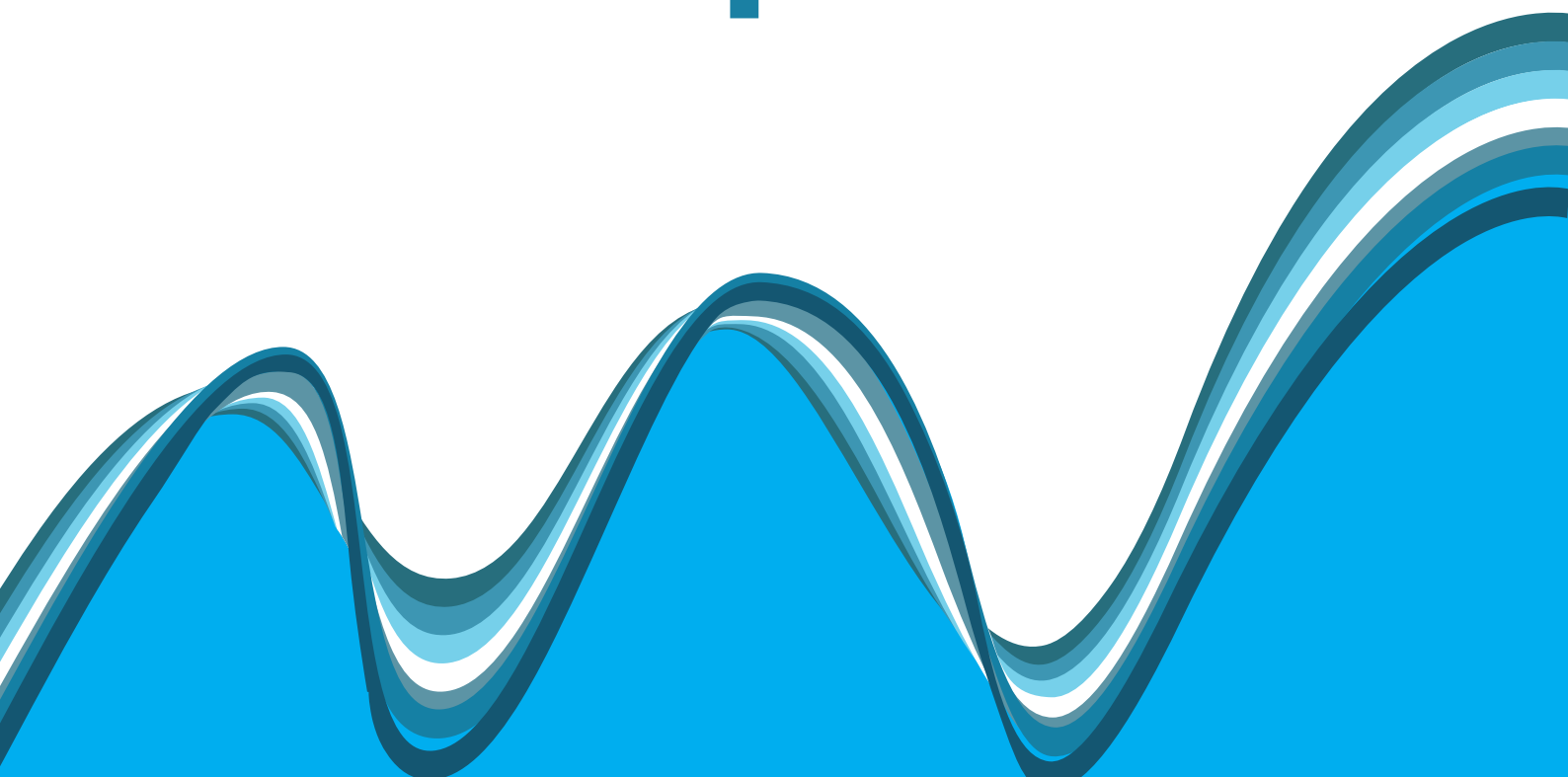


Making Spectroscopy Brighter

sarspec



SPEC STD
SPEC RES+
SPEC SENSE+
SPEC SPEED+
USER CONFIGURED

SPECTROMETERS
www.sarspec.com

Spectrometers

Flexibility, Resolution, Sensitivity and Speed

Sarspec's spectrometers are designed and optimized for UV/Vis/NIR applications, offering solutions for general purpose spectroscopy with the SPEC STD, high optical resolution (up to 0.2 nm) measurements with the SPEC RES+, low light level measurements with the highly sensitive SPEC SENSE+ and fast acquisition rate (up to 2857 spectra/sec) with the SPEC SPEED+.

One Spectrometer, Multi Applications

SPEC spectrometers are not just light detectors, with it it's possible to obtain light intensity vs. wavelength or even better light intensity vs. wavelength vs. time. Some examples of applications where Sarspec's spectrometers are used: R&D in chemistry, physics, biology, pharmaceutical and mechanical engineering areas, parameters control in industries (such as food and biodiesel), color measurement, light sources characterization, in-line applications in chemical industry, etc.

The flexibility of the SPEC range spectrometers allows to perform multiple applications with a single instrument and with a universal SMA905 connector using optical fibers to direct and collect light from basically everywhere without complex optical systems or significant attenuation. Also available in all models are trigger In/Out for synchronization with other devices like light sources or signal generators and in some models power supply and data transfer are made by a single USB 2.0 connection.

Configurable Spectrometers

All SPEC series spectrometers come as Standard configurations, with listed specifications, for different wavelength ranges/ resolution/application or can be user configured. For the user configured spectrometers almost every component can be chosen to perfect match the user's application. Support from Sarspec's specialists is always available for the best configuration/ performance.

