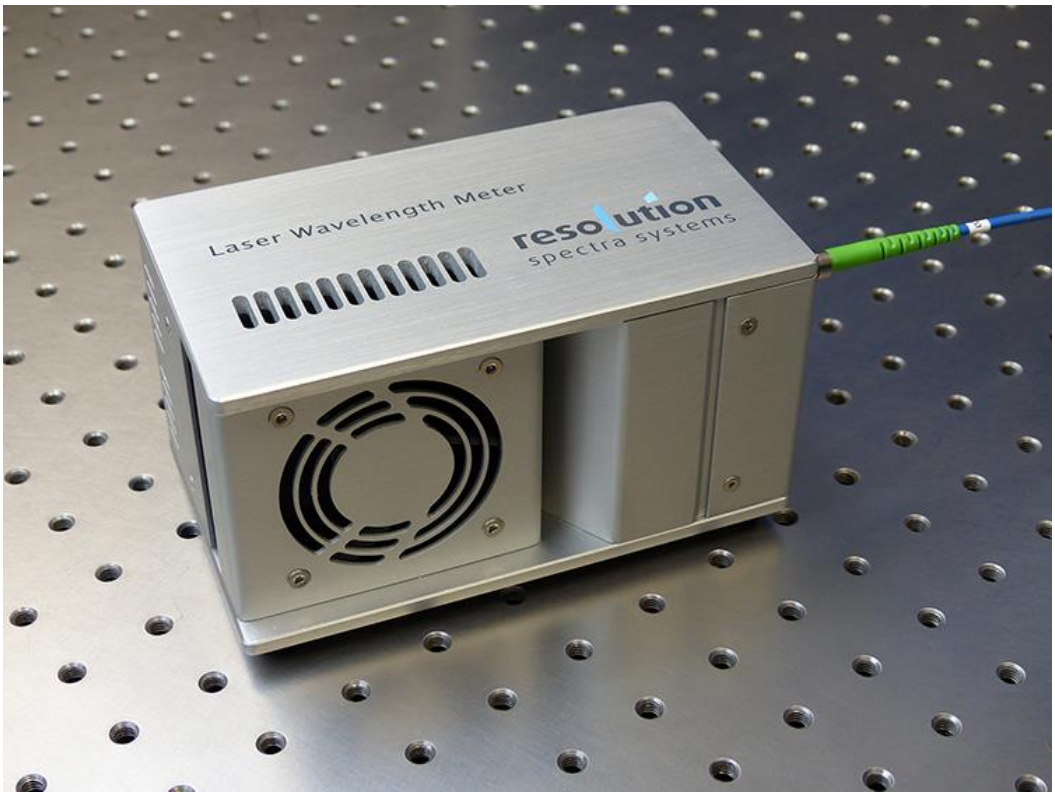
LW-10

Compact High-Resolution Laser Wavelength Meter



V4.0 User manual

RESOLUTION Spectra Systems
13, chemin du Vieux Chêne - 38240 MEYLAN - France
www.resolutionspectra.com

resolution
spectra systems

Table of contents

1 OVERVIEW

This document is compatible with the *Spectra Resolver software 1.5.2.626 and above.*

The *LW-10* laser wavelength meter provides the wavelength (or frequency or wavenumber) of narrow linewidth lasers with high-resolution in the visible and NIR range.
The unit is calibrated before delivery and is extremely simple to use. Thanks to its compactness, the *LW-10* can be easily integrated into existing systems.

Instrument description

The *LW-10* package includes a compact hardware (the device includes no moving parts), a PC Software application and the necessary cables. The light to be analyzed is coupled to the hardware by a single-mode fiber.

Fields of application

The *LW-10* device is the ideal tool for laser wavelength measurement in the range 700-1000 nm (wider range optionally). It is able to display the current laser wavelength with an absolute accuracy better than 200 MHz and can detect wavelength changes down to 20 MHz. In addition, several trigger mode options offer a unique configuration for the testing of pulsed lasers or the stability checking of continuous lasers. Furthermore, its user interface, *SpectraResolver*, includes wavelength detection over time display and other visualization and recording features.

Note that the *LW-10* wavelength meter is dedicated to measurement of single frequency lasers (pulsed and CW) with linewidth narrower than 30 GHz. Possible applications cover:

- Tunable laser control
- Laser stability control
- Frequency locking

Available options are:

- Multi-channel
- Analog Output (for Laser control PID)
- Laser spectrum analyzer function

Patents

The LW-10 is based on SWIFTS™ technology, which is protected by patents owned by UJF, INPG, UTT and CNRS and licensed to RESOLUTION Spectra Systems. SWIFTS™ is a new technology enabling innovative compact high-resolution and laser wavelength meters.

SWIFTS™ - Stationary-Wave Integrated Fourier Transform Spectrometer:

- Based on interferometry and the Lippmann Transform principle
- Uses semiconductors, integrated optics and nanotechnologies

2 SPECIFICATIONS

Specifications

Specifications	Value
Wavelength range (1)	700 – 1000 nm (optional: 630 – 700 / 1000 – 1100 nm)
Wavelength resolution (1)	20 MHz
Absolute accuracy (1) (2) (3) (4)	200 MHz
Maximum linewidth	30 GHz
Measurement speed (5)	> 20 Hz
Exposure time	16 µs – 10 s
Input power range (6)	10 nW – 1000 µW
Optical input	PM singlemode fiber N.A. 0.12
Fiber connection	FC/APC
Power consumption	11 W to 48 W @ 24V DC
Communication	Gigabit Ethernet + USB 2.0
Dimensions	149 x 86 x 80 mm
Weight	1046 g

(1) Performance guaranteed on the 700 – 1000 nm range.

(2) T° calibrated on 16-30°C. For quality check, an absolute accuracy calibration procedure is available with SpectraResolver. Not *frequently* required.

(3) Warm-up: best performances are achieved under steady state conditions, typically ambient temperature stable at +/- 0.5°C per hour maximum, constant air flow, LW-10 running for more than 30 minutes. No sensitivity to air pressure variation.

(4) According to 3σ criterion.

(5) Computational speed. PC hardware and settings dependent.

(6) Coupled in Polarization Maintaining singlemode fiber.

Functionalities

Characteristics	Contend
Compatibility	Windows 7 – 8 – 10
Unit change	nm (vacuum and standard air) / cm^{-1} / THz
Software development kit	server/C++, Python, DotNet, Vis libraries
Trigger	Front Trigger

These functionalities are accessible with *SpectraResolver* software.

3 PRECAUTIONS FOR USE

WHAT TO AVOID

- Never inspect or clean a fiber-optic cable without first disconnecting the entire cable assembly from the optical source. Failure to take this precaution may seriously damage your eyesight.
- Never clean the instrument without first disconnecting the power supply cable. Failure to take this precaution may seriously damage it.
- Never clean the instrument with water or another liquid. Failure to take this precaution may seriously damage it. Use only a cloth moistened with water to clean external casing parts. Do not attempt to clean the internals.
- Never connect directly to AC power, use the power supply provided with the *LW-10*.
- The ventilation fan must not be obstructed by any objects, as this may cause to overheat the instrument. Failure to take this precaution may seriously damage it.
- Do not open the *LW-10*. The warranty will be rendered null and void if the user attempts to open or repair the product.

CAUTION

- If this instrument is not used as specified in this document, the warranty is no longer valid.
- Keep the FC/APC connector's protective cap in place when you are not using the instrument.
- For optimal performance, be careful when handling fiber-optic connections. Always clean the fiber end and the FC/APC connector (with dry air) prior to inserting it into the instrument's fiber-optic connector. Failure to do so may result in damage to the instrument.
- It is mandatory to properly and fully screw the optical fiber to the *LW-10*. Failure to do so may result in damage to the instrument.
- If you use a power supply other than that provided with the *LW-10*, make sure that its voltage is 24V DC (2 A Minimum).
- Excessive levels of humidity can damage the *LW-10*. If the instrument has been stored in an extreme environment (moisture, heat, cold), it should be kept in normal operating conditions for a certain amount of time before being switched on.

TIPS

- It is strongly advised that the light analyzed at the entrance of the *LW-10* (input connector) is polarized in TE mode (locked to PM slow axis). If not correctly polarized, the data may be distorted and the resolution may be deteriorated. Use polarizing fiber. Contact us for your polarizing fiber solution.
- Less than 2 seconds after the power has been switched on, the LED lights up ORANGE. Please wait for the LED to turn GREEN before launching *SpectraResolver* software.
- After the start data acquisition, it is advisable to wait at least 30 minutes before the first measurement (minimum warm-up time for temperature stabilization inside the instrument).
- Caution: to ensure accurate data, make sure the correct integration time has to be selected otherwise please select 'Best dynamic control'.

4 GETTING STARTED

The instrument is delivered with the following items:

- The *LW-10*
- Single-mode polarization-maintaining (PM) fiber with FC/APC connectors or Polarizing fiber with FC/APC connectors depending on the configuration ordered
- 24V (2A or above) power supply with power cable
- Ethernet cable (2 m, Cat6)
- USB key with installation software and documentation (User Manual)

The following options if they have been selected:

- Trigger cable
- Polarizing and filtering accessories
- Switch box
- Analog Output Control

To start using the *LW-10*, please read paragraphs 5 and 6.

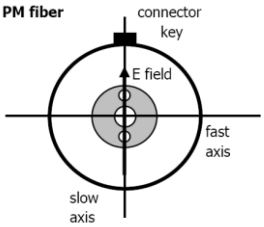
If you need any further information, please do not hesitate to contact us (info@resolutionspectra.com)

5 HARDWARE INTERFACE

Fiber connector

FC/APC connector: *Use a single-mode polarization-maintaining (PM) fiber or a polarizing fiber.*
It is strongly recommended to properly and fully screw the optical fiber on the FC/APC connector.

If not correctly polarized, the data may be distorted and the wavelength calculation may deteriorate. It is highly recommended to use a fiber optic polarizer with angled FC/APC connectors and polarization maintaining fiber.



Ethernet connector

Use the Ethernet cable supplied with the *LW-10,* or another Ethernet cable (cat6), to connect the instrument to a computer.

Power Connector

Use the power supply and cable supplied with the *LW-10*.
To insert the connector, simply turn it slightly.
When you hear a "click", the connector is properly inserted.

LED indicator

The LED indicates the status of the *LW-10*:

Color and state	Meaning
Green and continuous	OK
Green and blinking slowly	Waiting for external trigger (Trigger mode)
Red and continuous	Instrument is out of order (internal firmware error)
Orange and continuous	Initialization phase

Trigger connector

Use this connector if you need to operate in trigger mode, see the "*Trigger selector*" chapter for further information. For easier and faster connection to an external trigger signal, RESOLUTION Spectra Systems can offer a Trigger cable. Please contact *info@resolutionspectra.com*.

