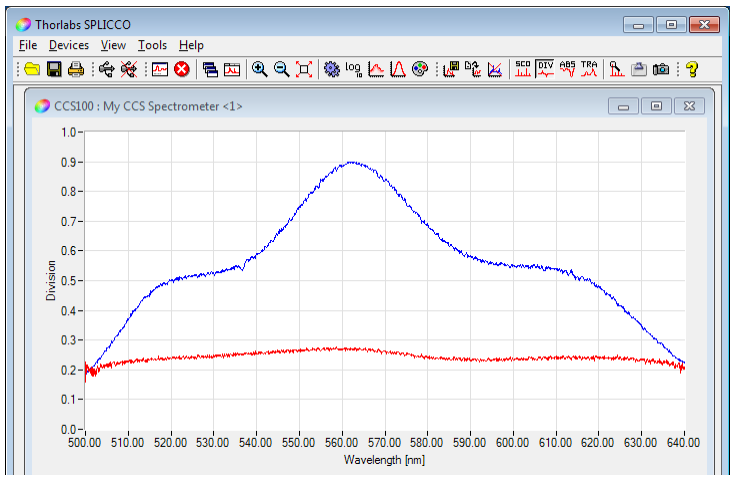
The scope view is the standard view in SPLICCO. The reference curve is shown as well as the original measurement data, no calculations made.



The blue curve is the reference (LED spectrum), the red curve represents the spectrum of the LED with the ND filter.

Ratio measurement:

The relative difference view shows for each wavelength the live measurement values (I_{meas}) divided by the reference curve values (I_{ref}), so that only changes in the spectrum are displayed:

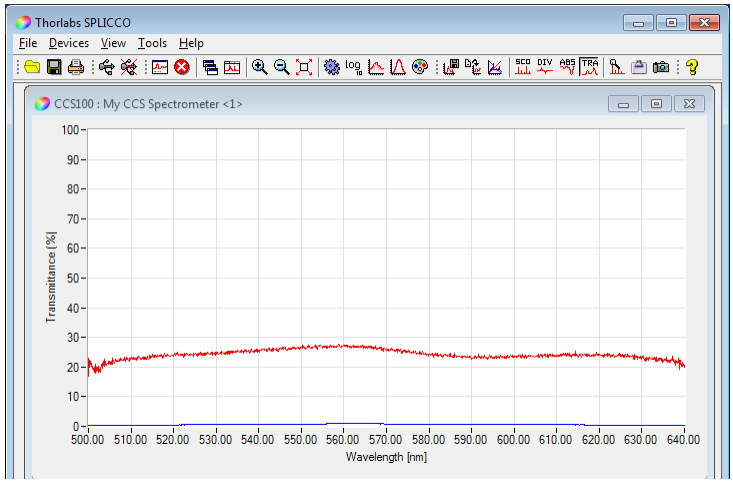


The original reference curve is still shown to allow an easy comparison.

Transmittance:

The transmittance view shows the light transmission by a sample in %:

$$T = \frac{I_{meas}}{I_{ref}} \times 100\%$$

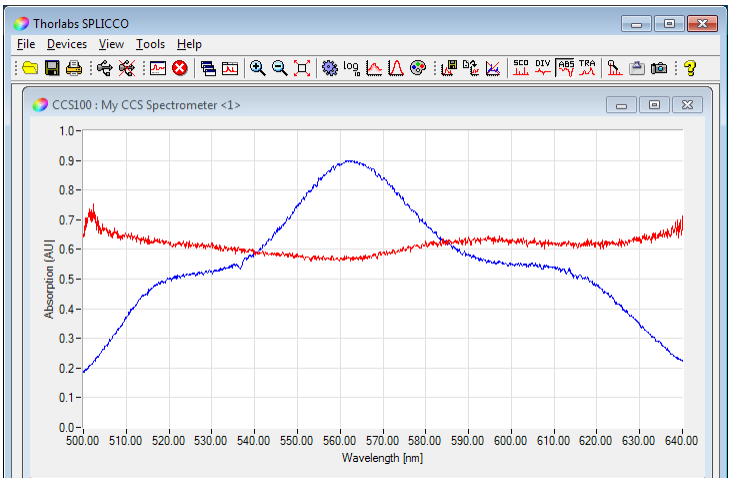


Please make sure, the Y axis is scaled to a convenient for display value (here to 100%, see section Zooming and Panning 31). The original reference curve is still shown for comparison.

Absorbance:

The absorbance A, also known as optical density OD, describes the light absorption by a sample:

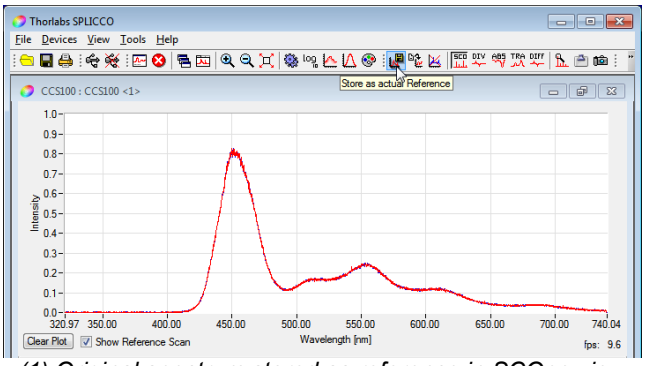
$$A = \log_{10}\left(\frac{I_{meas}}{I_{ref}}\right) = \log_{10} T$$



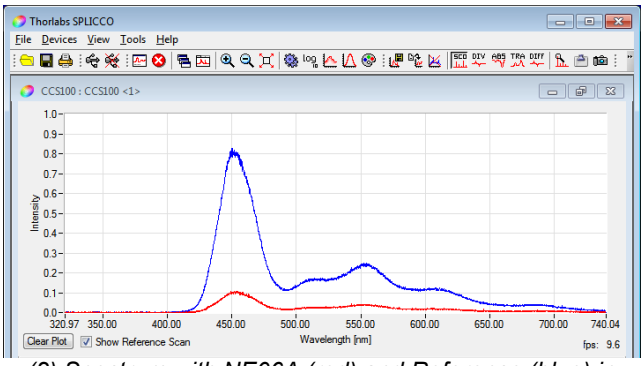
The original reference curve is still shown to allow an easy overview.

