HighFinesse
Laser and Electronic Systems

Ångstrom

# Spectrum Analyzer

Compact and robust spectrometers with fully customizable range and resolution parameters, able to measure pulsed and continous lasers.

One of the most common usages of our LSA and HDSA devices is monitoring the line-shape of lasers during their optical adjusting. With their unmatched measurement speed, our devices are uniquely suited for this task. In the same way, these devices can also be used in production certification of laser linewidths and shapes.

The echelle grating based HighFinesse/Ångstrom High Definition Spectrum Analyzer offers unrivaled capability for simultaneously measuring large wave-length ranges with an unmatched measurement speed. Nowhere else can you find a device that records its whole spectral range up to 60 times a second.

Utilizing the principle of non-moving parts just like the well known HighFinesse WS-series wavemeters, the HDSA offers the time-tested robustness and ability to measure both pulsed and cw lasers! Most importantly, a multitude of possibilities are open for tailoring the resolving power and spectral bandwidth of the device according to our customers' needs.

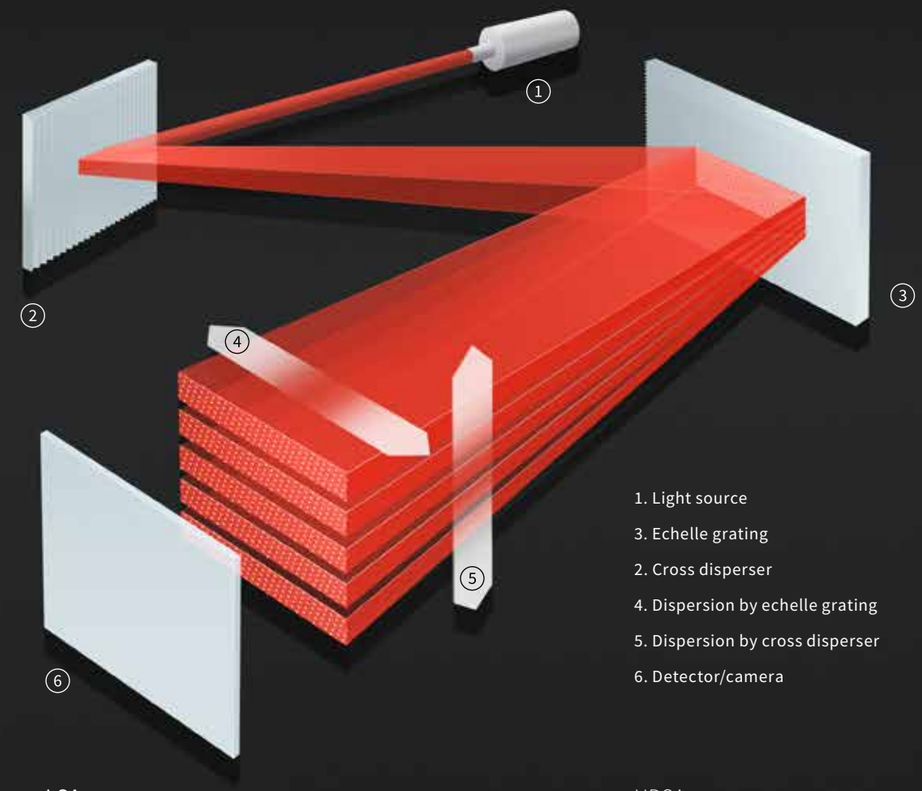
Our spectrum analyzers are connected to the PC by either a USB or an Ethernet cable. After a simple software installation the device is ready for use. All optical and electronical components of the device are safely packed in a compact, thermally insulating housing.

Attention to detail!




The design of our spectrum analyzers is based on different combinations and configurations of low order and echelle diffraction gratings. The spectra are read out by CCD arrays, resulting in exceptionally high measurement speeds.

Since these devices incorporate no moving parts,  you can expect the usual high accuracy and stability of our devices, as well as the capability to measure pulsed lasers in addition to CW.