Free software with every spectrometer

Every spectrometer is supplied with the powerful LightScan or LightScan+ software, including full modules for parameters control, data acquisition and processing.

Full Range of Accessories

Combine SPEC series with Sarspec's range of Light Sources, Optical Fibers, Probes and Accessories and get the right solution for your application.

✓ **Flexible**

✓ **Affordable**

✓ **Fast**

✓ **Robust**

✓ **Portable**

✓ **Small**



**BEST
PRICE**

**FLEXIBLE
SPECTROSCOPY**

SPEC STD SPECTROMETER

- **Detection from 180-1100 nm**
- **2048 pixels linear array CCD detector**
- **Minimum integration time of 2 ms**
- **Triggering functions for synchronization (trigger in/out and delay)**
- **Portable, fast and small size**
- **High speed mini USB 2.0 for power and control**
- **Software LightScan included**
- **Also available as an OEM instrument**
- **SMA 905 fiber connector, no optical alignment required**
- **Robust: fully built in aluminium**
- **LED backlight indicator**

Flexible and Affordable

Sarspec's SPEC STD range are affordable modular spectrometers using a Sony 2048 pixels linear array CCD detector with great flexibility that can be used in Absorbance, Transmittance, Reflectance, Irradiance, Color and Fluorescence measurements. With usable range from 180 to 1100 nm, the SPEC STD can be purchased as a standard configuration, pre-configured for different wavelength ranges/application, or can be user configured for the best performance in each application.

Advanced Electronics and Easy-to-use Software

SPEC STD offers advanced 16 bits electronics, is controlled and powered by USB 2.0 interface, with flexible trigger functions for synchronization with external devices, fast time acquisition - with minimum integration time of 2 ms. It allows gain and dark level control and also backlight LED to be turned ON or OFF. Sarspec is also able to supply drivers that allow customers to integrate the instrument on a specific experiment or in-line quality control. The powerful LightScan Software is included with all SPEC instruments.

Great UV sensitivity

For all UV configurations the CCD is provided with a specialized coating that extends the detector usable range down to 180 nm and increases greatly the sensitivity within the UV range.

Enhanced Sensitivity

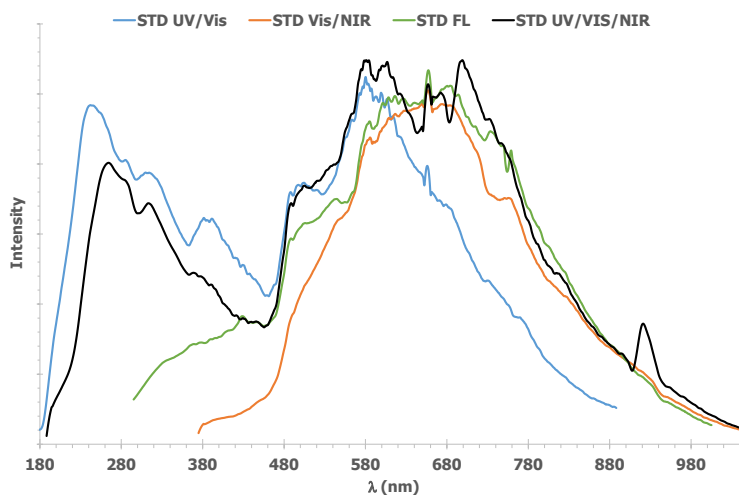
As an option to all standard configurations it can be added a Sarspec's design collecting lens that increase the sensitivity up to 6 times in full wavelength range, depending on the used optical fiber.

In-line integration

With a more accurate quality control, industry can make better products and using this principle, the flexibility and high quality of the SPEC STD range allow easy in-line integration through optical fibers probes and customizable software to every customer needs.

Small, Robust, Portable and it looks great!

Spec STD spectrometers are small and robust, totally built in aluminium and with no moving parts, combined with its USB power, makes this spectrometer ideal to take anywhere. With a LED backlight indicator that lights the Sarspec logo when the power is ON and a slick design it looks great on any laboratory!



Continuous spectra for all the four standard configurations from SPEC STD range spectrometers, obtained with Sarspec's LS-DW Deuterium Tungsten light source.

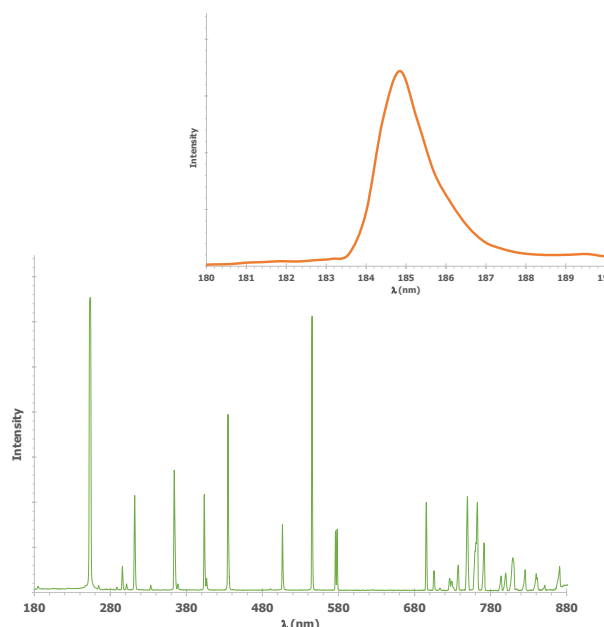
SPEC STD UV/Vis

- **Wavelength range: 180-880 nm**
- **Superior UV sensitivity**
- **Optical Resolution: 1.4 nm**
- **600 grooves/mm grating blazed at 300 nm**
- **Order sorting filters included**
- **Optional Enhanced Sensitivity version**

This standard configuration includes a 2048 pixels Sony CCD array detector, 25 μm slit which offers excellent compromise between resolution and sensitivity and 600 grooves/mm grating blazed at 300 nm. The SPEC STD UV/Vis is a flexible, multi application, spectrometer for users that need to measure in the ultraviolet and visible regions. It's suitable for a wide range of measurement techniques, including Absorbance, Transmittance, Reflectance and Irradiance.