Difference

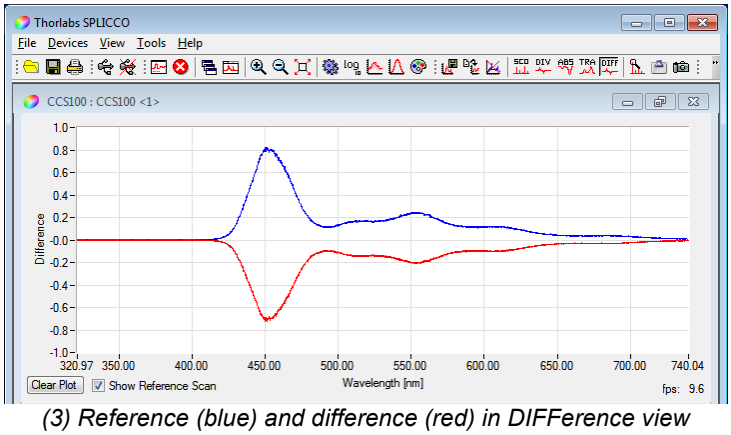
The screen shots below illustrate the difference view function.



(1) Original spectrum stored as reference in SCOpe view



(2) Spectrum with NE06A (red) and Reference (blue) in SCOpe view



(3) Reference (blue) and difference (red) in DIFFerence view

(1) The original spectrum of the LED has been stored as reference.

(2) A NE06A grey filter was inserted - the intensities decreased (red curve).

(3) Switched over to DIFFerence view. Please note the Y axis scaling has changed to (-1, +1) range. Now, the red curve shows the difference between actual intensities (ACT) and the refernece values (REF): Y=ACT-REF.

3.21 Copy to Clipboard

The actual scan data can be copied to the clipboard via the menu **Tools**, choose **Copy to Clipboard**, or by clicking to the icon in the toolbar.

These data can be pasted to a different application, e.g. Microsoft EXCEL© , for further processing. The data are comma separated pairs of values, where the first value represents the pixel number (wavelength in nm), the second - the intensity measured at this pixel.

3.22 Snapshot

A **Snapshot** of the actual scan includes the actual scan diagram area and a header:

- device type and device label 38
- date and time
- user name
- settings for integration time 14 and averaging counts 35

To make a snapshot, choose **Take a Snapshot** from the menu **Tools**, or by click to the icon in the toolbar. A Select File dialog appears, asking for a file name and format. Snapshots can be saved as *.bmp, *.jpg or *.png files.

3.23 Application Note

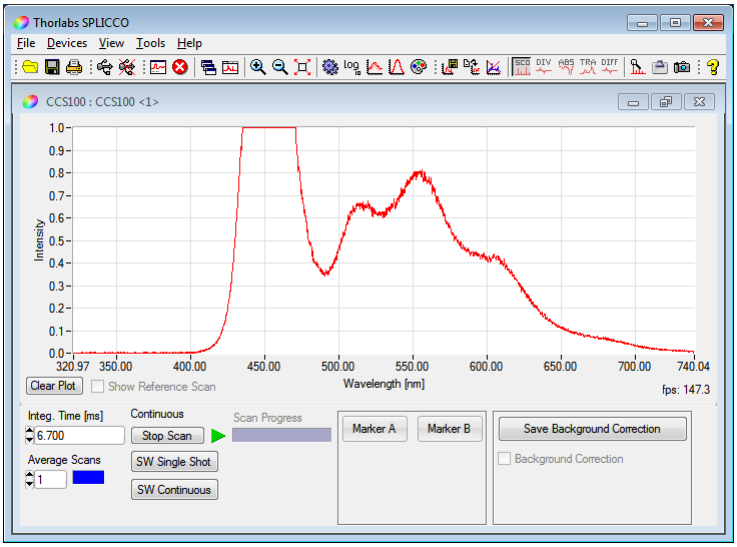
This section hopes to aid the user, by giving tips or hints on how to obtain the best measurements with the CCS spectrometers. It begins with a few general suggestions and finishes by giving a choice of question with solutions.

To obtain a good spectrum with minimum noise the light reaching the spectrometer should be maximized. Therefore a clean fiber with minimum bends is of high importance. Fiber-collimation packages, which physically fit to the SMA fiber, but are not designed for Multimode fibers might be less efficient than just the SMA connector in front of the sample.

Note

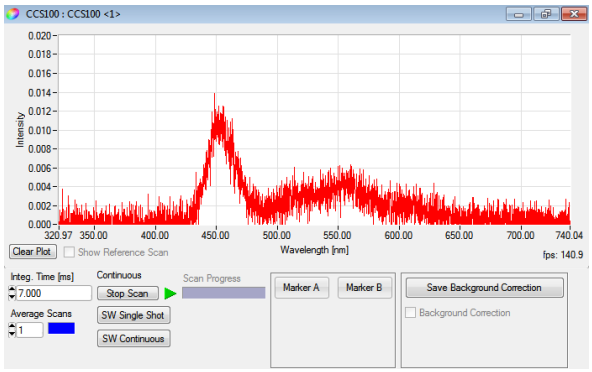
In some cases a small variation in the diameter of the SMA ferule, might lead to a tilted fixture of the connector in the fiber port. In this case loosen the fiber connector a few turns and reconnect it.

For a good signal to noise (S/N) ratio, it is recommended to have the spectral data of interest in between 70% and 95% of the intensity scale (0.7 - 0.95). This ensures that the signal is above the background noise, but not overexposed. You can identify an overexposed signal by the increased line width (see: blooming 51) and a characteristic plateau of the signal maximum.

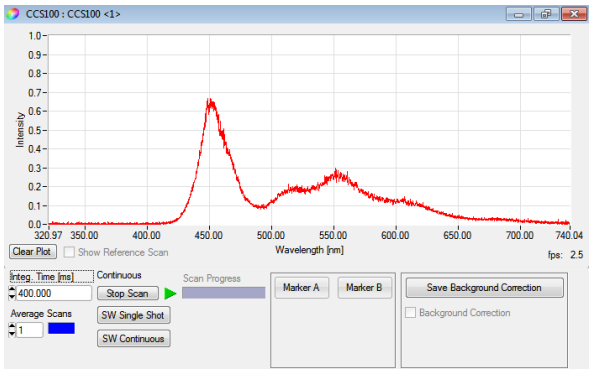


If your signal looks similar to the sample in the above figure, decrease the integration time to get a maximum peak intensity in between 0.9 and 1.0. If your signal is still overexposed at the minimum integration time of 10 µs, it is recommended to use neutral density filters or other optical attenuator in front of the light source to decrease its intensity.