6 SOFTWARE INTERFACE

SpectraResolver gives full control over acquisition parameters and data management. All data can be stored (.txt or .csv files). Graphs can also be saved as image files (.jpg, .bmp, .png, .tiff, .pdf, .svg). *SpectraResolver* complies with the GigE Vision® standard and the GenICam SFNC standard.

Installing SpectraResolver software

SpectraResolver must be installed prior to connecting the *LW-10* to the computer. This will install all the drivers the instrument requires. If *SpectraResolver* is not installed first, the LW-10 will not be recognized. Install the *SpectraResolver* software (provided on the USB Key) and follow the instructions. During the first installation *SpectraResolver* needs eBus SDK, if it is not already installed, follow instructions, please install only driver for gigabit Ethernet – not USB3.0.

During the installation you have to enter a password. . The password is supplied on USB Key.

After installation, a shortcut icon will be available on your desktop  .

Before upgrading *SpectraResolver* software, *SpectraResolver* interface must first be closed, the LW-10 disconnected and *UninstallSpectraResolver* launched.

Initial set-up

The *LW-10* can be used with any computer that meets the following requirements:

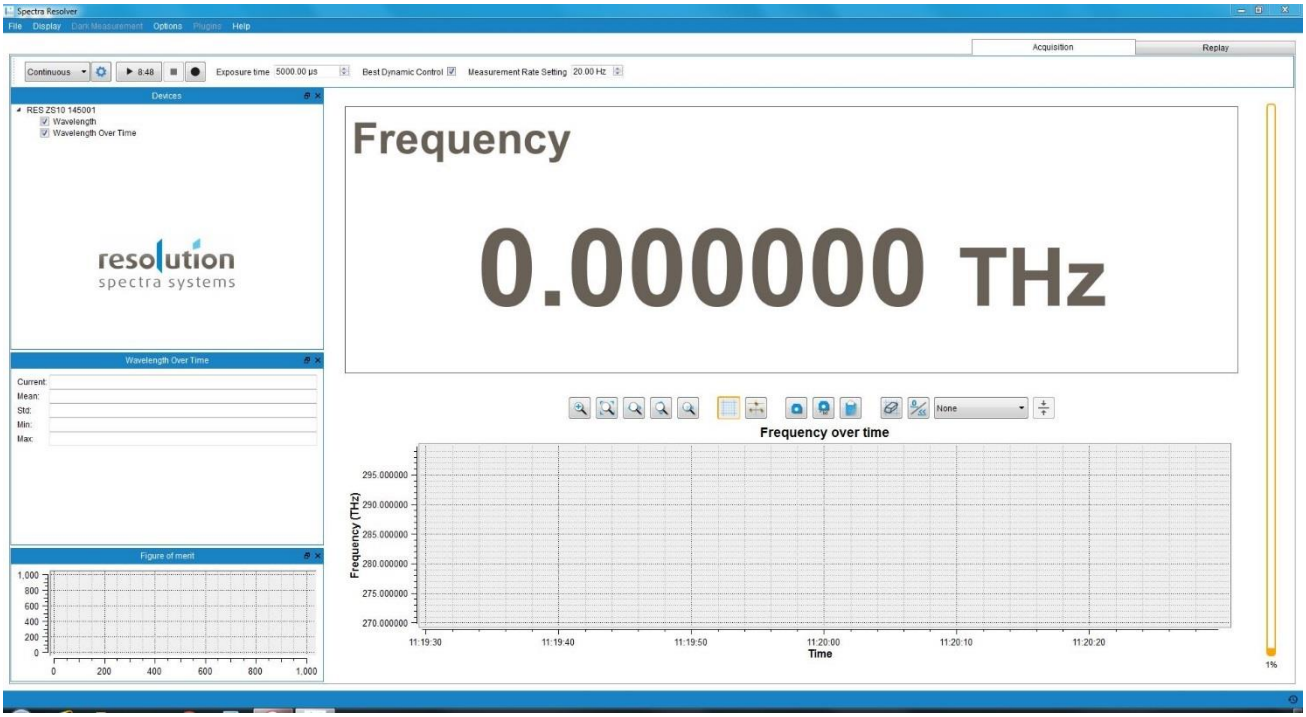
- Gigabit Ethernet network (it operates only at a transfer rate of 1Gbit/s in full-duplex mode)
- Processor frequency 2.6 GHz (minimum requirement)
- Up to 4 Go RAM
- 100 MB of space free on hard drive

The basic start-up process is as follows:

1. Connect the fiber
2. Connect the Ethernet cable
3. Switch on the *LW-10* (having connected the 24V power supply with the power cable)
4. Wait for the LED indicator to turn GREEN
5. Launch *SpectraResolver* with the shortcut icon 

When first opening *SpectraResolver*, the software takes few minutes to load the calibration tables on the computer. The software will then automatically link the calibration table with the serial number of the instrument.

Warm-up

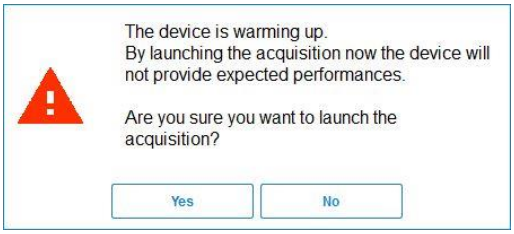


A 10 minutes warm-up time is required to ensure the best performances of LW-10. The timer on the play button gives an indication on the remaining warm-up time.

For instance, the button 

shows that 8 minutes and 48 seconds are needed to complete the warm-up.

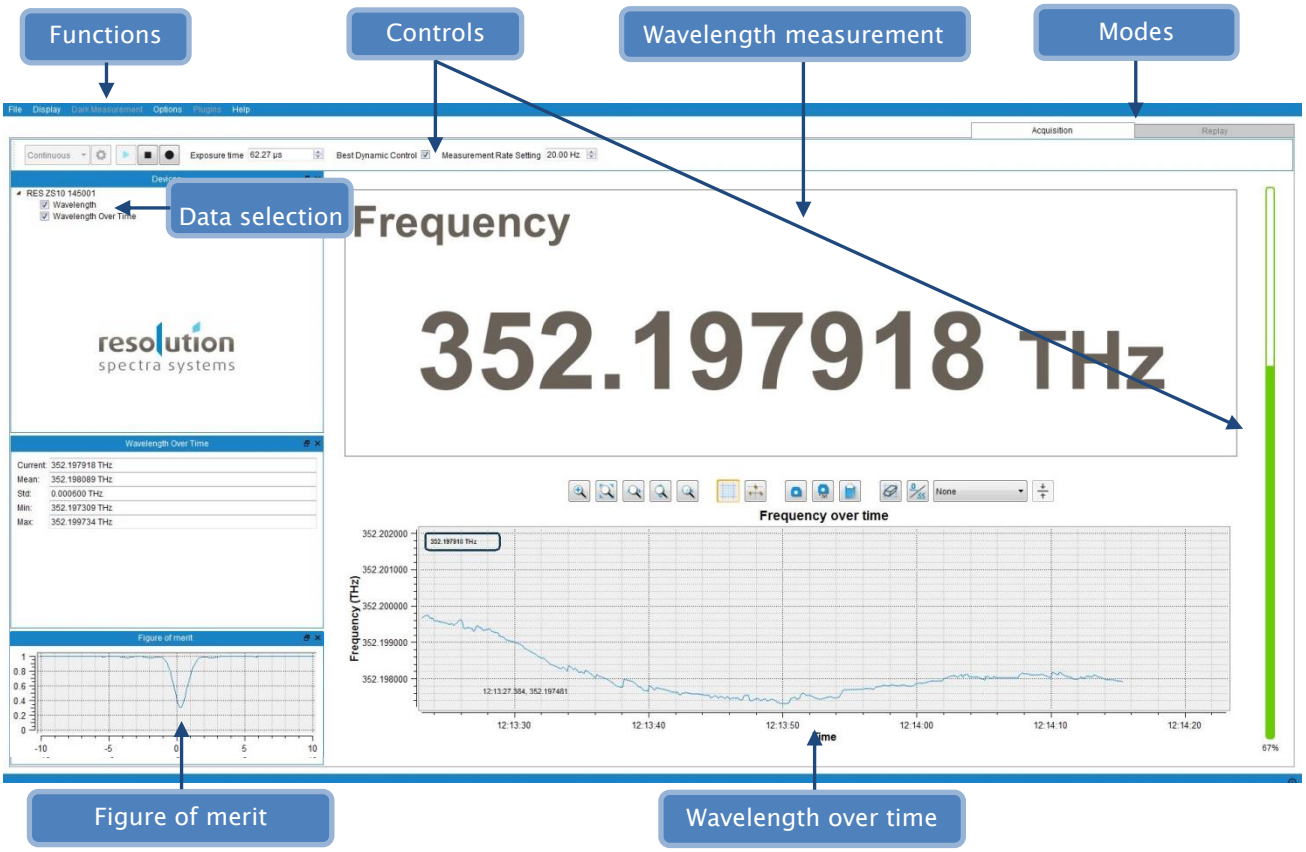
⚠ Skipping this step might lead to worsen performances, measurement inaccuracy and long term-drift.



Starting out with SpectraResolver

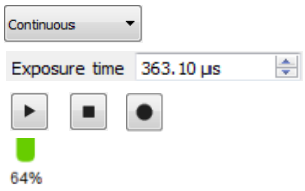
Wait for the LED to turn green before launching *SpectraResolver.*

To start data acquisition click on the "Start acquisition" ▶ button. The following window appears (the figure below describes the main functions of *SpectraResolver).*



The main control parameters are:

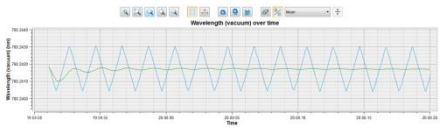
- Acquisition mode
- Exposure time
- Start / Stop / Record acquisition
- Signal level



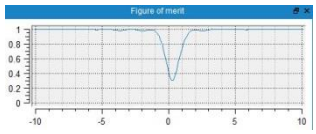
SpectraResolver is able to measure:

- Wavelength

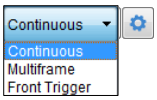
- Wavelength over time



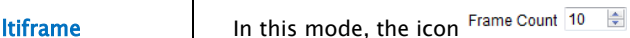
- Figure of merit



Controls



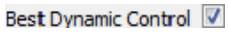
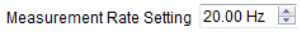
These two icons allow selecting how data is acquired.

Tool	Function
Continuous	Continuous acquisition
Multiframe	In this mode, the icon  appears in the "Control" area. It allows you to specify a certain number of acquisitions.
Front Trigger	Front Trigger mode, see chapter Trigger selector
	Trigger setup window, see chapter Trigger selector

The following icons are used to manage data acquisition.