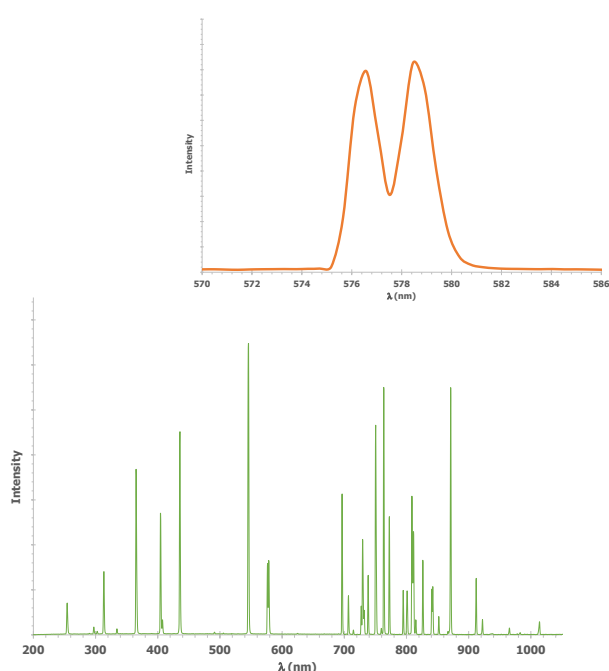
All STD UV spectrometers have the CCD coated for high UV sensitivity that extend UV range down to 180 nm (in the spectrum on the right is clearly visible the 184.95 nm line of Mercury).

We strongly recommend the Enhanced Sensitivity option for reflection measurements when the sample has low reflectivity, in irradiance measurements of low power emission sources and applications where high UV sensitivity is required.



SPEC STD UV/Vis/NIR

- **Wavelength range: 200-1050 nm**
- **Superior UV sensitivity**
- **Optical Resolution: 1.7 nm**
- **500 grooves/mm grating blazed at 300 nm**
- **Order sorting filters included**
- **Flexible/Affordable full range spectrometer**



The SPEC STD UV/Vis/NIR is a wide range spectrometer configured with a 500 grooves/mm grating blazed at 300 nm for great performance in the full range. Includes also a 2048 pixels Sony CCD array detector and 25 μm slit.

Built specially for multi-application users, this model is a great solution for educational purposes and research on institutions with multi-users and multi-applications that need a robust instrument for fast sample screening. It's suitable for a wide range of measurement techniques, including Absorbance, Transmittance, Reflectance, Irradiance, Color Measurement and many more. As standard, the SPEC STD UV/Vis/NIR has increased UV sensitivity due to the applied coating and as option we can add collecting lens for the Enhanced Sensitivity model.

The spectrum on the left shows multi-lines of a Mercury/Argon light source ranging from UV to NIR, and inserted a well resolved spectrum of the doublet 576.960 and 579.066nm.

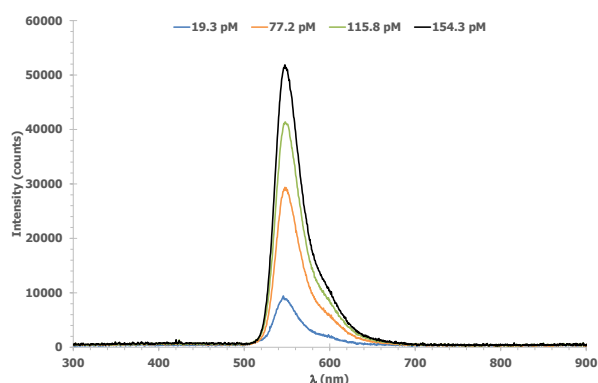
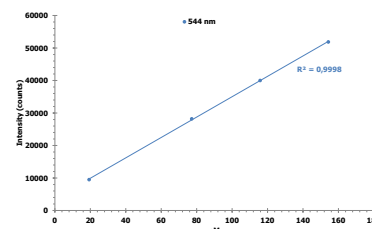
SPEC STD FL

- Designed for Fluorescence measurements
- Wavelength range: 300-1000 nm
- 200 μm slit and collecting lens for maximum sensitivity
- 600 grooves/mm grating blazed at 500 nm
- Order sorting filters included
- Gain control up to 500 levels

The SPEC STD FL spectrometer was specially designed to be an affordable option for fluorescence measurements, including a 200 μm slit and collecting lens as standard for maximum sensitivity. The detector is a Sony CCD with 2048 pixels and 200 μm pixel height.

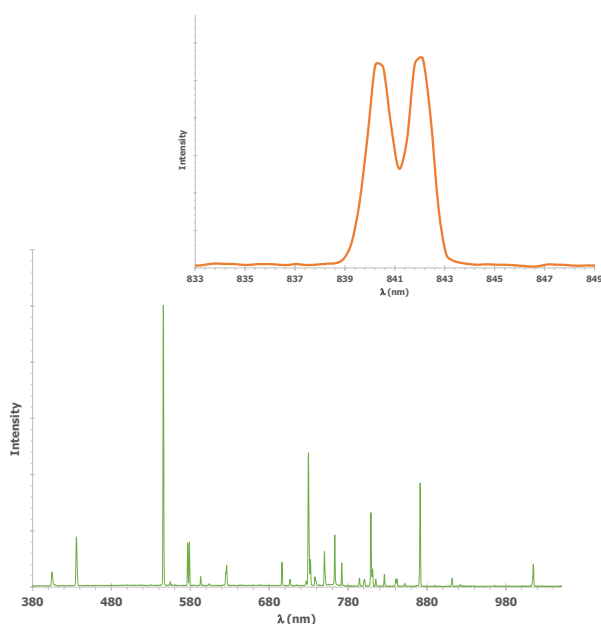
The SPEC STD FL offers great sensitivity allowing detection of 19.3 pM of Eosin Y when configured with our LED Light Source with LED-495, the multipurpose cuvette holder and 1000 μm optical fiber.