If the signal you are evaluating is very small, you can increase the integration time. As shown in the next figures, this way the peak intensity raises from ~ 0.018 (equal to 1.8% of the max. intensity) to about 0.7 (70%), which is a recommended value.

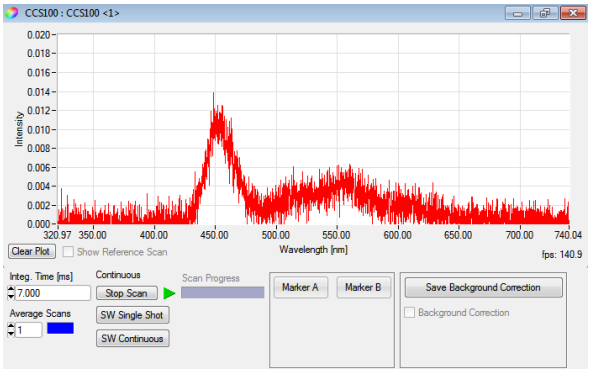


Scan recorded at 7 ms integration time

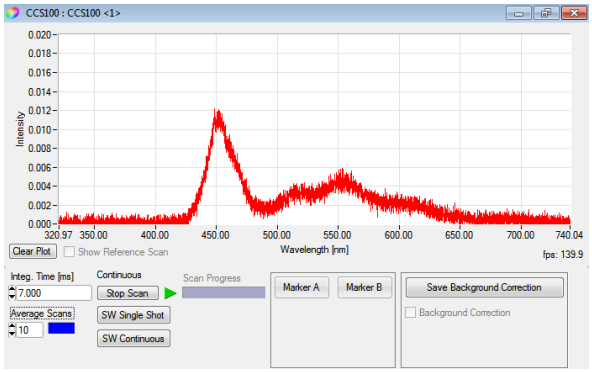


Scan recorded at 400ms integration time

If you are already at the maximum or if other parameters of your experiment do not permit long exposures, you can also use the averaging function to raise you signal above the noise. The result can be seen in the following figures. Please note, that the intensity is around 0.018 which corresponds to 1.8% of the available intensity scale.



Scan recorded at 7 ms integration time and 1 average



Scan recorded at 7ms integration time and 10 averages

Blooming

Blooming is a property owned by all CCD sensors, as used in the CCS spectrometers, is blooming. Strongly overexposed pixels tend to discharge neighboring/adjacent pixels, even if they are not illuminated. This can be seen in the spectra by an increased line width, which could lead to misinterpretations of the signal. You can avoid this effect by decreasing the integration time or using optical attenuators, as described above.

4 Virtual Devices

4.1 What are virtual devices?

SPLICCO offers a special feature named "Virtual devices" which allows to demonstrate the various application features without having a real device connected to the PC.

Those virtual devices can simulate line cameras or spectrometers. The properties of virtual devices can be set and will be stored in a XML file.

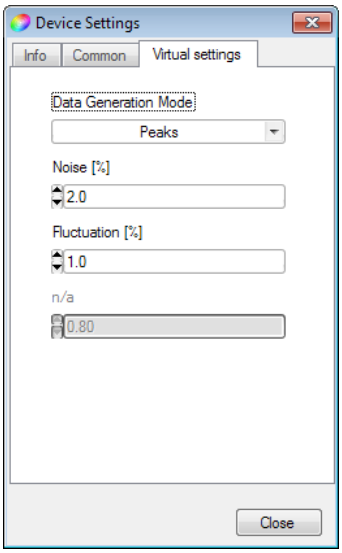
Available parameters:

- device type
- number of pixels
- minimum and maximum wavelength
- manufacturers and instruments name
- serial and revision number
- alias
- lock status

4.2 Configuration of virtual devices

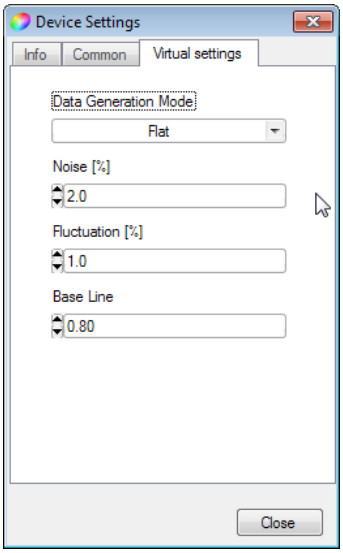
Virtual devices offers some options to manipulate the simulated data. The settings can be changed in Device Settings dialog, tab 'Virtual settings'.

Virtual spectrometer:



If the virtual device simulates a spectrometer the "Data Generation Mode" offers the mode "Peaks" only . Each time you select this mode new peaks will be generated. With the help of the control "Noise" the noise level in % can be changed as well as the fluctuation.

Virtual line camera:



If the virtual device simulates a line camera, the "Data generation mode" offers the modes "Line" and "Curve". The noise level and the fluctuation can be set and the baseline of the measurement and the amplitude of the curve can be changed.

4.3 The virtual devices description file

All virtual devices used by SPLICCO are described by a XML file, which can be modified with a simple text editor, e.g., Notepad. This description file can be found in the installation folder of SPLICCO software:

C:\Program Files\Thorlabs\SPLICCO\CameraDescription.xml

HINT: Make a backup of this file before you modify the original to restore it if needed.

Please close SPLICCO before you edit this file. The changes will become active after SPLICCO is started again.

Each virtual device has the following parameters:

DEVICETYPE	The device type. 0 for a spectrometer, 1 for a virtual line camera.
NUM_PIXELS	The number of pixels. 1 < NUM_PIXELS < 10000
WAVELENGTH_MIN	The minimum wavelength, minimal value should be ≥ 0.
WAVELENGTH_MAX	The maximum wavelength, maximal value should be ≤10000.
MANUFACTURER	The manufacturers name.
INSTRUMENT	The instruments name.
SERIALNUMBER	The virtual devices serial number.
REVISION	The virtual devices revision number.
ALIAS	The virtual devices alias.
LOCKSTATUS	The virtual devices lock status. 0 means unlocked, 1 means locked. The device can only be opened if the lockstatus is 0.