1. Light source
3. Echelle grating
2. Cross disperser
4. Dispersion by echelle grating
5. Dispersion by cross disperser
6. Detector/camera

LSA:

The LSA utilizes an echelle grating and  a low order grating in two separate beam paths. The echelle grating provides the LSA with high resolving power, enabling high accuracy measurements. The first order grating makes it possible to overcome the wavelength indeterminancy of the echelle grating.

The auto-calibration function of the LSA ensures that you never have to worry about routine maintenance.

HDSA:

Using gratings in a cross-dispersion configuration means that you do not have to sacrifice the measurement range for accuracy. The HDSA delivers high accuracy and resolution for its whole range at once. Combined with measurement rates of up to 60 Hz in some ranges, this instrument can easi-ly satisfy most spectroscopic needs.

## LSA

| Technical Data | | Unit | LSA |
|---|---|---|---|
| Measurement Range | Standard (330 – 1180 nm) | | ■ |
| | UV-I (248 – 1180 nm) | | ■ |
| | UV-II (192 – 800 nm) | | ■ |
| | UV-II-VIS (192 – 1180 nm) | | ■ |
| | VIS / IR (330 – 1750 nm) | | ■ |
| | IR-I (630 – 1750 nm) | | ■ |
| | IR-II (1000 – 2250 nm) | | ■ |
| | IR-III (1400 – 11000 nm) | | ■ [1] |
| Absolute Accuracy [2] | 192 – 330 nm [3] | pm | 6 |
| | 330 – 420 nm | pm | 3 |
| | 420 – 1100 nm | GHz | 6 |
| | IR-I | | 12 |
| | IR-II | | 25 |
| | IR-III | nm | 1 – 5 [1] |
| Quick Coupling Accuracy (with multi mode fiber) | | GHz | 20 [4] |
| Wavelength Deviation Sensitivity/ Measurement Resolution | 192 – 330 nm [3] | pm | 5 |
| | 330 – 420 nm | pm | 2 |
| | 420 – 1100 nm | GHz | 3 |
| | IR-I | | 6 |
| | IR-II | | 12 |
| | IR-III | nm | 1 |
| Resolving Power (λ/Δλ) [5] | Standard / UV | Singlemode \| Multimode fiber | 20000 \| 10000 |
| | IR-I | | 4000 \| 2000 |
| | IR-II | | 2800 \| 2000 |
| | IR-III | | 15 – 30 nm [1] |
| Linewidth Measurement Accuracy [6] | Standard / UV | GHz | 7 |
| | IR-I | | 40 |
| | IR-II | | 60 |
| | IR-III | | 15 % (≥ 200 GHz) |
| Maximal Linewidth | | THz | 1.5 |
| Measurement Speed [7] | Data Acquisition | Hz | 500 |
| | Wavelength Calculation | | 60 |
| | Spectrum Calculation | | 15 |
| Required Input Energy and Power [8] | Standard | µJ (or µW) | 0.0001 – 0.04 |
| | UV-I, UV-II | | 0.0001 – 0.1 |
| | IR-I, IR-II | | 0.02 – 2 |
| | IR-III | mW | 1 [1] |
| Diffraction Grating | FSR | THz | ~5.4 |
| Coupling Fiber Diameter | | | 50 µm or single mode fiber set |
| Calibration | | | Built-in calibration [9] |
| Calibration Period | | | ≤ 1 month |
| Warm-up Time | | | No warm-up time under constant ambient conditions. Otherwise until thermal and air pressure equilibrium is reached |
| Dimensions L × W × H | | mm | 325 × 180 × 77 |
| Weight | | kg | 2.8 |
| Interface | | | High-speed USB 2.0 connection |
| Power Supply | | | Power consumption < 2.3 W, supply directly via USB cable; IR-II & IR-III: external power supply included |