Tool	Function
	Start data acquisition. In progress play button turns blue: 
	Stop the acquisition in progress
	Start data acquisition with recording. A file is created containing the data acquired

The following parameters are used to control data acquisition.

Tool	Function
	Integration time in µs (Min=16 µs. Max=10 s).
	When the *Best dynamic control* box is checked, the integration time is determined by an algorithm so that the intensity on the detector array remains between 30 % and 95% of the maximum dynamic of the detector. When the intensity goes outside these limits, the *Best dynamic control* algorithm starts and there is no measurement available until a suitable integration time is found again.
	Measurement rate Min=0.01Hz. Typ=20 Hz. Max=600 Hz.

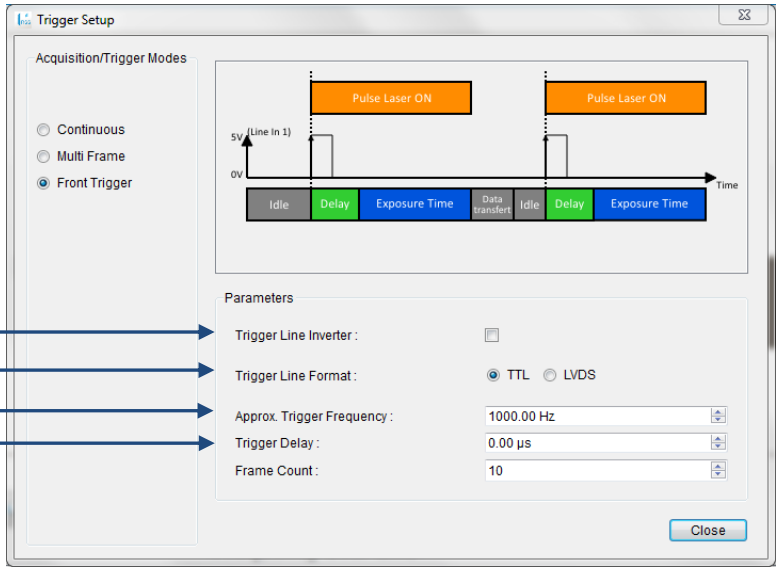
This icon indicates the signal level. It is advisable to work only in optimal configuration.

Too weak (< 30%)	Optimal (30% to 94%)	Too close to saturation (> 94%)
 1%	 82%	 99%

Trigger selector

This icon  opens the “Trigger Setup” window.
In Trigger mode the averaging (frame count) is automatically set to 1.

The “Front Trigger” mode is recommended for synchronization and acquisition with a pulsed laser.
The initial setting is: exposure starts at the rising edge of the signal trigger (TTL signal) with no delay.



It is mandatory to indicate the following parameters of trigger signal:

- The sense (rising or falling edge)
- The electrical level (TTL or LVDS)
- The frequency of trigger (Hz)

The start of the exposure can be delayed.

- Trigger Delay (Min) = 0,03 µs
- Trigger Delay (Max) = 10000000 µs (100 s)
- Trigger Delay = 0 → no delay

The exposure time is monitoring by this parameter: 

.

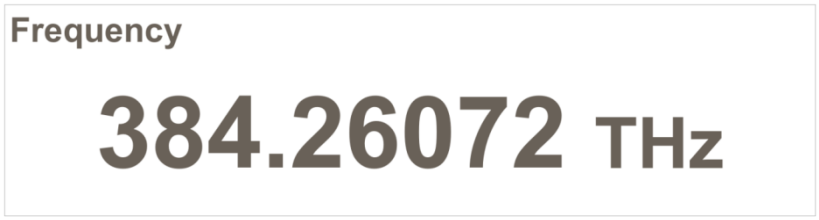
Exposure Time + Trigger Delay must be lower than Trigger period.
If it is higher than Trigger period, the signal trigger is lost.

Example of timing:

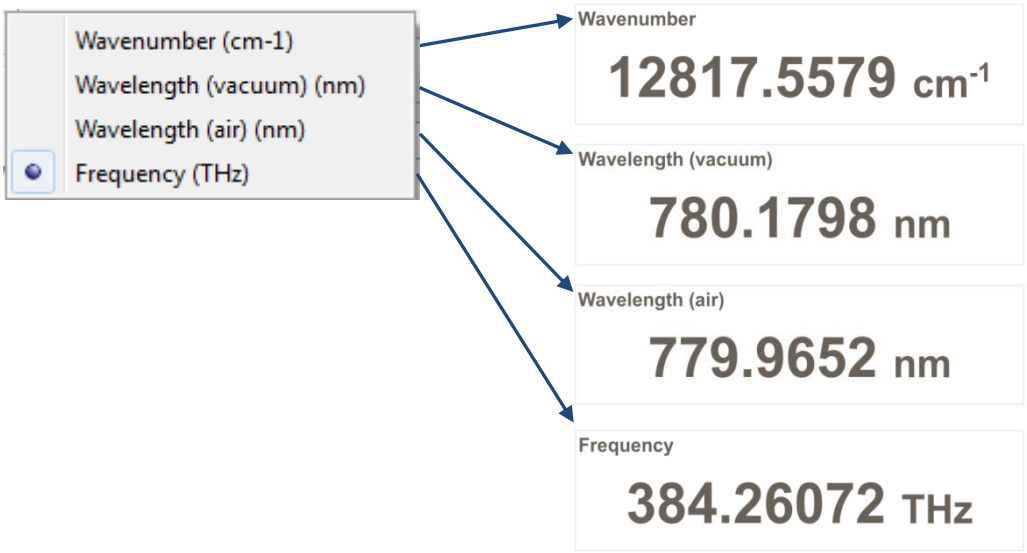
- if trigger frequency = 200Hz → Exposure Time + Trigger Delay must be < 5 ms
- if trigger period = 1 ms → Exposure Time + Trigger Delay must be < 1 ms

Wavelength measurement

This window indicates the laser's wavelength:



With a right-click the unit of the wavelength measure can be changed to: wavenumber (cm^{-1}), wavelength (nm) and frequency (THz, is the default unit).



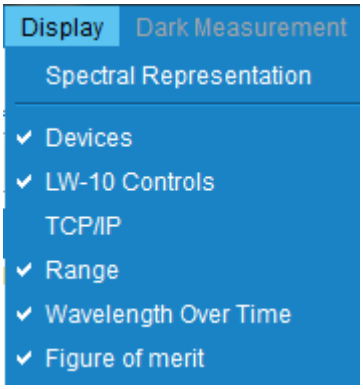
Air wavelength is calculated for standard dry air (15°C and 760 mm Hg).

The measurement is stopped if:

- The intensity of signal is too weak
- The intensity of signal is too strong
- The wavelength of signal is out of bounds
- Untrusted wavelength measurement

Range of wavelength measurement

Defining a wavelength range measurement is possible to increase the real-time measurement rate of the device. To activate the function, “Range” in the Display menu.



Wavelength range (Typical)

- Min = 700 nm
- Max = 1000 nm

Example:

- Change “Min” value and write 1050.44 nm
- Change “Max value” and write 1072.17 nm
- Confirm the modification with button “Apply”

⚠ Please do not use this function if you do not know in advance the approximate wavelength value of the laser. If the true wavelength value is located outside the measurement range, wrong wavelength values can be displayed.

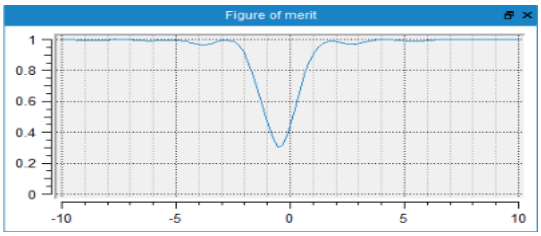
Figure of merit

A figure of merit is displayed on *SpectraResolver* interface. Its purpose is to give an indication on the current running state of the laser: single mode, multimode or reduced coherence.
The chart displayed is a convergence function. This figure does not represent a physical quantity and should only be taken as an indicator on the laser running state. Its axes represent normalized vectors adjusted to display a readable figure for quick understanding.

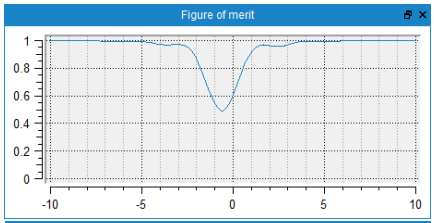
If the laser is single mode with good coherence, the valley displayed on the figure of merit must fulfill these two requirements:

- Centered
- Amplitude as low as possible

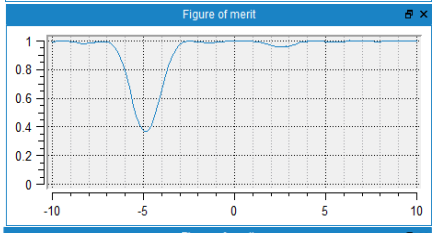
If these two conditions are met, the figure of merit is likely to be as follows:



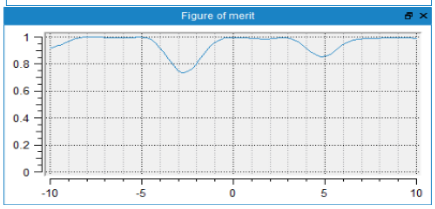
If the current figure of merit displayed by *SpectraResolver* is not equivalent to the above graph, the wavelength measurement may not be meeting the LW-10 specifications. The following examples show different cases where the laser is not single mode or lacks of coherence:



→ **Low amplitude** = Not OK! The laser is likely to lack of coherence (> 30 GHz)



→ **Not centered** = Not OK! The laser is likely to lack of coherence (> 30 GHz) and/or is not singlemode



→ **Two low amplitude valleys** = Not OK! The laser is likely to be running multimode (two modes or more).

If no figure of measure is displayed, it signifies that *SpectraResolver* algorithm could not find a suitable result and/or does not trust the wavelength measurement. For example:

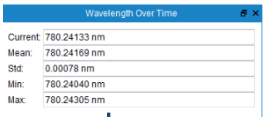
- The laser beam spectrum is broader than 30 GHz
- The laser source is running multimode (2 modes or more)
- The laser source is not correctly polarized

If this is your case, try to get a better signal from your source or check your setup/laser polarization.

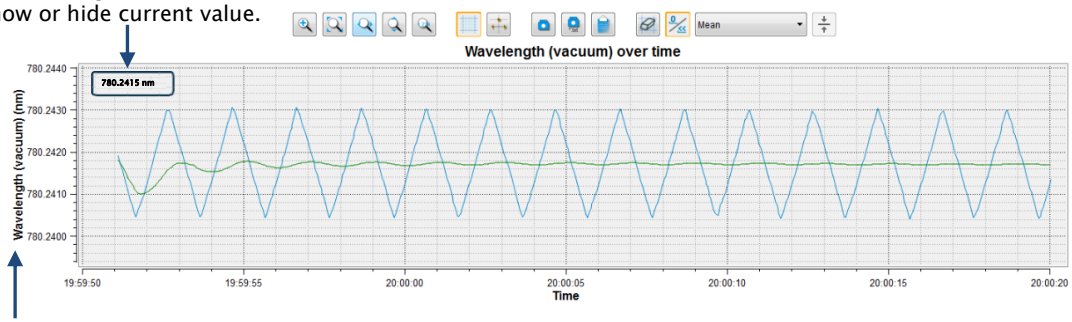
Wavelength over time

This function allows the tracking over time of the wavelength value.