To create a new virtual device for SPLICCO, please open the file "CameraDescription.xml" in the installation folder. A new entry should be formatted in the same way as the original virtual devices. Open the description file, add your device and save it as XML file to above folder.

Note

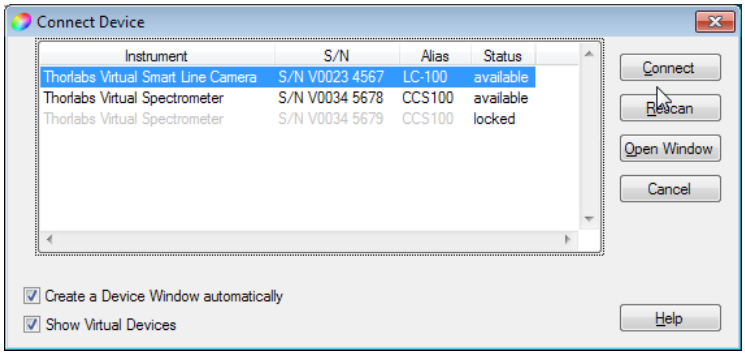
Please make sure that serial numbers are unique.

Example:

The following changes were made; a third device was added in lock state:

```
- <SPLICCO>
  - <CAMERA_1>
      <DEVICETYPE>1</DEVICETYPE>
      <NUM_PIXELS>3000</NUM_PIXELS>
      <WAVELENGTH_MIN>420</WAVELENGTH_MIN>
      <WAVELENGTH_MAX>660</WAVELENGTH_MAX>
      <MANUFACTURER>Thorlabs</MANUFACTURER>
      <INSTRUMENT>Virtual Smart Line Camera</INSTRUMENT>
      <SERIALNUMBER>S/N V0023 4567</SERIALNUMBER>
      <REVISION>1.00</REVISION>
      <ALIAS>LC-100</ALIAS>
      <LOCKSTATUS>0</LOCKSTATUS>
    </CAMERA_1>
  - <CAMERA_2>
      <DEVICETYPE>0</DEVICETYPE>
      <NUM_PIXELS>3000</NUM_PIXELS>
      <WAVELENGTH_MIN>371</WAVELENGTH_MIN>
      <WAVELENGTH_MAX>842</WAVELENGTH_MAX>
      <MANUFACTURER>Thorlabs</MANUFACTURER>
      <INSTRUMENT>Virtual Spectrometer</INSTRUMENT>
      <SERIALNUMBER>S/N V0034 5678</SERIALNUMBER>
      <REVISION>0.90</REVISION>
      <ALIAS>CCS100</ALIAS>
      <LOCKSTATUS>0</LOCKSTATUS>
    </CAMERA_2>
  - <CAMERA_3>
      <DEVICETYPE>0</DEVICETYPE>
      <NUM_PIXELS>3000</NUM_PIXELS>
      <WAVELENGTH_MIN>371</WAVELENGTH_MIN>
      <WAVELENGTH_MAX>842</WAVELENGTH_MAX>
      <MANUFACTURER>Thorlabs</MANUFACTURER>
      <INSTRUMENT>Virtual Spectrometer</INSTRUMENT>
      <SERIALNUMBER>S/N V0034 5679</SERIALNUMBER>
      <REVISION>0.90</REVISION>
      <ALIAS>CCS100</ALIAS>
      <LOCKSTATUS>1</LOCKSTATUS>
    </CAMERA_3>
  </SPLICCO>
```

This leads to the virtual devices dialog as below:



5 Write Your Own Application

In order to write your own application, you need a specific instrument driver and some tools for use in different programming environments. The driver and tools are being installed to your computer during software installation and cannot be found on the installation CD.

In this section the location of drivers and files, required for programming in different environments, are given for installation under Windows XP (32 bit) and Windows 7 (32 and 64 bit)

Note

SPLICCO software and drivers are 32 bit applications. As for this reason, in 32 bit systems, they are installed to

```
C:\Program Files\...
```

while in 64 bit systems - to

```
C:\Program Files (x86)\...
```

In the table below you will find a summary of what files you need for particular programming environments.

Programming environment	Necessary files
C, C++, CVI	*.h (header file) *.lib (static library)
C#	.net wrapper dll
Visual Studio	*.h (header file) *.lib (static library) or .net wrapper dll
LabView	*.fp (function panel) and NI VISA instrument driver Beside that, LabVIEW driver vi's are provided with the *.llb container file

Note

All above environments require also the NI VISA instrument driver dll !

In the next sections the location of above files for all hardware, supported by SPLICCO drivers, is described in detail.

5.1 CCS Series

NI VISA Instrument driver:

C:\Program Files\IVI Foundation\VISA\WinNT\Bin\CCS_Series_Drv_32.dll

Note

This instrument driver is required for all development environments!

The source code of this driver can be found in

C:\Program Files\IVI Foundation\VISA\WinNT\Thorlabs CCSseries\CCS_Series_Drv.c

Online Help for NI VISA Instrument driver:

C:\Program Files\IVI Foundation\VISA\WinNT\Thorlabs CCSseries\Manual

NI LabVIEW driver

C:\Program Files\National Instruments\LabVIEW xxxx\Instr.lib\CCSseries\CCSseries.llb

(LabVIEW container file with driver vi's - "LabVIEW xxxx" stands for actual LabVIEW installation folder.)

Header file

C:\Program Files\IVI Foundation\VISA\WinNT\include\CCS_Series_Drv.h

Static Library

C:\Program Files\IVI Foundation\VISA\WinNT\lib\msc\CCS_Series_Drv_32.lib

C:\Program Files\IVI Foundation\VISA\WinNT\Thorlabs CCSseries\CCS_Series_Drv_32.lib

Function Panel

C:\Program Files\IVI Foundation\VISA\WinNT\Thorlabs CCSseries\CCS_Series_Drv.fp

.net wrapper dll

C:\Program Files\Microsoft.NET\Primary Interop Assemblies\Thorlabs.CCS_Series.dll

Example for C

C:\Program Files\IVI Foundation\VISA\WinNT\Thorlabs CCSseries\Examples\C

sample.c - C program how to communicate with a CCS series spectrometer

sample.exe - same, but executable

Example for C#

Solution file:

C:\Program Files\IVI Foundation\VISA\WinNT\ThorlabsCCSseries...
...\Examples\CSharp\CCS100_CSharpDemo.sln

Project file

C:\Program Files\IVI Foundation\VISA\WinNT\ThorlabsCCSseries...
...\Examples\CSharp\CCS100_CSharpDemo\CCS100_CSharpDemo.csproj

Executable sample demo

C:\Program Files\IVI Foundation\VISA\WinNT\Thorlabs CCSseries...
...\Examples\CSharp\CCS100_CSharpDemo\bin\Release\CCS100_CSharpDemo.exe

Example for LabView

C:\Program Files\IVI Foundation\VISA\WinNT\Thorlabs CCSseries\Examples....