1) For further information on IR-III devices see upper table on following page 2) According to 3σ criterion 3) With multi mode fiber
4) Only for standard range 5) Spectral resolution Δλ = λ / R; R = resolving power. According to Rayleigh criterion. 6) But not better than 5% of the linewidth
7) Depending on PC hardware and settings. Without autocalibration usage

## LSA IR-III

| Technical Data | | Unit | LSA IR-III TYPE 2 – 3 | LSA IR-III TYPE 2 – 6 | LSA IR-III TYPE 2 – 11 |
|---|---|---|---|---|---|
| Measurement Range | | nm | 1400 – 3000 | 1400 – 6000 | 1400 – 11000 |
| Absolute Accuracy [2] | | nm | 1 | 2 | 5 |
| Relative Accuracy | | | $1.25 \times 10^{-4}$ | $3 \times 10^{-4}$ | $5 \times 10^{-4}$ |
| Wavelength Deviation Sensitivity/Measurement Resolution | | | $0.7 \times 10^{-4}$ | $1.5 \times 10^{-4}$ | $2.5 \times 10^{-4}$ |
| Resolving Power (λ/Δλ) [5] | | nm | 15 | 20 | 30 |
| Linewidth Measurement Accuracy [6] | | | 15% | | |
| Maximal Linewidth | | THz | 1 (up to 15) | | |
| Measurement Speed [7] | Data Acquisition | Hz | 100 | | |
| | Wavelength Calculation | | 100 | | |
| | Spectrum Calculation | | 15 | | |
| Required Input Energy and Power [8] | Pulsed | µJ | 10 | | |
| | cw | mW | 0.2 | | |
| Diffraction Grating | FSR | THz | ~ 2.7 | | |
| Coupling Fiber | | | PIR-550/600 or CIR-550/600 | | |
| Calibration | | | SLR-1532 or 3.39 µm HeNe calibration laser (not included) | | |
| Calibration Period | | | ≤ 15 days | | |
| Warm-up Time | | | No warm-up time under constant ambient conditions. Otherwise until thermal and air pressure equilibrium is reached | | |
| Dimensions L x W x H | | mm | 325 × 180 × 77 | | |
| Weight | | kg | 3.0 | | |
| Interface | | | High-speed USB 2.0 connection | | |
| Power Supply | | | External power supply included | | |