With the right-click you can how or hide current value.



- Current value
- Average
- Standard deviation
- Min value
- Max value



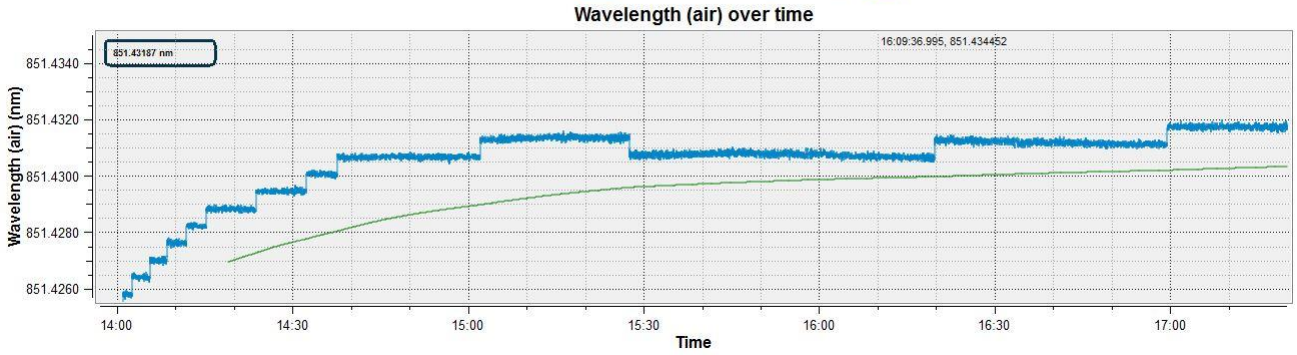
With a right-click the unit of the wavelength measure can be changed to: wavenumber (cm-1), wavelength (nm) and frequency (THz). Frequency is the default unit).

SpectraResolver also offers a range of options to view, customize or save graphs.

	Tool	Function
Zoom functions		Activate zoom mode (Left click or Mouse-Wheel)
		Zoom to fit the whole curve
		Zoom to fit the whole horizontal curve
		Zoom to fit the whole vertical curve
		Set the windows boundaries
Graphic functions		Show or hide grid
		Activate or deactivate marker mode (Add Delta Marker)
Save functions		Save current graph to image file (*.jpg, *.pdf, *.svg, *.ps, *.bmp, *.png, etc.)
		Save current graph as an (.txt or .csv) file
		Copy plot to clipboard
Data functions		Clear data on the graph
		Display only the last 30 seconds or all the measurement if selected
		Hide mean value on the graph or other value (see next page)
		Display the deviation from a reference wavelength (see next page)

When an icon is activated it is highlighted  (orange color).

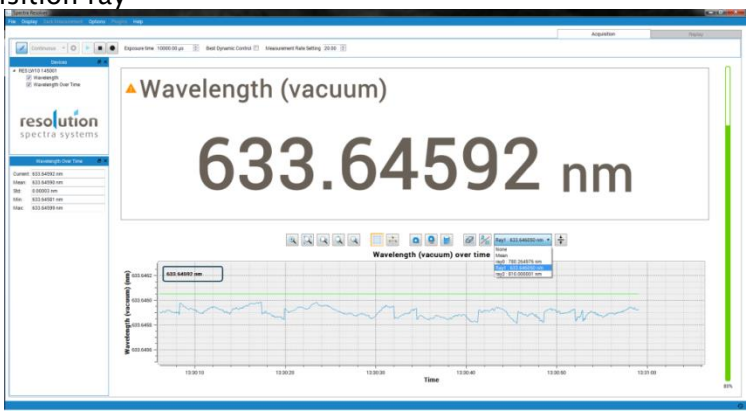
Mean : Hide mean value on the graph and display all the measurement 



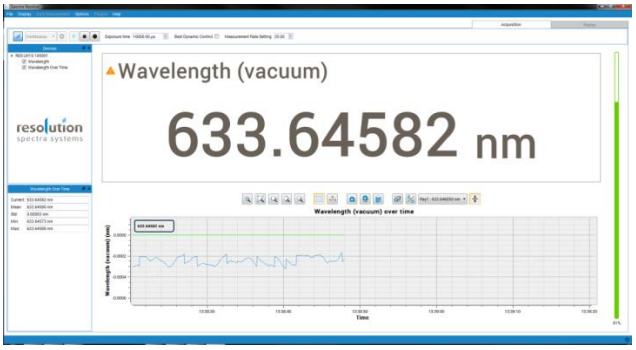
In “Wavelength Over Time” mode: the overtime graph can be centered on a transition ray using the following procedure:

1. A new transition ray should be added to the wavelength list (in “Option/Preference” menu).

2. Select the transition ray 



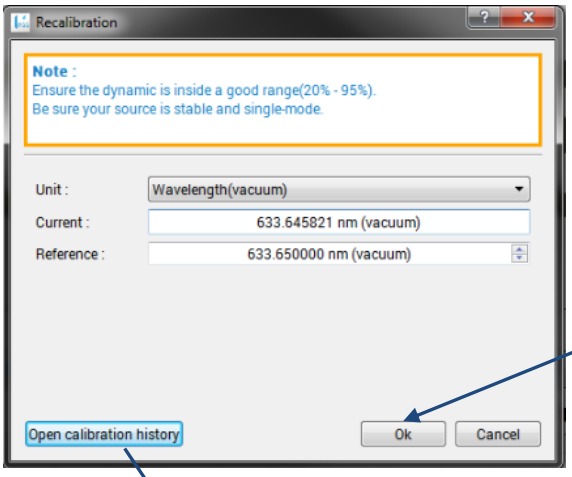
3. and click on this button  .



Recalibration tool

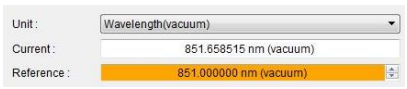
For the best results, make sure the device has been properly adjusted and calibrated beforehand. The calibration process especially should be undertaken periodically (and if remarkable environmental conditions have changed) to reach the specified precision.

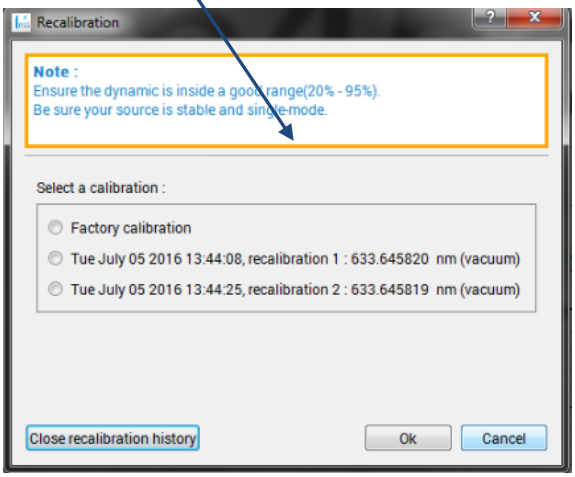
The Recalibration tool can be found in the “Option/Recalibration” menu.



1. Current value (measured)
2. Enter the reference laser value for recalibration
3. Click OK to active recalibration

If the calibration value is too far from the measured value, the software highlights the value.





All calibrations are recorded and may be reused.

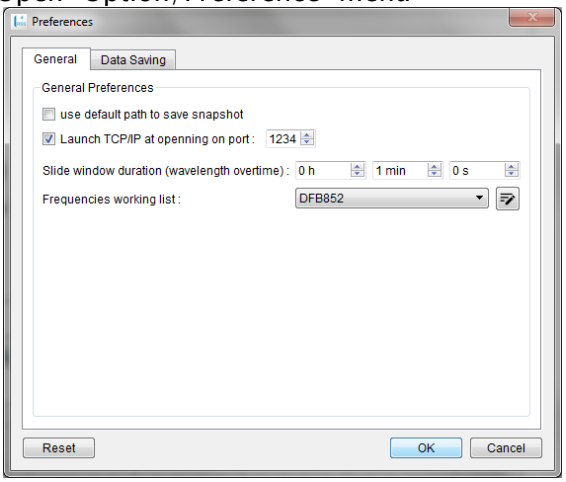
- Factory calibration
- Recalibration at 633.645820 nm
- Recalibration at 633.645819 nm

All calibrations are saved on the computer.

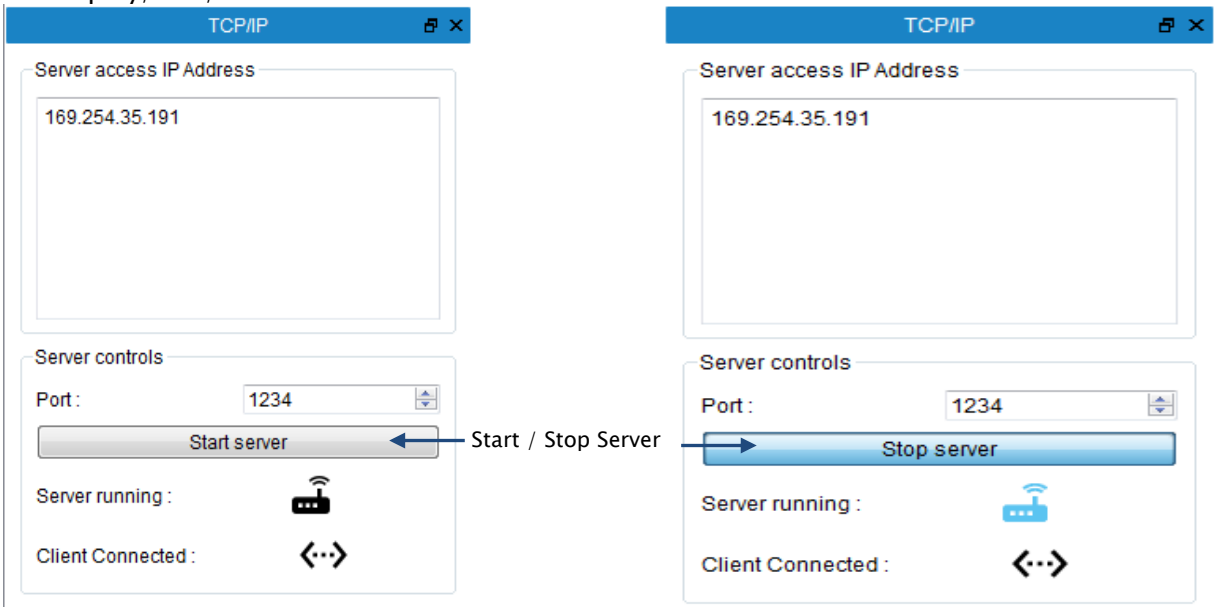
TCP/IP server

TCP/IP server: allows the remote control and acquisition of the measured wavelengths via TCP/IP.