...\LabVIEW\CCS Series Sample.llb

5.2 LC100 Smart Line Camera

NI VISA Instrument driver:

C:\Program Files\IVI Foundation\VISA\WinNT\Bin\LC100_Drv_32.dll

Note

This instrument driver is required for all development environments!

The source code of this driver can be found in

C:\Program Files\IVI Foundation\VISA\WinNT\Thorlabs LC100\LC100_Drv.c

Online Help for VISA Instrument driver:

C:\Program Files\IVI Foundation\VISA\WinNT\Thorlabs LC100\Manual

NI LabVIEW driver

C:\Program Files\National Instruments\LabVIEW xxxx\Instr.lib\LC100\LC100.llb

(LabVIEW container file with driver vi's - "LabVIEW xxxx" stands for actual LabVIEW installation folder.)

Header file

C:\Program Files\IVI Foundation\VISA\WinNT\include\LC100_Drv.h

Static Library

C:\Program Files\IVI Foundation\VISA\WinNT\lib\msc\LC100_Drv_32.lib

C:\Program Files\IVI Foundation\VISA\WinNT\Thorlabs LC100\LC100_Drv_32.lib

Function Panel

C:\Program Files\IVI Foundation\VISA\WinNT\Thorlabs LC100\LC100_Drv.fp

.net wrapper dll

C:\Program Files\Microsoft.NET\Primary Interop Assemblies\Thorlabs.LC100.dll

Example for C

C:\Program Files\IVI Foundation\VISA\WinNT\Thorlabs LC100\Examples\C

sample.c - C program how to communicate with a LC100 Smart Line Camera

sample.exe - same, but executable

Example for C#

Solution file:

C:\Program Files\IVI Foundation\VISA\WinNT\Thorlabs LC100\Examples...

...\CSharp\ LC100_CSharpDemo.sln

Project file

C:\Program Files\IVI Foundation\VISA\WinNT\Thorlabs LC100...

...\Examples\CSharp\LC100_CSharpDemo\LC100_CSharpDemo.csproj

Executable sample demo

C:\Program Files\IVI Foundation\VISA\WinNT\Thorlabs LC100...
...\Examples\CSharp\LC100_CSharpDemo\bin\Release\LC100_CSharpDemo.exe

Example for LabView

C:\Program Files\IVI Foundation\VISA\WinNT\Thorlabs LC100\Examples...

...\LabVIEW\LC100 Sample Source Distribution.llb

5.3 SPX Series

NI VISA Instrument driver:

C:\Program Files\IVI Foundation\VISA\WinNT\Bin\SPX_Drv_32.dll

Note

This instrument driver is required for all development environments!

The source code of this driver can be found in

C:\Program Files\IVI Foundation\VISA\WinNT\Thorlabs SPx\SPX_Drv.c

Online Help for VISA Instrument driver:

C:\Program Files\IVI Foundation\VISA\WinNT\Thorlabs SPx\Manual

NI LabVIEW driver

C:\Program Files\National Instruments\LabVIEW xxxx\Instr.lib\SPx\SPX.llb

(LabVIEW container file with driver vi's - "LabVIEW xxxx" stands for actual LabVIEW installation folder.)

Header file

C:\Program Files\IVI Foundation\VISA\WinNT\include\SPX_Drv.h

Static Library

C:\Program Files\IVI Foundation\VISA\WinNT\lib\msc\SPX_Drv.lib

C:\Program Files\IVI Foundation\VISA\WinNT\Thorlabs SPx\SPX_Drv.lib

Function Panel

C:\Program Files\IVI Foundation\VISA\WinNT\Thorlabs SPx\SPX_Drv.fp

.net wrapper dll

C:\Program Files\Microsoft.NET\Primary Interop Assemblies\Thorlabs.SPx_Drv.dll

Examples for CVI:

C:\Program Files\IVI Foundation\VISA\WinNT\Thorlabs SPx\Examples\CVI

contains examples in source code and executable

5.4 LC1 Line Camera

NI VISA Instrument driver:

C:\Program Files\IVI Foundation\VISA\WinNT\Bin\LC1_Drv_32.dll

Note

This instrument driver is required for all development environments!

The source code of this driver can be found in

C:\Program Files\IVI Foundation\VISA\WinNT\Thorlabs LC1\LC1_Drv.c

Online Help for VISA Instrument driver:

C:\Program Files\IVI Foundation\VISA\WinNT\Thorlabs LC1\Manual

NI LabVIEW driver

C:\Program Files\National Instruments\LabVIEW xxxx\Instr.lib\LC1\LC1.llb

(LabVIEW container file with driver vi's - "LabVIEW xxxx" stands for actual LabVIEW installation folder.)

Header file

C:\Program Files\IVI Foundation\VISA\WinNT\include\LC1_Drv.h

Static Library

C:\Program Files\IVI Foundation\VISA\WinNT\lib\msc\LC1_Drv.lib

C:\Program Files\IVI Foundation\VISA\WinNT\Thorlabs LC1\LC1_Drv.lib

Function Panel

C:\Program Files\IVI Foundation\VISA\WinNT\Thorlabs LC1\LC1_Drv.fp

.net wrapper dll

C:\Program Files\Microsoft.NET\Primary Interop Assemblies\Thorlabs.LC1_DRV.dll

Examples for CVI

C:\Program Files\IVI Foundation\VISA\WinNT\Thorlabs LC1\Examples\CVI
contains examples in source code and executable

Examples for LabVIEW

C:\Program Files\IVI Foundation\VISA\WinNT\Thorlabs LC1\Examples...
...\Labview\LC1-USBexample.llb

6 Maintenance and Service

6.1 Maintenance

Protect the CCS spectrometer from adverse weather conditions. The CCS spectrometer series is not water resistant.