## HDSA

NEW

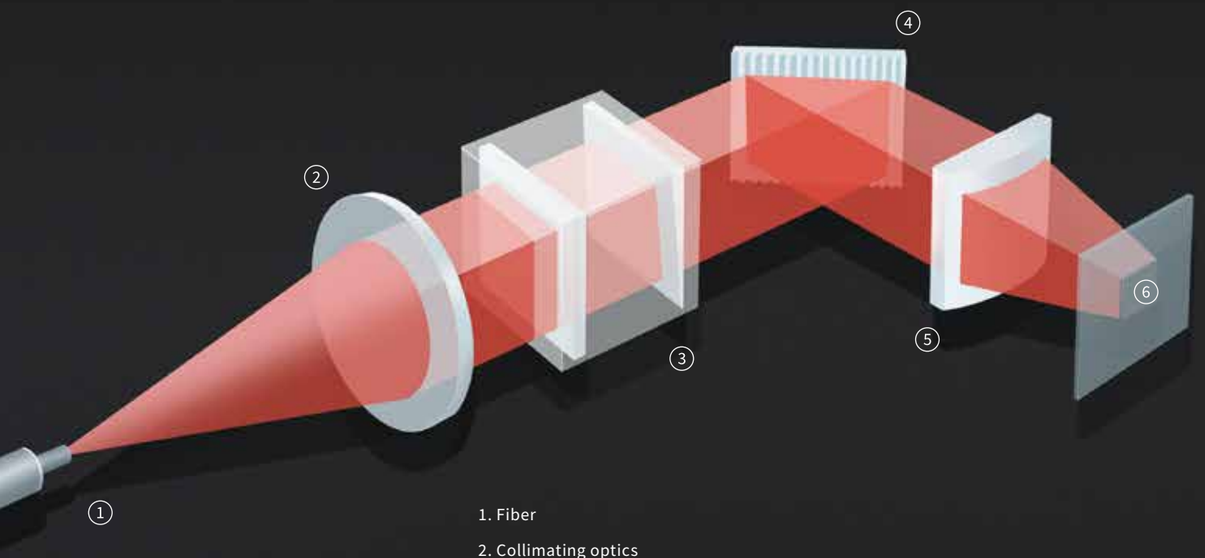
| Technical Data | | Unit | HDSA UV-II | HDSA UV-I | HDSA Standard | HDSA IR-I | HDSA Telecom [11] | HRSA |
|---|---|---|---|---|---|---|---|---|
| Measurement Range | | nm | 192 – 400 | 330 – 800 | 350 – 1050 | 940 –1740 | 1500 – 1600 | Customize as you wish |
| Absolute Accuracy [2] | | GHz | 20 | 5 | 5 | 20 | 3 | |
| Wavelength Deviation Sensitivity/ Measurement Resolution | | GHz | 5 | 1 | 2 | 2 | 0.6 | |
| Resolving Power (λ/Δλ) [5] | | | 10000 @ 325 nm | 10000 @ 325 nm | 30000 @ 633 nm | 5000 @ 1500 nm | 20000 @ 1500 nm | |
| Measure-ment Speed [7] | Data Acquisition | Hz | 1 | 16 | 7.5 | 60 | 60 | |
| | Wavelength Calculation | | ? | ? | ? | ? | ? | |
| | Spectrum Calculation | | 1 | 16 | 7.5 | 50 | 60 | |
| Required Input Energy and Power [8] | | nJ | 0.05 @ 325 nm | 0.05 @ 325 nm | 0.01 @ 633 nm | 50 @ 1500 nm | 100 @ 1500 nm | |
| Calibration | | | External calibration source (included in delivery) | | | | | |
| Calibration Period | | | ≤ 7 days | | | | | |
| Warm-up Time | | | No warm-up time under constant ambient conditions. Otherwise until thermal and air pressure equilibrium is reached | | | | | |
| Dimensions L × W × H | | mm | 360 × 210 × 120 | | | | | |
| Weight | | kg | ~4.5 | | | | | |
| Interface | | | 1000BASE-T Gigabit Ethernet | | USB 3 | USB 2.0 | | |
| Power supply | | | External power supply included; Power consumption: 5 W | | Directly via USB-cable | | | |

8) The cw power interpretation in [µW] compares to an exposure of 1s (generally the energy needs to be divided by the exposure time to obtain the required power)
9) IR-III: external calibration sources required, e.g. SLR-1532 10) Broad line versions. For further information please contact: info@highfinesse.com
11) Various modifications available: other spectral range, resolution, accuracy and measurement speed. Please contact us for further details!

Spectrum measurement solutions for all wavelength ranges

New Product
HRSA

Our new HRSA offers even greater resolution than our previous devices. We achieve this improvement by combining the Fizeau interferometer technology with the grating-based configuration of the LSA. The result is a device with an unprecedented spectral resolution.