It is also suitable for reflectance measurements of low reflection samples and its a flexible solution for users that have emitting sources with very low intensity. These spectrometers due to it's performance and price is ideal for educational purposes in Chemistry, Biology, and Pharmaceutical areas.



SPEC STD Vis/NIR

- Wavelength range: 380-1050 nm
- Optical Resolution: 1.4 nm
- Superior NIR sensitivity
- 600 grooves/mm grating blazed at 750 nm
- Order sorting filters included
- Optimal enhanced sensitivity version



Ranging from 380 to 1050 nm the SPEC STD Vis/NIR was designed with a 25 μm slit for good resolution and sensitivity, a 600 grooves/mm grating blazed at 750 nm for maximum efficiency on the NIR region and, as all STD spectrometers, includes a Sony 2048 pixels linear CCD array, order sorting filters, SMA connector for optical fibers and a Enhanced Sensitivity version as an option.

The SPEC STD Vis/NIR is suitable for Absorbance, Transmittance, Reflectance, and Irradiance in its detection range.

The spectrum on the left shows multi-lines of a Mercury/Argon light source in the Vis/NIR range, and inserted a well resolved spectrum of the doublet 840.821 and 842.465nm.

SPEC STD Specifications Table

	SPEC STD UV/Vis	SPEC STD UV/Vis/NIR	SPEC STD FL	SPEC STD Vis/NIR
Wavelength Range	180-880 nm	200-1050 nm	300-1000 nm	380-1050 nm
Slit	25 μ m	25 μ m	200 μ m	25 μ m
Grating	600 lines @ 300 nm	500 lines @ 300 nm	600 lines @ 500 nm	600 lines @ 750 nm
Resolution	1.4 nm	1.7 nm	5.4 nm	1.4 nm
Detector	2048 pixels CCD array Sony	2048 pixels CCD array Sony	2048 pixels CCD array Sony	2048 pixels CCD array Sony
Pixel width x height	14 x 200 μ m	14 x 200 μ m	14 x 200 μ m	14 x 200 μ m
Optical design	Symmetrical Czerny-Turner	Symmetrical Czerny-Turner	Symmetrical Czerny-Turner	Symmetrical Czerny-Turner
Order Sorting Filters	Included	Included	Included	Included
Collecting Lens	Optional (ES version)	Optional (ES version)	Included	Optional (ES version)
Focal length	50 mm	50 mm	50 mm	50 mm
Dark Noise (RMS)	37	37	37	37
Dynamic Range	1771	1771	1771	1771
Signal/Noise	350	350	350	350
Linearity	99.99 %	99.99 %	99.99 %	99.99 %
Integration time	2 ms-214 s	2 ms-214 s	2 ms-214 s	2 ms-214 s
QE (%) @ peak	40%	40%	40%	40%
Peak Wavelength	450 nm	450 nm	450 nm	450 nm
Pixel Well Depth	90 000	90 000	90 000	90 000
PRNU	5%	5%	5%	5%
A/D Converter	16 bits	16 bits	16 bits	16 bits
Interface	Mini USB 2.0	Mini USB 2.0	Mini USB 2.0	Mini USB 2.0
Trigger	In/Out	In/Out	In/Out	In/Out
Trigger Delay	In	In	In	In
Fiber Connector	SMA 905	SMA 905	SMA 905	SMA 905
Weight	660 g	660 g	660 g	660 g
Dimensions	116 (L) x 93 (D) x 55 (H)	116 (L) x 93 (D) x 55 (H)	116 (L) x 93 (D) x 55 (H)	116 (L) x 93 (D) x 55 (H)
Part Number	SP-STD-UV-Vis	SP-STD-UV-Vis-NIR	SP-STD-FL	SP-STD-Vis-NIR
Enhanced Sensitivity Option				
Part Number	SP-STD-UV-Vis-ES	SP-STD-UV-Vis-NIR-ES	-	SP-STD-Vis-NIR-ES



**BEST
PRICE**

**GREAT
RESOLUTION**

SPEC RES+

- Detection from 180 to 1100 nm
- 3648 pixels linear array CCD detector
- Great optical resolution of 0.2 nm in a standard configuration
- Triggering functions for synchronization (trigger in/out and delay)
- Portable, fast and small size
- High speed mini USB 2.0 for power and control
- Also available as an OEM instrument
- SMA 905 fiber connector, no optical alignment required
- Robust: fully built in Aluminium
- LED Backlight indicator

The power to Resolve

For users looking for an affordable spectrometer with great resolution, Sarspec offers the SPEC RES+ spectrometers range. With the best resolution/wavelength range ratio for a miniature CCD spectrometer, the SPEC RES+ is the best option for Absorbance and Transmittance measurements as well for high throughput light source characterization. The Standard configurations available include the wide range (200-1050 nm) model SPEC RES+ UV/Vis/NIR and the specific range models SPEC RES+ UV, SPEC RES+ UV/Vis and SPEC RES+ Vis/NIR.

All-in for Resolution

The SPEC RES+ spectrometers have been configured and optimized for high resolution measurements with a 10 μm slit and a 3648 Toshiba CCD array detector. All standard instruments include collecting lens to ensure the best sensitivity and order sorting filters.