Attention

To avoid damage to the spectrometer, do not expose it to spray, liquids or solvents!

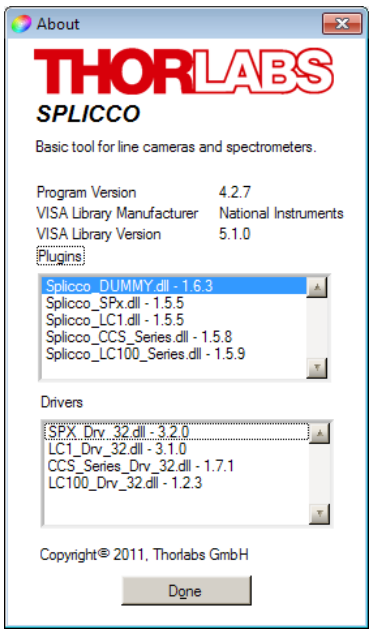
The unit does not need a regular maintenance by the user.

If necessary the unit and the display can be cleaned with a cloth dampened with water.

The CCS spectrometer does not contain any modules that could be repaired by the user himself. If a malfunction occurs, the whole unit has to be sent back to *Thorlabs* 69. Do not remove any covers!

6.2 Version Information

The menu entry 'Help -> About' displays all application relevant data: Splicco , VISA and the .dll versions.



In case of a support request, please submit the software version of the application. This will help to locate the error.

Visit Thorlabs website www.thorlabs.com for available updates to download.

6.3 Troubleshooting

SPLICCO software terminates with error message "Software cannot be installed"

- Check if you have administrator privileges on your computer
- For WindowsXP© users: Make sure, Service Pack 3 is installed.

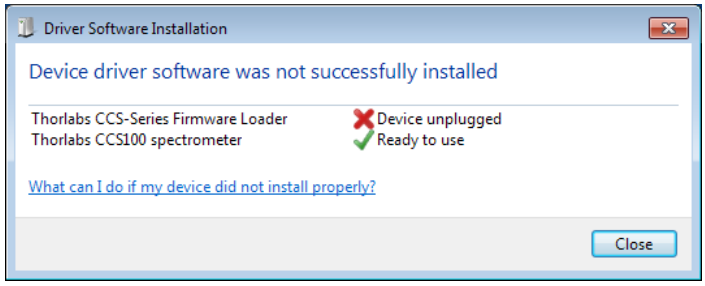
SPLICCO cannot find any devices but the virtual devices :

- Check if VISA runtime 5.1 or higher is installed.
- Make sure that the connected device is made by Thorlabs.
- Try to connect the device to another USB port.

Installation wizard prompts to specify the path of a ".sys" file:

- point wizard to "Windows\System32\drivers"

When connecting a spectrometer, an error message is displayed:



- This error message can be ignored. The reason is that firstly, Windows recognizes a device which requires a firmware download into the device. After finishing the download, the spectrometer reboots and a identifies himself with the exact type. Windows may recognize this reboot as a disconnect and thus, the above error message appears. Don't worry - your device will operate normally.

Measurement is running but the diagram is not updated with new measurement values :

- Look if the device is set to idle mode.
- Maybe you pressed the "Stop" button.
- Set device into "software trigger single shot" mode, trigger once, return to "software trigger continuous" mode
- if in "external trigger single/continuous", check your trigger source or re-arm the trigger

After opening an exported *.csv file with Microsoft Excel, a large number of incorrect numbers are displayed at the Excel sheet :

- The decimal separator in your Microsoft Excel may be set to ',' instead to '.'. The *.csv files generated by this program requires that Excel interprets '.' as the decimal separator.

"Found New Hardware Wizard" finishes with the error "the wizard cannot find the necessary software":

- This error occurs when the installer cannot find SPLICCO installed on your system.
- Install SPLICCO.
- Be sure that your device is configured as a VISA device.
- Check if VISA runtime 5.1 or higher is installed on your system.

The Intensity of the measured signal does not increase linearly with the integration time:

- The CCD array applies an electronic shutter function, if integration times below 4ms are used. In that case the pixels are sequentially recharged, until the time to the next CCD readout matches the wanted integration time. Unfortunately the manufacturer of the CCD does not guarantee this recharging/resetting of the array to be 100% effective. Therefore it cannot be guaranteed that all photons are ignored, before the actual integration time starts. This might cause peak heights to in- or decrease to a higher degree than the integration time was changed.
- If you want to make relative comparisons of signal heights or areas beneath the curve, try using integration times above 4ms and use the dark current correction (Properties/CCS settings/ Save dark current correction).

The scan seems to be shifted - the intensity at pixel #0 is displayed at pixel # 512

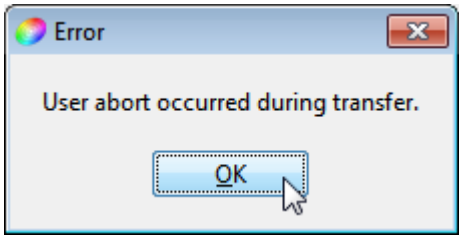
- This is a synchronization issue between the camera and the software. 512 is the size of the USB buffer. Please change trigger mode or averaging temporarily - this stops the data acquisition and resets the buffer.

The CCS spectrometer works, but the Progress Bar does not work:

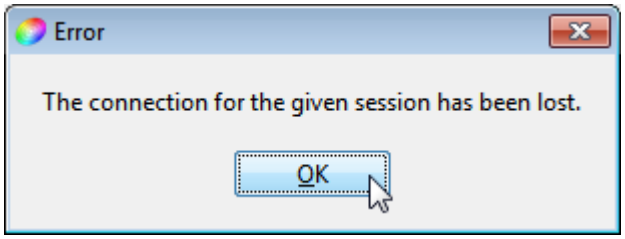
- Make sure, the integration time is set >500ms - below that, the progress bar is not functional (see tab "Common 37" of the GUI)
- If integration time is >500ms, check the firmware version downloaded to the CCS spectrometer (see tab "Info 33" of the GUI) - there must be displayed "1.3.0 / 1.1.0". If there is a different display, please contact Thorlabs 69 for support.