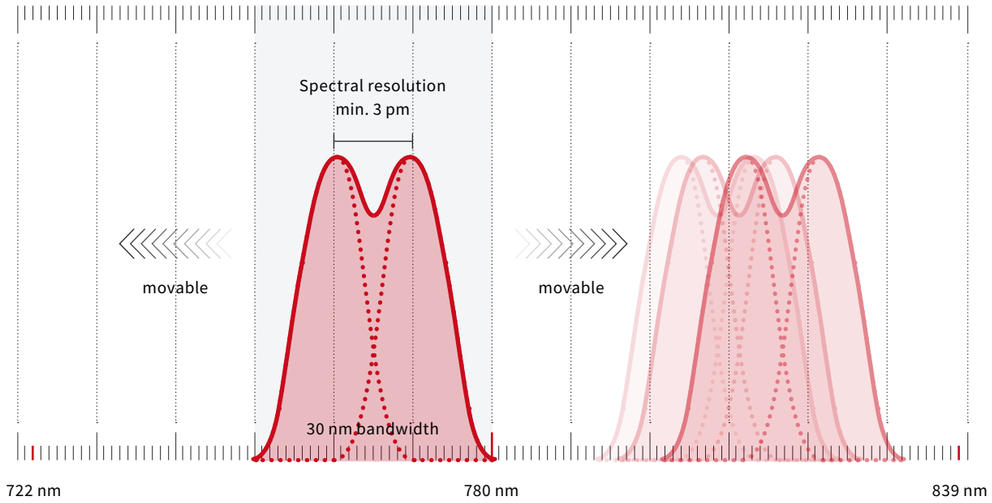



1. Fiber
2. Collimating optics
3. Fizeau interferometer
4. Echelle grating
5. Imaging optics
6. 2D detector


## Measurement range

The basic version of the HRSA has a 15 % measurement range around the design wavelength. This design wavelength is freely chosen by the customer to suit their specific needs. By limiting the spectral bandwidth, the resolving power can be expanded to the hundred thousands or in extreme cases up to 2,000,000. The maximum measurement range remains at 15% around central wavelength.

## An explanation of the spectral bandwidth




At any time, the measured signal has to be not wider than 30 nm, but this 30 nm window can be freely selected for each measurement shot inside the 15% measurement range (117 nm if centered around 780 nm).

## A few examples of the variable window sizes and the reachable resolutions

A large number of different custom configurations can be worked out, allowing each device to be hand-tailored to the customers' needs. The examples provided on this page are just a few of the many possibilities. Do not hesitate to contact us for your own unique spectrometer!

| Center Wavelength | Bandwidth | Resolving Power | Maximum Spectral Width |
|---|---|---|---|
| 530 nm | 80 nm | More than 2,000,000 | 94.5 pm |
| 630 nm | 90 nm | 250,000 | 30 nm |
| 1000 nm | 100 nm | 410,000 | 20 nm |
| 1550 nm | 100 nm | 35,000 | 100 nm |

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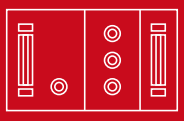
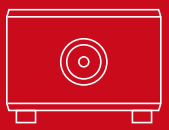
## Wavelength Meter

HighFinesse/Ångstrom offers sensitive and compact wavelength meters with a large spectral range for high speed measurement of lasers. The optical unit consists of temperature-controlled Fizeau-based interferometers that are read out by photodiode arrays. The high absolute accuracy is achieved by use of solid state, non-moving optics. The optical unit and associated electronics are housed in a compact, thermal casing. The connection to a computer or notebook is realized via a highspeed USB 2.0 port, which allows a high data read-out rate. The analyzing software displays all the interferometer information.



## Precision Current Sources

HighFinesse Precision Current Sources have been developed for experiments and quantum technologies in the areas of cold-atom and solid state physics. The linearly regulated BCS (Bipolar Current Source) and UCS (Unipolar Current Source) series deliver highly stable, low noise source currents for high precision magnetic field control. The current output is floating or is on a used defined potential. Ultrafast response to control signals and trigger functions, clear grounding, connection and signal isolation schemes make the integration of the current sources into complex experimental systems easy.



## Linewidth Analyzer

HighFinesse Linewidth Analyzers (LWA) are specialized high-end devices for measuring and analyzing the spectral shape of various laser sources. Through the use of two measurement modes, the LWA can analyze both very narrow laser lines down to 100kHz as well as broader spectra up to 1GHz. They feature an extremely high resolution and accuracy in determining the linewidth of the respective laser source and its spectral lineshape. The LWAs are ideal for optimizing the stability of laser setups.

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