This configuration allows for resolutions down to 0.2 nm in the standard configurations and 0.1 nm when user configured using a 3600 lines/mm grating.

Advanced Electronics and Easy-to-use Software

All Sarspec's spectrometers offer 16 bits electronics powered and controlled by mini USB 2.0. Also included are trigger functions (In/Out and delay) for synchronization with external devices. With a minimum integration time of 3 ms, it's possible to perform fast screening with high resolution. This feature is quite relevant in chemical reaction measurements where wavelengths of reagents and products are similar and require high resolving power.

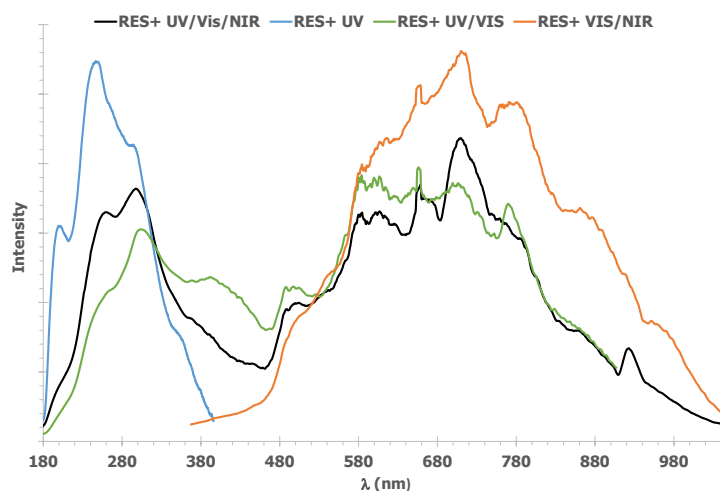
LightScan Software is included with all SPEC instruments and it's really easy to use. It takes just a few seconds to get a result without the need to go through a large number of steps. Its construction allows the user to have for its measurement only the buttons that matters reducing complexity and increasing productivity.

OEM

Sarspec designs their spectrometers from draft and the SPEC RES+ is no exception. The small size, performance and portability makes it perfect for OEM integration.

Small, Robust, Portable and it looks good!

SPEC RES+ spectrometers are small and robust, totally built in aluminum and with no moving parts. Combined with its USB powered makes this spectrometer ideal to take anywhere. With a LED backlight indicator that light the Sarspec logo when power is ON and a slick design it looks good on any laboratory!



Continuous spectra for all the four standard configurations from SPEC RES+ range spectrometers, obtained with Sarspec's LS-DW Deuterium Tungsten light source.

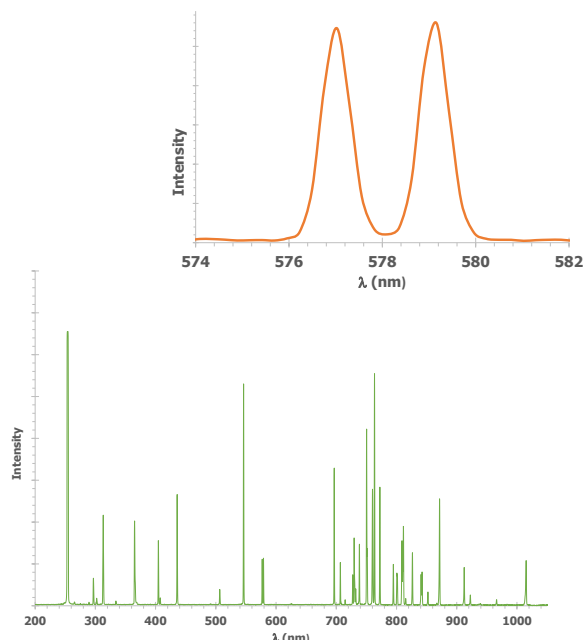
SPEC RES+ UV/Vis/NIR

- **Wavelength range: 200-1050 nm**
- **Optical Resolution: 0.75 nm**
- **3648 pixels Toshiba CCD array detector**
- **500 grooves/mm grating blazed at 300 nm**
- **Portable, Robust and Affordable**
- **LightScan software included**

Configured with a Toshiba CCD array 3648 pixels, 10 μm slit for the best resolution, collecting lens, order sorting filters and SMA 905 fiber optic connector the SPEC RES+ UV/Vis/NIR is the perfect solution for replacing the traditional spectrophotometers with a technology that is more flexible and allows the user to get full spectra with millisecond time resolution.

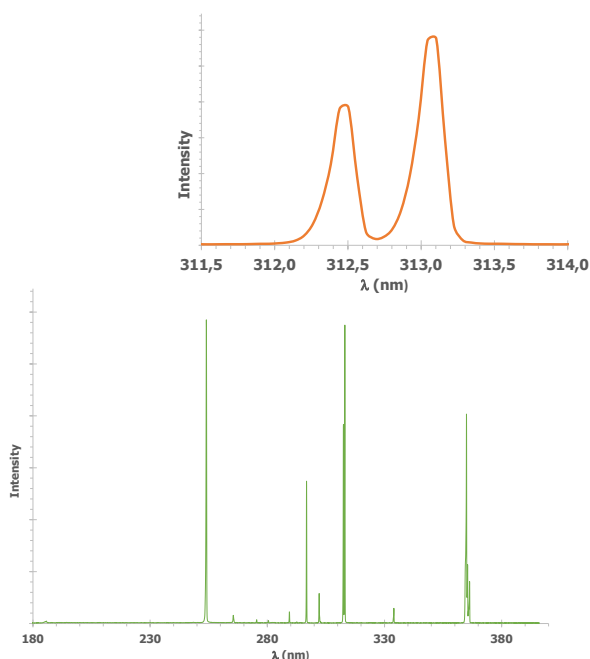
When thinking in time dependent reactions in Chemistry and Biology applications SPEC RES+ UV/Vis/NIR offers the possibility to follow the reaction in real time taking full spectra at an affordable cost with a wavelength range from 200 to 1050 nm.