Error messages as below appear

and / or



- Actually, prior to above error messages another panel should have appeared:



- Usually, the reason is a hardware disconnect - the USB cable has been unplugged. Please check.
- If a USB hub is used, it's power supply might have dropped.
- A common USB interface failure might have occurred.
- Possibly, the computer has been turned to Sleep or Hibernate during a running SPLICCO session - after wake up, the session won't be restored.

7 Appendix

7.1 Technical Data

Item #	CCS150	CCS100	CCS175	CCS200
Optical Specs				
Wavelength Range	**200 − 400nm** [1])	**350 − 700nm**	**500 − 1000nm**	**200 − 1000nm**
Spectral Resolution	**<0.4nm FWHM @ 365nm**	**<0.5nm FWHM @ 435nm**	**<0.6nm FWHM @ 633 nm**	**<2nm FWHM @ 633nm**
Slit (WxH)	20 µm x 2 mm			
Grating	1800 Lines/mm, 240nm Blaze	1200 Lines/mm, 500nm Blaze	830 Lines/mm, 800nm Blaze	600 Lines/mm, 800nm Blaze
Sensor Specs				
Detector Range (CCD Chip)	200 - 1100nm	350 - 1100nm		200 - 1100nm
CCD Pixel Size	8 µm x 200 µm (8 µm pitch)			
CCD Sensitivity	160 V / (lx · s)			
CCD Dynamic Range	300			
CCD Pixel number	3648			
Resolution	12 px/nm	10 px/nm	6 px/nm	4 px/nm
Integration Time	10 µs − 10 s [3])			
Scan Rate Max.	200 Scans/s [2])			
S/N ratio	**≤ 2000 : 1**			
External Trigger				
Fiber Connector	SMA 905			
Trigger Input	SMB			
Trigger Signal	TTL			
Trigger Frequency Max.	100 Hz			
Trigger Puls Length Min.	0.5 µs			
Trigger Delay	8.125 µs ± 125 ns			
General Specs				
Interface	Hi-Speed USB2.0 (480 Mbit/s)			
Dimensions (LxWxH)	122 x 80 x 30 mm			
Weight	< 0.4 kg			

All technical data are valid at 23 ± 5°C and 45 ± 15% rel. humidity (non condensing)

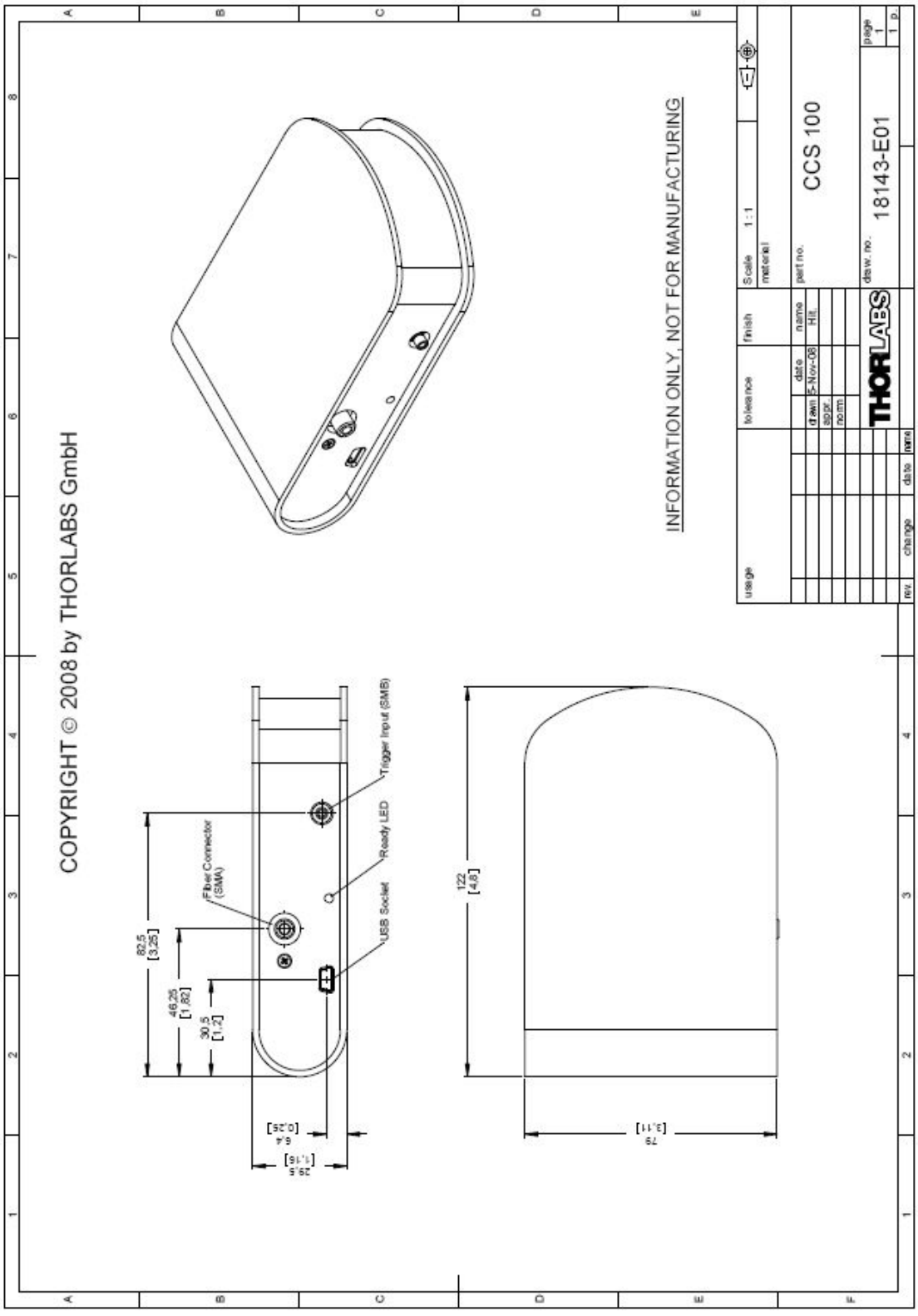
[1]) 220 - 440 nm version available

[2]) integration time 5 ms

[3]) software allows to set up to 60 s. Hot pixels and noise may increase drastically. See section Integration Time 14