Open “Option/Preference” menu



Open “Display/TCP/IP” window



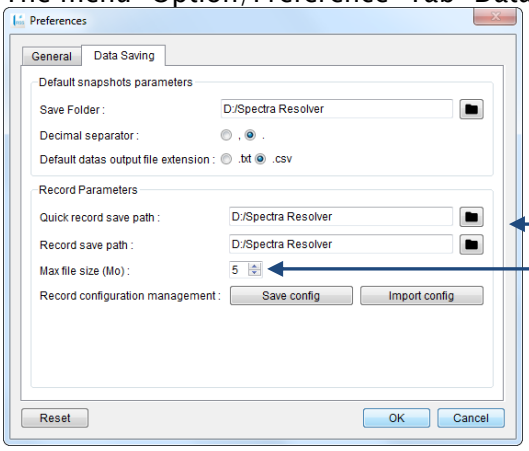
Recording

 This icon starts spectral data acquisition with recording (and stop record with the same icon).

-  : No recording
-  : Recording in progress

The format of the file name is MM_DD_YYYY_hh_mm_ss_iii_0.srr (MM: Month / DD: Day / YYYY: Year / hh: hour / mm: minute / ss: second / iii: millisecond). It is possible to read the recorded file in the "Replay" tab. For more information, please read the next chapter. If the user activates the peak detection while recording, it will be displayed in replay mode.

The menu “Option/Preference” Tab “Data Saving” manages the recording parameters.



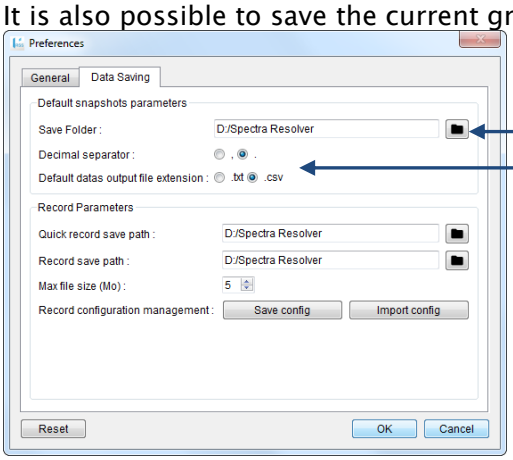
Select the save folder

Select the file size of the recording

- Min = 1 MB
- Typ = 5 MB
- Max = 50 MB

 If the computer has only 4 GB of RAM the file size must be lower than 20 MB

It is also possible to save the current graph as (.csv) or (.txt).



Select the save folder

Select the type of file (txt or csv), and the decimal separator

 Excel cannot open a .csv file if it is larger than 10MB

The file is created with button  , the csv and text files are organized as follows:

WavelengthOT_02_25_2016_19_53_19_546.csv

##########		
time	02/25/2016 19:53:23:261	
##########		
Time	Relative time(ms)	Frequency (THz)
19:30:00.188	0	473.607314914550727 3
19:30:00.348	160	473.607283538755041 3
19:30:00.498	310	473.607299656005864 1

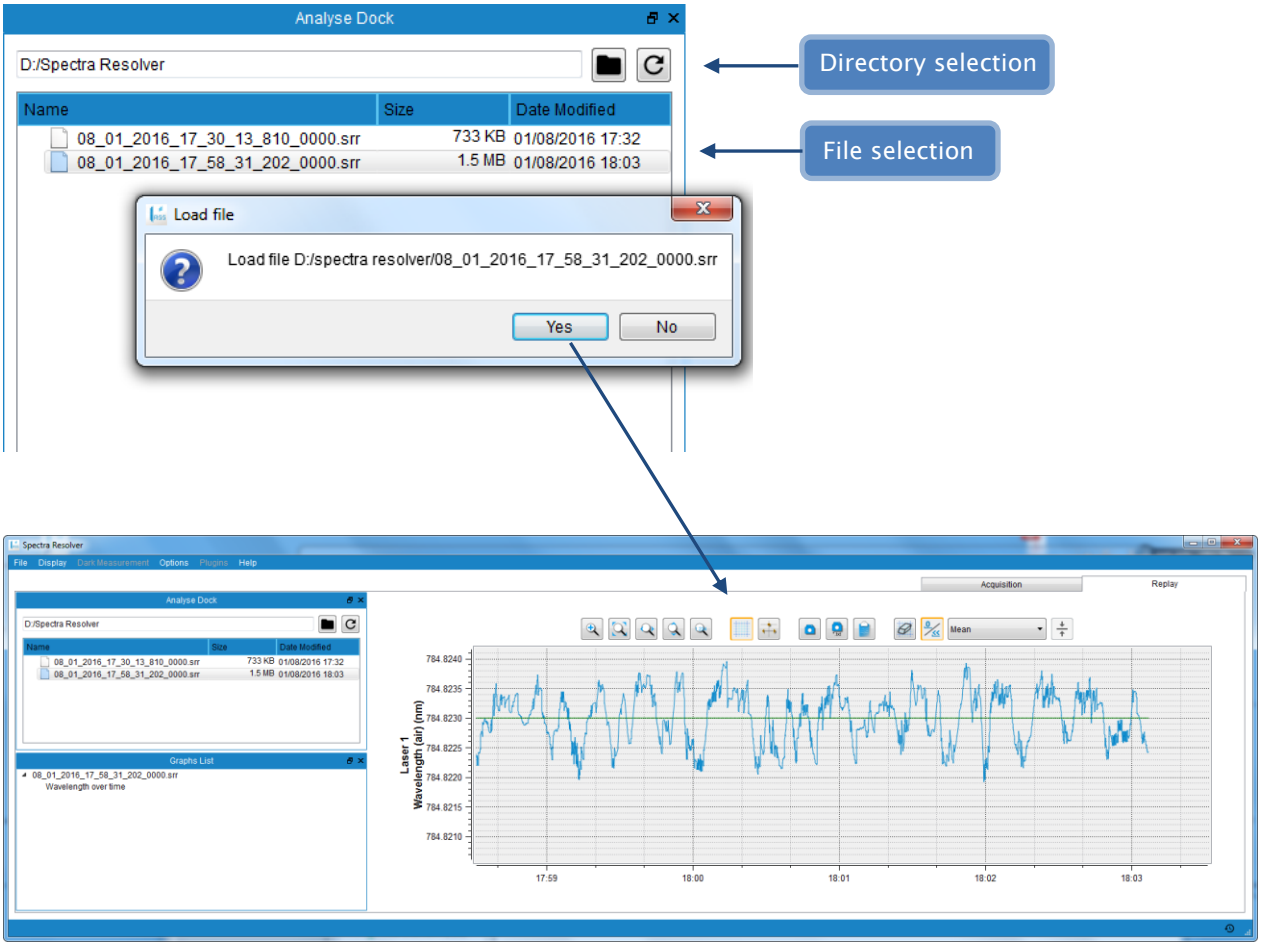
WavelengthOT_02_25_2016_19_54_39_641.txt

```
############################################################
time;02/25/2016 19:54:44:698
############################################################
Time ;          Relative time(ms) ;     Frequency (THz)
19:30:00.188;   0;                      473.607314914550727 3;
19:30:00.348;   160;                    473.607283538755041 3;
19:30:00.498;   310;                    473.607299656005864 1;
19:30:00.653;   465;                    473.607296617507813 6;
19:30:00.808;   620;                    473.607311479726718 1;
19:30:00.968;   780;                    473.607334796897077 9;
19:30:01.123;   935;                    473.607291068946040 0;
```

Replay mode

The recorded data can be replay in the “Replay” tab.

First the measurement has to be loaded, and then it can be read as if it was a real time measurement. To start “Replay” mode you must first choose a recorded file. To do this just select a directory and load the desired .srr file.



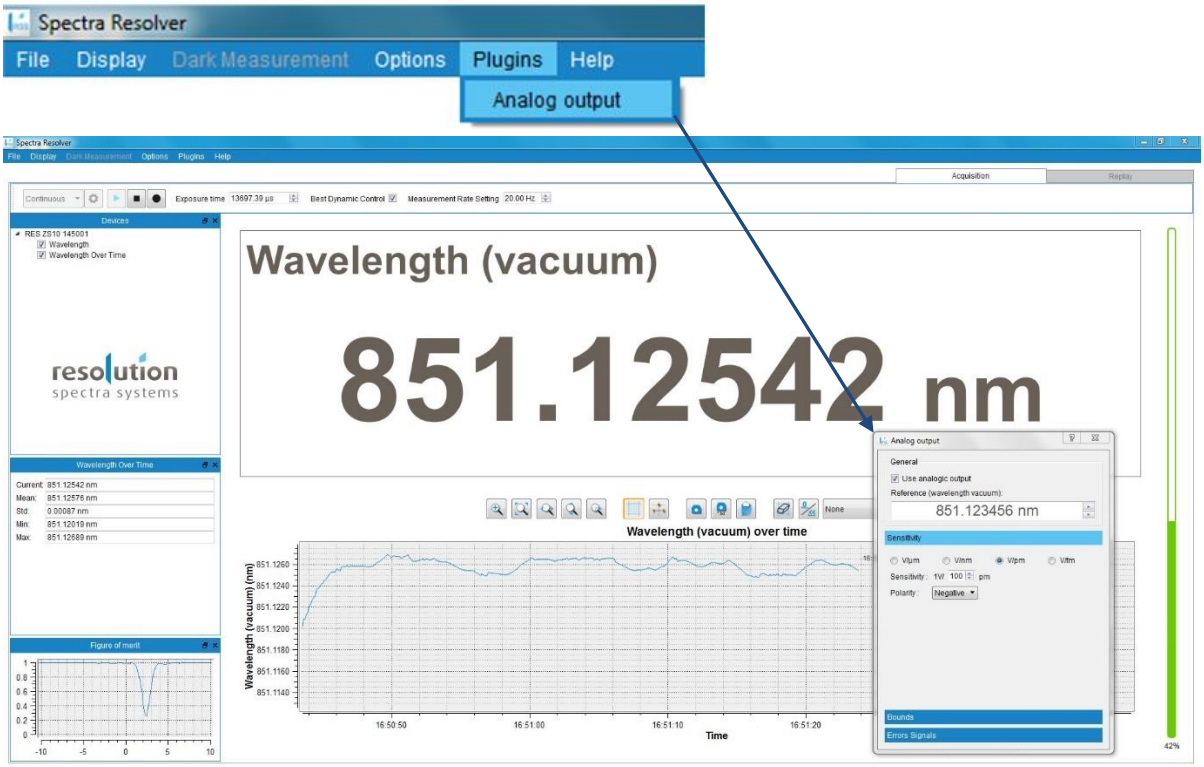
7 OPTIONS

Analog Output plugin

To perform wavelength stabilization, frequency locking, PID control or just deviation measurement on a single-mode laser signal, the LW-10 wavelength-meter offers the capabilities of an analog output feature. Its control is done via an external USB-DAQ device providing a voltage proportional to the wavelength measured by the LW-10. The output voltage has a large covering range from -10 V to +10 V with a step resolution of 1.22 mV, according to its 14-bit Digital-to-Analog Converter (DAC) resolution. The signal can be accessed using a coaxial BNC connector (other solutions on demand).