The spectrum on the right shows multi-lines of a Mercury/Argon light source ranging from UV to NIR, and inserted a well resolved spectrum of the doublet 576.960 and 579.066nm.



SPEC RES+ UV

- **Wavelength range: 180-400 nm**
- **Optical Resolution: 0.2 nm**
- **3648 pixels Toshiba CCD array detector**
- **1800 grooves/mm grating blazed at 250 nm**
- **Best solution for high resolution UV**
- **LightScan software included**



For UV enthusiasts that need really good resolution in that range the SPEC RES+ UV is the perfect choice. Covering the entire UV range with an optical resolution of 0.2 nm. It's configuration complies a 10 μm slit, a 1800 grooves/mm grating blazed at 250 nm, collecting lens, SMA 905 connector and a Toshiba 3648 pixels CCD array.

This configuration is suitable for high resolution Absorbance where in the Chemistry field it's possible to test aromatic compounds and solvents. In Biology and Medical areas the purity and type of a nucleic acid is determined by the ratio of Absorbance values, read at 260 and 280 nm. Combine it with a Flow Cell FCASS or FCAPE and a Light Source LS-DW or LS-DWHP to use it as an HPLC detector.

The SPEC RES+ UV spectrometers have the CCD coated for high UV sensitivity and extended UV range down to 180 nm.

The spectrum on the left shows the full spectra using a Mercury lamp with special focus on two very close lines: 312.57 and 313.15 nm.

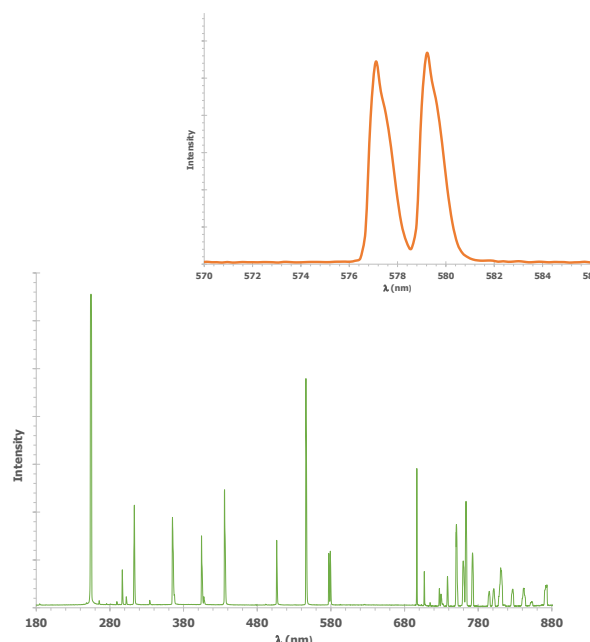
SPEC RES+ UV/Vis

- **Wavelength range: 180-880 nm**
- **Optical Resolution: 0.6 nm**
- **3648 pixels Toshiba CCD array detector**
- **600 grooves/mm grating blazed at 300 nm**
- **Great solution for Absorbance measurements**
- **Software LightScan included**

This model is configured with a 600 grooves/mm grating blazed at 300 nm, 10 μm slit, Collecting lens, SMA 905 Optical fiber connector and a Toshiba CCD array detector with 3648 pixels.

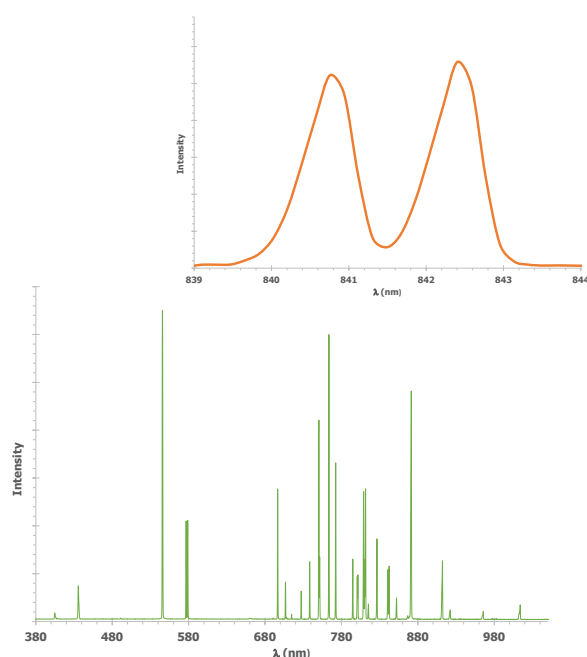
The wavelength range (180-880nm) from this configuration covers the majority of applications in Absorbance / Transmittance measurements, granting great resolution over the entire range. When used as a Diode Array HPLC detector supplies the best results with maximum acquisition speed.

The great resolution can be observed in the inserted spectrum on the right where the separation between peaks 576.960 and 579.066 nm from a Mercury Argon light source is perfectly achieved.



SPEC RES+ Vis/NIR

- **Wavelength range: 380-1050 nm**
- **Optical Resolution: 0.6 nm**
- **3648 pixels Toshiba CCD array detector**
- **600 grooves/mm grating blazed at 750 nm**
- **Order sorting filter included**
- **LightScan software included**



Covering the entire visible range and most of NIR range with high resolution, the SPEC RES+ Vis/NIR is configured with a 600 grooves/mm blazed at 750 nm grating, 10 μm slit, Toshiba 3648 pixels CCD array, collecting lens, order sorting filter and SMA 905 optical fiber connector.