Operating Temperature	0 ... +40 °C
Storage Temperature	-40 ... +70 °C
Relative Humidity	Max. 80% up to 31 °C; decreasing to 50% at 40 °C
Operation Altitude	< 3000 m

7.2 Dimensions



7.3 Certifications and Compliances

Category	Standards or description
EC Declaration of Conformity - EMC	Meets intent of Directive 2004/108/EC [1]) for Electromagnetic Compatibility. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities:
EN 61326:2006	EMC requirements for Class A electrical equipment for measurement, control and laboratory use, including Class A Radiated and Conducted Emissions [2,3,4]) and Immunity. [2,3,4])
IEC 61000-4-2	Electrostatic Discharge Immunity (Performance criterion B)
IEC 61000-4-3	Radiated RF Electromagnetic Field Immunity (Performance criterion A)
IEC 61000-4-4	Electrical Fast Transient / Burst immunity (Performance criterion B)
FCC EMC Compliance	Emissions comply with the Class A Limits of FCC Code of Federal Regulations 47, Part 15, Subpart B [2,3,4]).
EC Declaration of Conformity - Low Voltage	Compliance was demonstrated to the following specification as listed in the Official Journal of the European Communities: Low Voltage Directive 2006/95/EC [5])
EN 61010-1:2001	Safety requirements for electrical equipment for measurement, control and laboratory use.
UL 61010-1 2nd ed.	Safety requirements for electrical equipment for measurement, control and laboratory use.
CAN/CSA C22.2 No. 61010-1 2nd ed.	Safety requirements for electrical equipment for measurement, control and laboratory use.
IEC 61010-1:2001	Safety requirements for electrical equipment for measurement, control and laboratory use.
Equipment Type	Test and measuring
Safety Class	Class I equipment (as defined in IEC 60950-1:2001)

[1]) Replaces 89/336/EEC
[2]) Compliance demonstrated using high-quality shielded interface cables.
[3]) Emissions, which exceed the levels required by these standards, may occur when this equipment is connected to a test object.
[4]) Minimum Immunity Test requirement.
[5]) Replaces 73/23/EEC, amended by 93/68/EEC.

7.4 Listings

7.4.1 List of acronyms

The following acronyms and abbreviations are used in this manual:

CCD	Charge-coupled Device
CSV	Comma Separated Values
DLL	Dynamic Link Library
FCC	Federal Communications Commission
GPIO	General Purpose Input/Output
GUI	Graphical User Interface
IEC	International Electrotechical Commission
LL TTL	Low Level TTL
OEM	Orginal Equipment Manufacturer
PC	Personal Computer
PCB	Printed Circuit Board
RoHS	Restriction of the use of certain hazardous substances in electrical and electronic equipment
SPLICCO	Spectrometer and Line camera Control
SW	Software
USB	Universal Serial Bus
VISA	Virtual Instrument Software Architecture
VME	Virtual-8086 Mode Enhancement
VXI	VMEbus eXtensions for Instrumentation
VXIPNP	VMEbus eXtensions for Instrumentation Plug aNd Play
WEEE	Waste Electrical and Electronic Equipment Directive
XML	eXtensible Markup Language

7.4.2 Thorlabs Worldwide Contacts

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Email: chinasales@thorlabs.com

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Thorlabs 'End of Life' Policy (WEEE)

As required by the WEEE (Waste Electrical and Electronic Equipment Directive) of the European Community and the corresponding national laws, Thorlabs offers all end users in the EC the possibility to return “end of life” units without incurring disposal charges.

This offer is valid for Thorlabs electrical and electronic equipment

- sold after August 13th 2005
- marked correspondingly with the crossed out “wheelie bin” logo (see figure below)
- sold to a company or institute within the EC
- currently owned by a company or institute within the EC
- still complete, not disassembled and not contaminated.

As the WEEE directive applies to self contained operational electrical and electronic products, this “end of life” take back service does not refer to other Thorlabs products, such as:

- pure OEM products, that means assemblies to be built into a unit by the user (e. g. OEM laser driver cards)
- components
- mechanics and optics
- left over parts of units disassembled by the user (PCB’s, housings etc.).

Waste treatment on your own responsibility

If you do not return an “end of life” unit to Thorlabs, you must hand it to a company specialized in waste recovery. Do not dispose of the unit in a litter bin or at a public waste disposal site.

WEEE Number (Germany) : DE97581288

Ecological background

It is well known that waste treatment pollutes the environment by releasing toxic products during decomposition. The aim of the European RoHS Directive is to reduce the content of toxic substances in electronic products in the future.
The intent of the WEEE Directive is to enforce the recycling of WEEE. A controlled recycling of end-of-life products will thereby avoid negative impacts on the environment.

Crossed out "Wheelie Bin" symbol

Warranty

Thorlabs warrants material and production of the SPLICCO for a period of 24 months starting with the date of shipment. During this warranty period Thorlabs will see to defaults by repair or by exchange if these are entitled to warranty.
For warranty repairs or service the unit must be sent back to Thorlabs. The customer will carry the shipping costs to Thorlabs, in case of warranty repairs Thorlabs will carry the shipping costs back to the customer.
If no warranty repair is applicable the customer also has to carry the costs for back shipment. In case of shipment from outside EU duties, taxes etc. which should arise have to be carried by the customer.

Thorlabs warrants the hard- and software determined by Thorlabs for this unit to operate fault-free provided that they are handled according to our requirements. However, Thorlabs does not warrant a fault free and uninterrupted operation of the unit, of the software or firmware for special applications nor this instruction manual to be error free. Thorlabs is not liable for consequential damages.

Restiction of Warranty

The warranty mentioned before does not cover errors and defects being the result of improper treatment, software or interface not supplied by us, modification, misuse or operation outside the defined ambient stated by us or unauthorized maintenance.

Further claims will not be consented to and will not be acknowledged. Thorlabs does explicitly not warrant the usability or the economical use for certain cases of application.

Thorlabs reserves the right to change this instruction manual or the technical data of the described unit at any time.

Copyright

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Under no circumstances can we guarantee that a particular objective can be achieved with the purchase of this product.
Insofar as permitted under statutory regulations, we assume no liability for direct damage, indirect damage or damages suffered by third parties resulting from the purchase of this product. In no event shall any liability exceed the purchase price of the product.
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