Specifications	Value
Analog Output Voltage Range	± 10 V DC
Step Resolution	1.22 mV DC
DAC Resolution	14-bit
Absolute Accuracy (typical), at full scale	9.1 mV
Maximum Sample Rate	5 kS / s
Output Impedance	0.2 Ohm
Output Connection	Coaxial BNC
Communication interface	USB
Operating System	Windows 7 – 8 – 10

If the analog output option has been chosen, an analog output control dialog box is made available under the menu item “Plugins” -> “Analog Output” of the *SpectraResolver software*. The dialog box allows the switching on and off of the device, and the output setting adjustment.



Installation

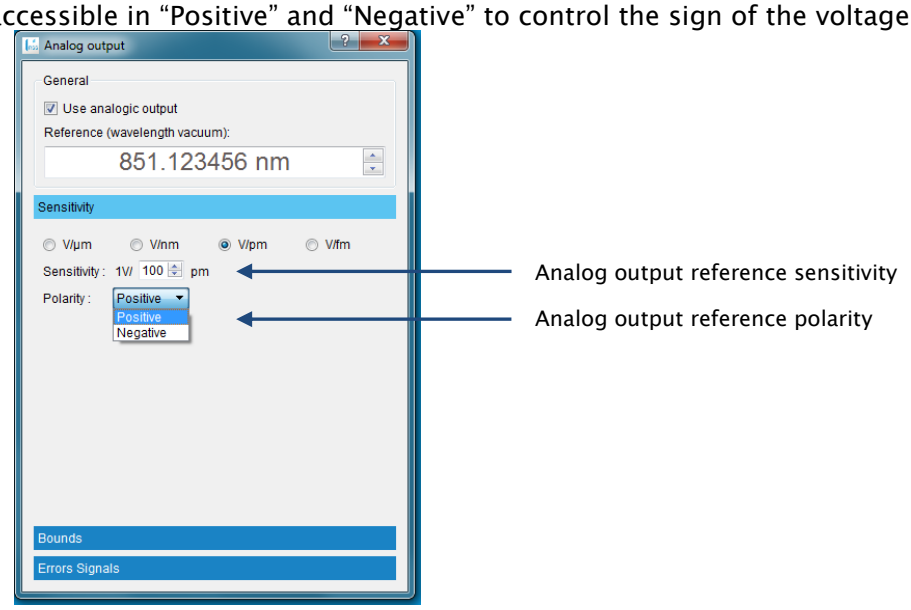
After a clean installation of SpectraResolver software (see “User Manual LW-10”), please install Analog Output plugin with the “Spectra Resolver Analog Output Plugin.exe” installer provided in the USB key.

Make sure that the LW-10 wavelength-meter and the USB-DAQ are not connected when installing the software and the plugin. The option will require the installation and the use of National Instrument DAQ Runtime library (NI-DAQmx provided in the USB key). Restarting the computer may be necessary to complete the installation. After a clean installation, please first connect the LW-10 wavelength-meter and then the USB-DAQ device. Please wait for the driver installation and the Ethernet connection. Launch SpectraResolver software and check the availability of the “Analog Output” option in the “Plugins” toolbar.

If the “Multi-Channel” option is also available with *SpectraResolver* software and the optical switch device connected, the “Analog Output” option is no longer available. To recover access to this option, please disconnect the optical switch device and start again *SpectraResolver* software

Analog Output functionalities

- Reference wavelength
  The “Reference” wavelength must be set for value in vacuum. All deviations will be determined in function of the value. In order to be activated, the box “Use analogic output” must be checked.
- Sensitivity and Polarity
  The “Sensitivity” sheet allows the control in sensitivity of the generated voltage (in Volt) in relation with the wavelength deviation, with V/µm, V/nm, V/pm and V/fm ranges. The “Polarity” is accessible in “Positive” and “Negative” to control the sign of the voltage deviation.

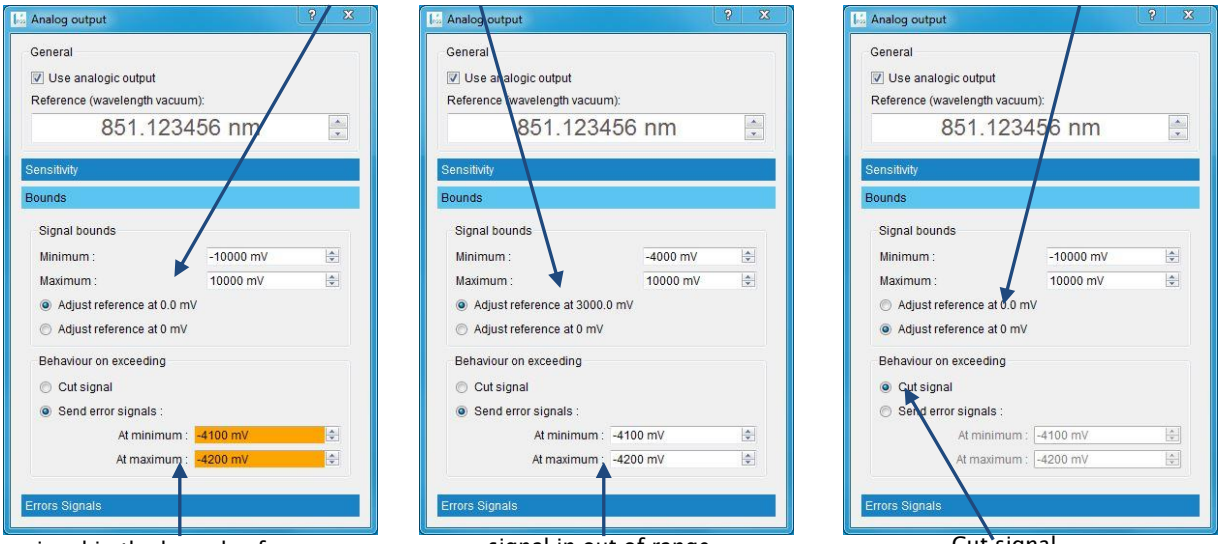


- Bounds

  Signal bounds: Maximum and minimum signal bounds can be defined in the +/- 10 000 mV voltage range (in mV). If the absolutes of both the values are different, it is possible to adjust the reference wavelength to the center of both the values or to “0 mV” value.

Adjustment of reference to center of range

Adjustement of reference to the zero



signal in the bounds of range

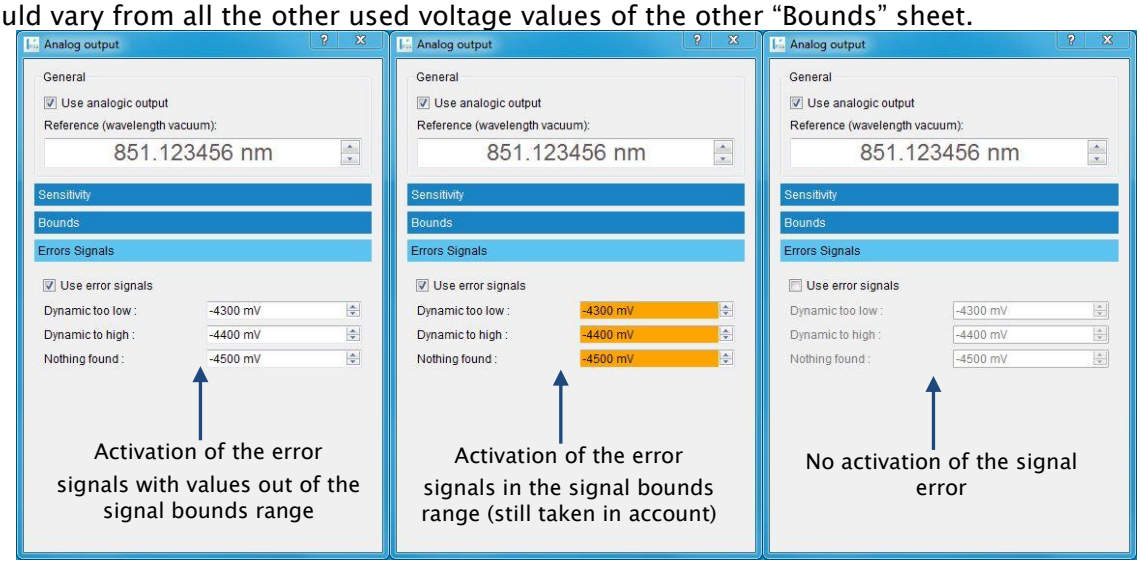
signal in out of range

Cut signal

Behaviour on exceeding: If the signal exceeds the signal bounds' interval, the user can choose to leave the signal simply being cut or to send an other specific entered values. If the values to be entered here overlap with the signal bounds range, the commands are marked with an orange warning color but still taken into account. Also it is recommended that these signals should vary from all the other used voltage values of the other “Error Signals” sheet.

- Errors Signals

  Specific voltages can be set to appear if the measurement has led to an error value because of optical signal dynamic too low or tow high, or in case a correct wavelength is not found. To enable these error signals, the check box “Use error signals” must be activated. If the values (in mV) to be entered here overlap with the signal bounds range, the commands are marked with an orange warning color but still taken into account. Also it is recommended that these signals should vary from all the other used voltage values of the other “Bounds” sheet.