There are a wide range of applications on Spectroscopy using visible and NIR light where we can mention transition metals due to their ability to complex with organic and inorganic molecules which absorb in the visible region and can be qualified and quantified by this technique, and in the analytical third overtone region (700-1050 nm) where are normally found absorbance bands related to ROH, H₂O, CH₂, CH₃, ArCH, ArOH, RNH₂.

The measurement techniques applied to this instrument are high resolution Absorbance, Transmission, Irradiance, Reflectance and color measurement. The application areas are Chemistry, Physics, Biology, Materials, etc.

The inserted spectrum on the left shows the Argon doublet 840.821 and 842.465 nm completely resolved.

SPEC RES+ Specifications Table

	SPEC RES+ UV/Vis/NIR	SPEC RES+ UV	SPEC RES+ UV/Vis	SPEC RES+ Vis/NIR
Wavelength Range	200-1050 nm	180-400 nm	180-880 nm	380-1050 nm
Slit	10 μm	10 μm	10 μm	10 μm
Grating	500 lines @ 300 nm	1800 lines @ 250 nm	600 lines @ 300 nm	600 lines @ 750 nm
Resolution	0.75 nm	0.2 nm	0.6 nm	0.6 nm
Detector	3648 pixels CCD array Toshiba	3648 pixels CCD array Toshiba	3648 pixels CCD array Toshiba	3648 pixels CCD array Toshiba
Pixel width x height	8 x 200 μm	8 x 200 μm	8 x 200 μm	8 x 200 μm
Optical design	Symmetrical Czerny-Turner	Symmetrical Czerny-Turner	Symmetrical Czerny-Turner	Symmetrical Czerny-Turner
Order Sorting Filters	Included	-	Included	Included
LongPass Filters	-	-	-	-
Collecting Lens	Included	Included	Included	Included
Focal length	50 mm	50 mm	50 mm	50 mm
Dark Noise (RMS)	32	32	32	32
Dynamic Range	2048	2048	2048	2048
Signal/Noise	350	350	350	350
Linearity	99.94 %	99.94 %	99.94 %	99.94 %
Integration time	3 ms - 214 s	3 ms - 214 s	3 ms - 214 s	3 ms - 214 s
QE (%) @ peak	40%	40%	40%	40%
Peak Wavelength	550 nm	550 nm	550 nm	550 nm
Pixel Well Depth	120 000	120 000	120 000	120 000
PRNU	5%	5%	5%	5%
A/D Converter	16 bits	16 bits	16 bits	16 bits
Interface	Mini USB 2.0	Mini USB 2.0	Mini USB 2.0	Mini USB 2.0
Trigger	In/Out	In/Out	In/Out	In/Out
Trigger Delay	In	In	In	In
Weight	660 g	660 g	660 g	660 g
Dimensions	116 (L) x 93 (D) x 55 (H)	116 (L) x 93 (D) x 55 (H)	116 (L) x 93 (D) x 55 (H)	116 (L) x 93 (D) x 55 (H)
Part Number	SP-RES-UV-Vis-NIR	SP-RES-UV	SP-RES-UV-Vis	SP-RES-Vis-NIR



ULTIMATE
SENSITIVITY

SPEC SENSE+

- Largest sensitive area, using 1000 μm height pixels
- Back thinned CCD array detector with 2048 pixels
- Detection from 200-1100 nm
- Great sensitivity and quantum efficiency up to 78%
- Great performance in the UV
- Triggering functions for easy integration and synchronization
- SMA 905 fiber connector, no optical alignment required
- High speed mini USB for full control of the spectrometer
- Software LightScan Included
- Fully built in aluminium with LED backlight indicator

Ultimate sensitivity

Sarspec's SPEC SENSE+ is a spectrometer specially built for low light level measurements such as Fluorescence and Raman but it is also flexible and can be used in Absorbance, Transmittance, Irradiance and Reflectance measurements. The back thinned 2048 pixels CCD array detector from Hamamatsu has large detection area combined with high Quantum Efficiency up to 78% for ultimate sensitivity. Using Sarspec's design collecting lens improves the sensitivity of the spectrometer up to 3 times, depending on the optical fiber.

FEMTOMOLAR detection limits in Fluorescence

Fluorescence is an application that normally requires high sensitivity, using the SPEC Sense+ with 495nm LED excitation (using the LS-LED light source) and the multipurpose cuvette holder we were able to measure, with high linearity, Eosin Y in the femtomolar range.

Advanced Electronics

With 16 bits electronics, the SPEC SENSE+ high sensitivity spectrometer is fully controlled by mini USB 2.0 interface, flexible trigger functions with external trigger input and pulse output for synchronization with external devices, minimum integration time of 1ms allowing fast acquisition rates and gain level control for sensitivity optimization.

Easy-to-use Software

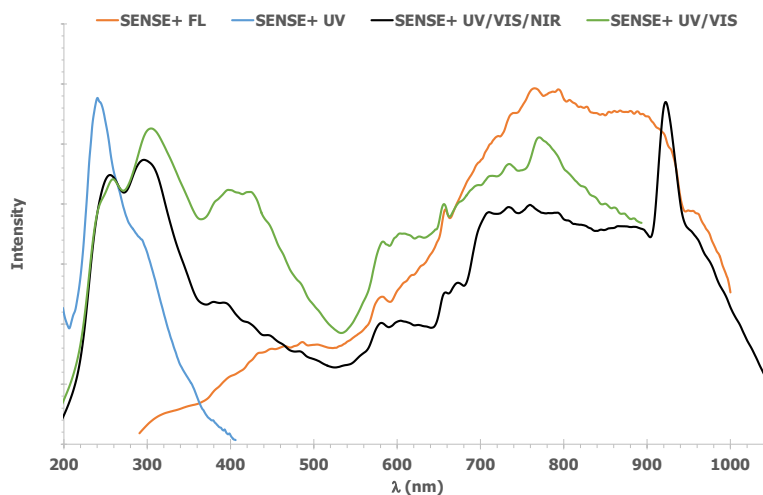
LightScan Software is included with all SPEC instruments and it's really easy to use. It takes just a few seconds to get results without the need to go through a large number of steps. Designed to allow users having for it's measurements only the buttons that matters reducing complexity and increasing productivity.