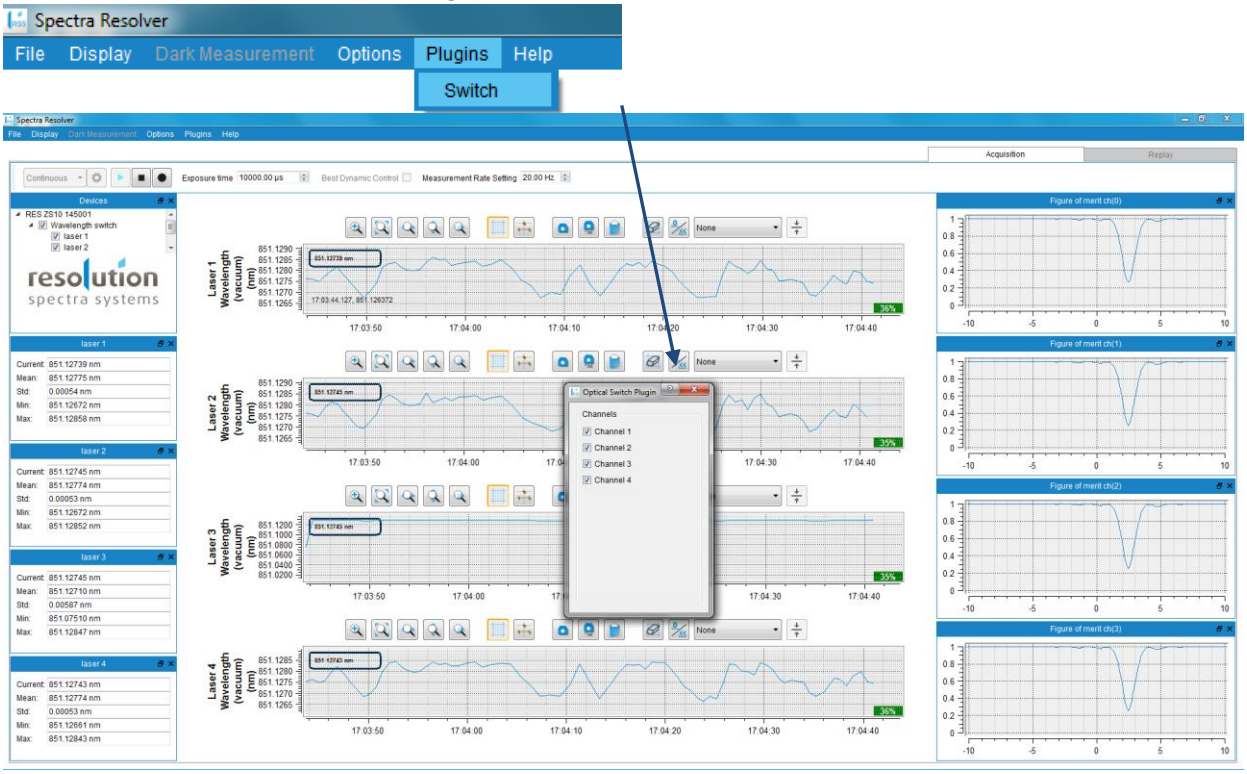


Multi-Channel Switch plugin

The LW-10 wavelength-meter offers the capabilities of interfacing with a specific fibered optical single-mode switch to serve for the most demanding applications in testing and measurement. The optomechanical design (MOEMS) of the switch ensures an excellent optical performance combined with short switching time due to refractive micro-optical components and industry proofed high resonant actuators. Thanks to its *SpectraResolver*, the LW-10 wavelength-meter is able to analyze and monitoring up to 4 lasers almost simultaneously (other numbers of channels on demand).

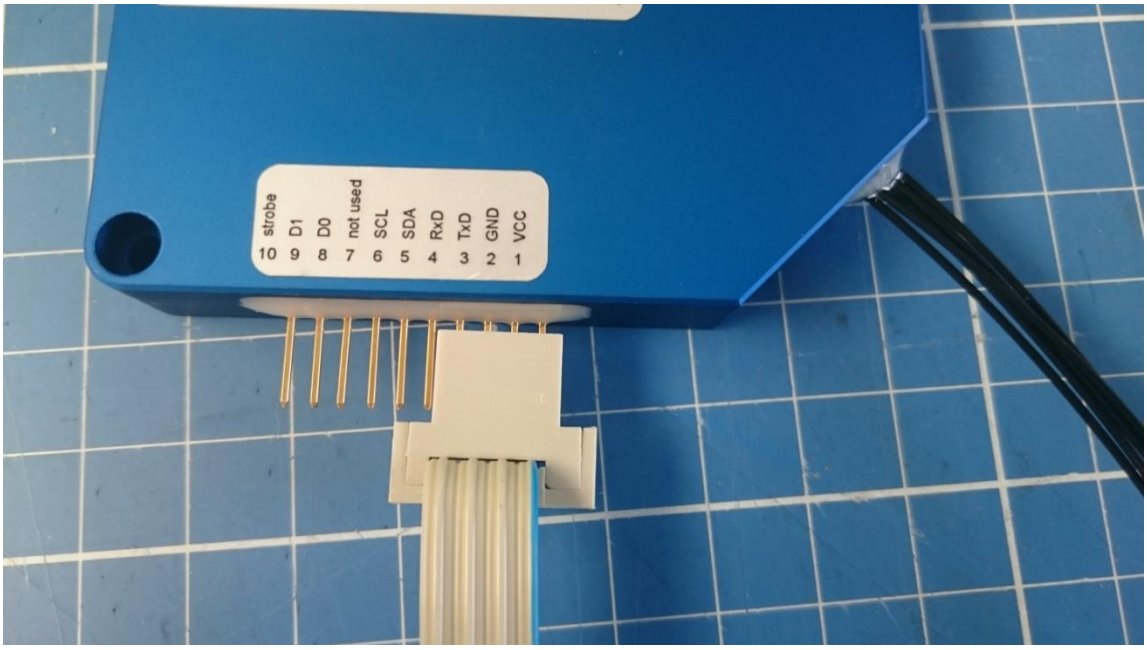
Specifications	Value
Number of channels	4
Operating Wavelength Range	630 – 1000 nm
Insertion Loss	< 3 dB
Crosstalk	< -55 dB
Fibers type	PM single-mode fibers
Polarization extinction ratio PER	20 dB
Connector type	FC-APC
Switching frequency	50 Hz max.
Guaranteed lifetime	> 10^8 cycles
Communication interface	RS232 or USB
Operating voltage	5 V
Power consumption	< 450 mW
Operating temperature	0 – 60 °C

If required as an option, the feature is available under the menu “Plugins > Switch” of *SpectraResolver* software, opening a dialog box. Switching on and off independently each of the 4 channels can be done in this dialog box.



Hardware installation

The power supply connection of the switch box should be done as follows:



As shown in the picture above, the blue indicator of the flat cable should face the VCC pin.

Software plugin installation

After a clean installation of SpectraResolver software (see "User Manual LW-10"), please install Multi-Channel Switch plugin with the "Spectra Resolver Optical Switch Plugin.exe" installer provided in the USB key.

Be sure that the LW-10 wavelength-meter and the optical switch are not connected when installing the software and thie plugin. The communication is done via a serial RS232 connection. If the USB connection is preferred (USB to Serial converter provided), the option will require the installation and the use of the Brainboxes Boost Runtime library (installer provided in the USB key). Restarting the computer may be necessary to complete the installation. After a clean installation, please first connect the LW-10 wavelength-meter; then connect the optical switch device with the RS232 or USB connection and plug its power supply. Please wait for the driver installation and the Ethernet connection. Launch SpectraResolver software and check the availability of the "Switch" option in the "Plugins" toolbar.

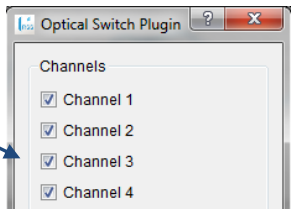
If the "Analog Output" option is also available with *SpectraResolver* software and the optical switch device connected, the "Analog Output" option is no longer usable. To recover access to this "Analog Output" option, please disconnect the optical switch device and start again the *SpectraResolver* software

Multi-Channel Switch functionalities

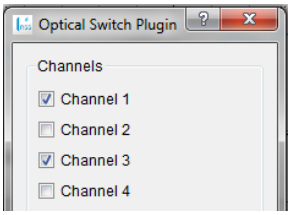
- Choice of activated channels and Configuration
  The Optical Switch Plugin box allows to switch on and off independently each of the 4 channels.

Please note that the “Exposure time” and other parameters cannot be defined independently for each channel. The cycle time of measurement can be configured with the “Measurement Rate setting” command.

All chanels selected

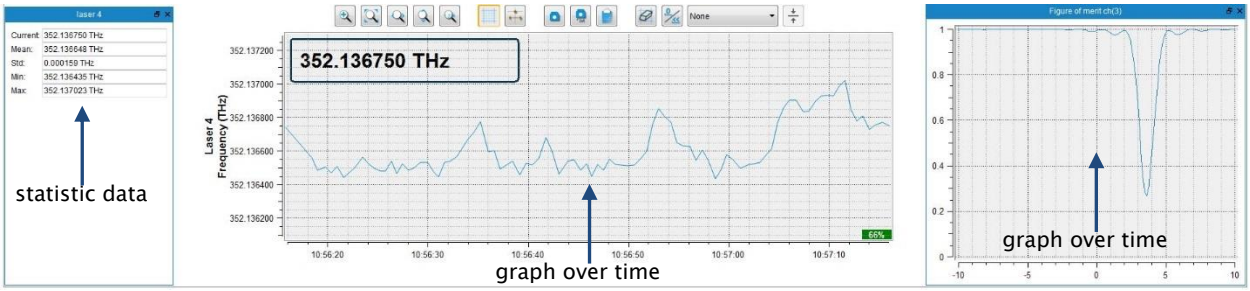


Only All chanels



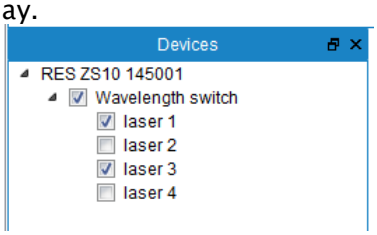
- Wavelength overtime

  Each channel is linked to a specific graph over time, where the current measured wavelength is screened in a blue box, and the signal dynamic of the channel is provided in the bottom right of the graph (in %). Zoom, saving, and scaling functions are accessible independently for each channel. Statistical data can be also determined for each evolution in the Display tab, and the figure of merit linked to the wavelength calculation convergence is accessible for each channel (see “LW-10 User Manual” for more details).

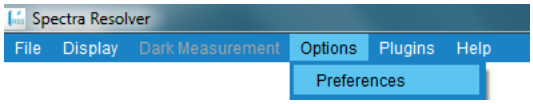


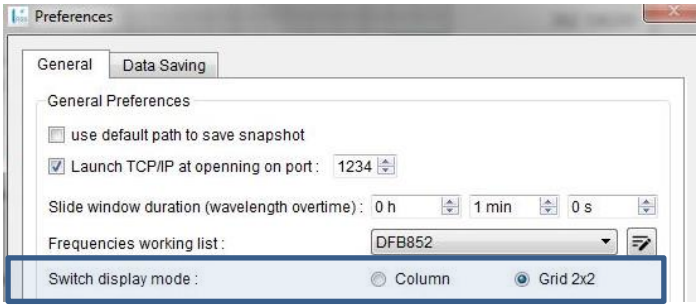
- Graph Settings

  The displays of the graphs over time are accessible with the check boxes of the « Wavelength switch » menu in the « Devices » toolbar. Please note that these settings does not desactivate the switch operation but only the display.

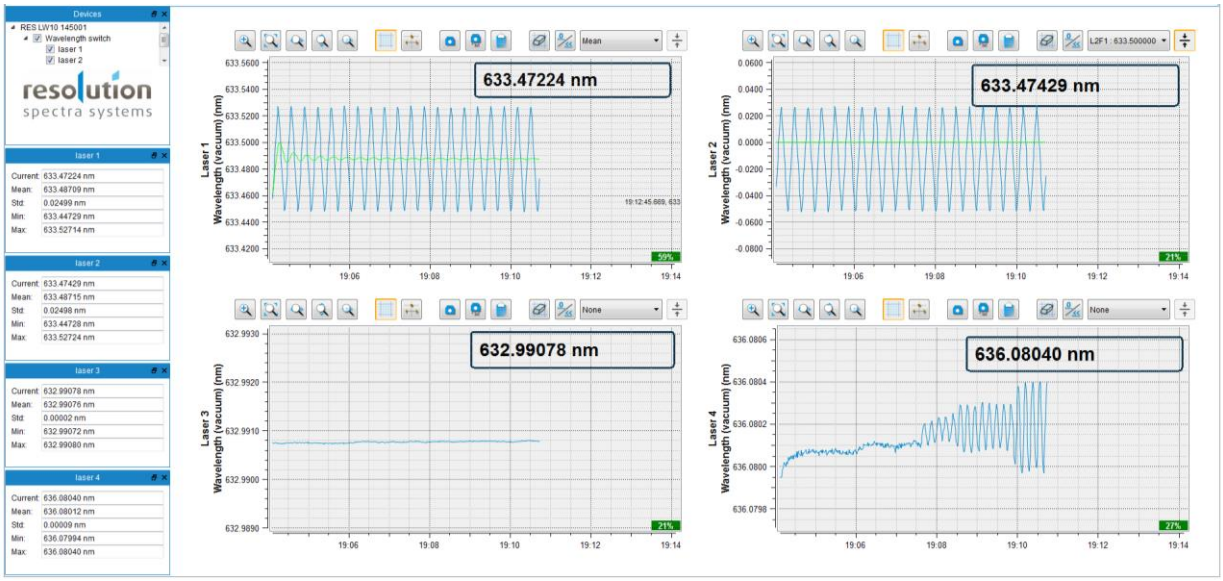


The *SpectraResolver* software offers the possibility to display the different graphs over time in successive lines (“Column” display mode) or in a square configuration (“Grid 2x2” display mode). The “Switch display mode” is available over the menu “Options > Preferences > General” of *SpectraResolver* software.





In both modes, each channel can independently benefit from the display (zooms, cursors, deviation to reference scaling) and saving functions (see "LW-10 User Manual" for more details).



Multi-Channel Switch measurement of 4 different lasers around 632-636 nm (Grid display mode), with different display functions (evolution vs. mean value (top, left), deviation to reference (top, right), or classical screenings (bottom)).

8 TROUBLESHOOTING

The LW-10 does not start

Status: LED indicator is off (no light) and the fan does not work.

1. Check the connection with *LW-10* Power Connector
2. Check the connection to the AC power supply
3. If the *LW-10* still does not work, change the 24V power supply and power cable or contact Resolution Spectra Systems *info@resolutionspectra.com*

No connection

Status: no communication with the device (the window "no device found" appears"), the fan works.

1. If the LED still lights up ORANGE after 40 seconds, please contact *info@resolutionspectra.com*
2. If the LED lights up GREEN, check the Ethernet cable (connection to PC and spectrometer) it must be connected and the LED of Ethernet connector must be ON
3. Verify the connection of Gigabit Network. It must be 1 Gbits/s
4. Launch *Spectra Resolver,* if no communication please contact *info@resolutionspectra.com*

Firewall incompatibility

Status: Lost communication after few seconds or no data.
→Firewall blocking transmission: Disable firewalls and re-attempt a connection.

This section provides you with the steps to take to disable the Windows 7 firewall. In the Windows 7 operating system you can control the firewall setting for domain networks (corporate), home or a public network. We recommend that you do not deactivate the firewall on a public network.

To set your network type	To disable the firewall on Windows 7
1. Click Start > Control Panel.	1. Click Start > Control Panel.
2. Click Network and Internet.	2. Click System and Security.
3. Click Network and Sharing Center.	3. Click Windows Firewall.
4. Adjust the network settings.	4. In the Control Panel Home, click Turn Windows Firewall On or Off.
5. Close the Control Panel.	5. Select Turn Off Windows Firewall
	6. Close the Control Panel.

Note: If disabling the firewall has no effect: Antivirus may also block the transmission: Disable Antivirus and re-attempt a connection.

Secure network

Status: Lost communication after few seconds or no data.
→ Many networks (corporate) are secured and might block the connection to the instrument. To overcome this, please use another Gigabit Ethernet port by added

1. USB3.0 Gigabit Ethernet adapter (Example product: D-Link DUB-1312 (depend on product, in trigger mode you may have some limitation)

2. PCI card Gigabit Ethernet.

Limitation of PCI network adapters

This document present the knowledge about different manufacturer driver we acquire based on experience, validation and customer reports. This is a work in progress and this document will be updated as our knowledge improves about the different products on the market. Limitations noted were found during the eBUS Universal Pro validation process. Information may be relevant to other drivers but was not validated with them. Minor issues with a couple of adapters have been observed but the eBUS Universal Pro can install on top of any network adapters with good results.

Intel are still selling really good network adapter and are more likely to provide a great experience to work with. Intel is the preferred vendor.

List of network adapters with potential issues

Commercial Name:	**Marvell Yukon 88E8058 PCI-E Gigabit Ethernet Controller (On MacBook Pro)**
Vendor ID:	11AB
Device ID:	436A
OS :	Microsoft Windows 7 – 64 bits
Problem:	Drops packets when streaming at around 400 Mbps
Solution:	Use another adapter or another bandwidth range

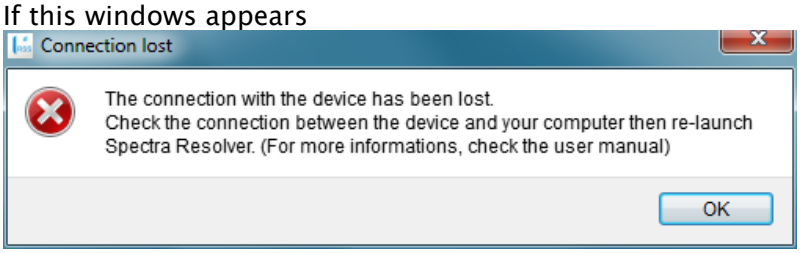
Commercial Name:	**SysKonnect SK-9521 V2.0 10/100/1000 Base-T Adapter (Marvell Yukon)**
Vendor ID:	1148
Device ID:	4320
OS :	Microsoft Windows 7 – 23 and 64 bits
Problem:	Number of RX 32 scriptors to low with the default driver
Solution:	Increase the number of RX descriptors in the driver configuration page.

Commercial Name:	**Intel ® Gigabit CT Desktop Adapter (Intel Pro 1000 CT – 82574L)**
Vendor ID:	8086
Device ID:	10D3
OS :	Microsoft Windows XP – 32 bits, other Microsoft Windows versions are working properly
Problem:	Major streaming problem
Solution:	Need to try with another OS or another adapter.

Commercial Name:	**Intel ® Gigabit PL Desktop Adapter (Intel Pro 1000 PL – 82573L)**
Vendor ID:	8086
Device ID:	10D3
OS :	Red Hat Enterprise Linux 5.4 32 and 64 bits
Problem:	Jumbo frames may not working properly on some laptops
Solution:	By design. Refer to the document "Intel ® 82573 Family Gigabit Ethernet Controllers Specification Update (http://download.intel.com/design/network/specupdt/82573.pdf)" in section "17 - ASPM/Jumbo Frames Disabled Due to Early Receive Threshold Overrun Buffer"

Connection lost

If this windows appears



Status: The connection with the device has been lost

1. Check the connection with *LW-10* Power Connector
2. Check the connection to the AC power supply
3. Verify the connection of Gigabit Network. It must be 1 Gbits/s
4. Launch *Spectra Resolver,* if no communication please contact *info@resolutionspectra.com*

9 PRODUCT SUPPORT

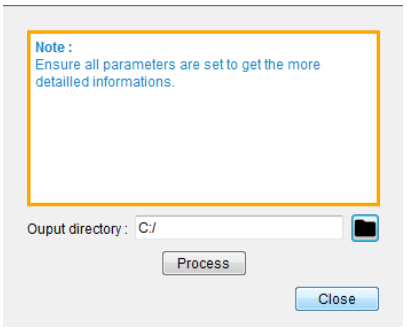
Please read the document "General Terms and Conditions RESOLUTION Spectra Systems" for the conditions and the term on warranties.

To make a warranty claim, the purchaser shall promptly notify RESOLUTION Spectra Systems following discovery of the basis for the claim (and, in any event, within the applicable warranty period). To facilitate any repairs/changes, you must first contact Customer Support and obtain a Return Merchandise Authorization (RMA) number. Contact us by Email, in writing or by telephone:

RESOLUTION Spectra Systems
Address: 13 chemin du Vieux Chêne – 38240 Meylan France
Tel.: 00 33 458001249 – Fax: 00 33 458001252
Email: info@resolutionspectra.com

The warranty is rendered null and void if the purchaser attempts to service or repair the product (other than performing the routine maintenance described in the User Manual), or if servicing is performed by an individual not authorized by RESOLUTION Spectra Systems.

Spectra Resolver provides an after sale service options storing all the product parameters in order to allow a better analysis of the problem. Open the menu "Option/Product Support" and follow the instructions.



1. Choose directory
2. Click on Process
3. Close window

At the end of the procedure, a file is created: 201601081617_sr_diagnosis_0000.srr

Please note, for any technical support or RMA, thank you to send this file with an explanation of the defect.

10 STANDARD COMPLIANCE

The instrument has been tested using the following equipment:

- 24V (2 A) power supply delivered with LW-10
- An Ethernet cable Cat6

CE compliance

The instrument complies with the requirements of EMC (European) directive 2004/108/EC (EN 50081-2, EN 61000-6-2).

FCC compliance

The instrument complies with Part 15 of the FCC rules, which states that its operation is subject to the two following conditions:

- The device must not cause harmful interference
- The device must accept any interference received, including interference that may cause undesired operation

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

RoHs compliance

The instrument complies with the requirement of RoHs directive 2002/95/EC.

Environmental considerations

In the European Union, this label indicates that this product should not be disposed of with household waste. It should be deposited at an appropriate facility to enable recovery and recycling.

11 MECHANICAL DRAWINGS

All dimensions are in mm.