Back Thinned Technology

The back thinned technology used provides a significant improve in the sensitivity by thinning the active region to a few micron, typically 10-20 μm , and collecting photons from backside, avoiding the absorption of those photons by the polysilicon gates.

Small, Robust, Reliable and it looks good!

At Sarspec we develop spectrometers for the best performance and robustness, this is why the SPEC SENSE+ is totally built in aluminium and with no moving parts, but we also want it to look good in your laboratory so we built a slick design with a LED backlight indicator that lights the Sarspec logo when ON.



Continuous spectra for all the four standard configurations from SPEC SENSE+ range spectrometers, obtained with Sarspec's LS-DW Deuterium Tungsten light source

SPEC SENSE+ UV/Vis

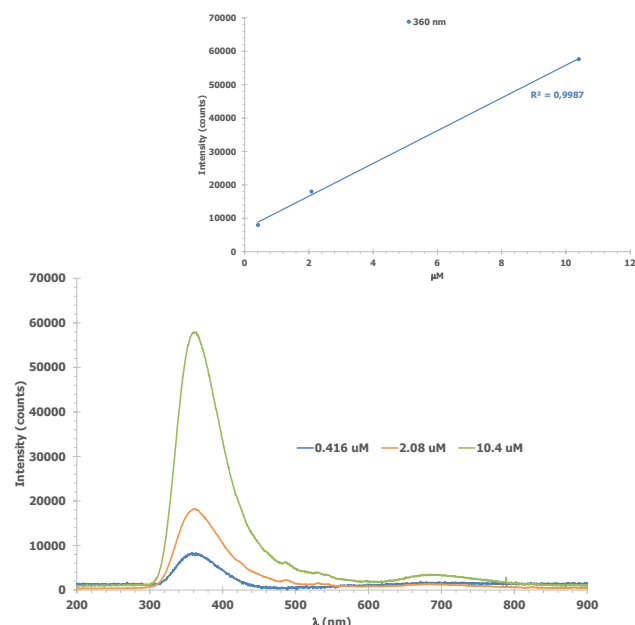
- Wavelength range: 200-880 nm
- Quantum Efficiency of 78% at 600 nm
- Back thinned 2048 pixels CCD array detector
- 600 grooves/mm grating blazed at 300 nm
- Collecting Lens included
- Software LightScan included

The SPEC SENSE+ UV/Vis is configured with a 600 grooves/mm grating blazed at 300 nm, 200 μm slit and collecting lens allowing high sensitivity measurements in a wavelength range of 200-880 nm.

This flexible and highly sensitive spectrometer is ideal for low light emitting sources, but also for fluorescence and chemiluminescence of biological samples.

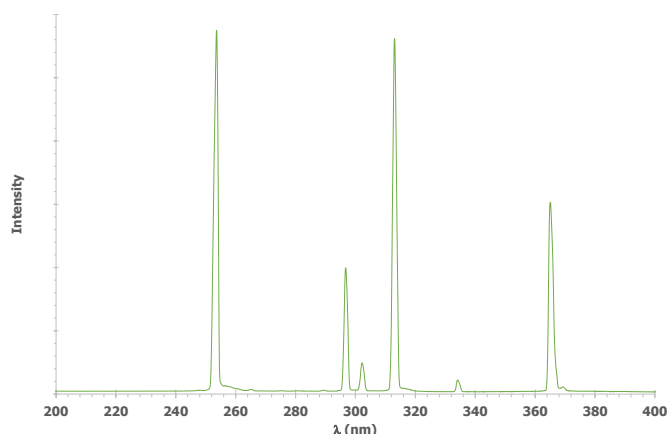
The extreme sensitivity of this spectrometer is confirmed by the results obtained with Tryptophan (right). This compound has a low quantum yield of 0.13 which makes it ideal for sensitivity testing. The minimum concentration tested was 0.416 micromolar (μM) and the fit was obtained using 360 nm as the emission peak.

The configuration used to obtain these results is available as a pre-configured solution: FLUORESCENCE SPEC PACK XeF.



SPEC SENSE+ UV

- Wavelength range: 200-400 nm
- Quantum Efficiency of 65% at 300 nm
- Optical Resolution: 1.8 nm
- 1800 grooves/mm grating blazed at 250 nm
- 1 mm pixel height for a large detection area
- LightScan software included



Front side illuminated CCD's have residual sensitivity in the UV range due to the absorbance by the polysilicon gate. Combining the back thinned 2048 pixels CCD linear array detector from Hamamatsu with Quantum Efficiency of 65% at 300 nm (minimum of 50% within all UV region) with the large detection area offered by these detectors, Sarspec offers an unrivaled spectrometer for UV detection.

Being a spectrometer specially built for UV detection Sarspec was able to use a 1800 grooves/mm grating blazed at 250 nm allowing an optical resolution of 1.8 nm even with a 200 μm slit.

This model allows light collection from low light emitting sources in Irradiance measurements, UV Chemiluminescence, and with fast acquisition rates making it possible to follow fast events such as Kinetics measurements, in areas such as Chemistry and Biophysics. The high dynamic range, sensitivity, resolution, speed and easy integration makes it perfect to use as an HPLC Detector when combined with Sarspec's flow cells and light sources.

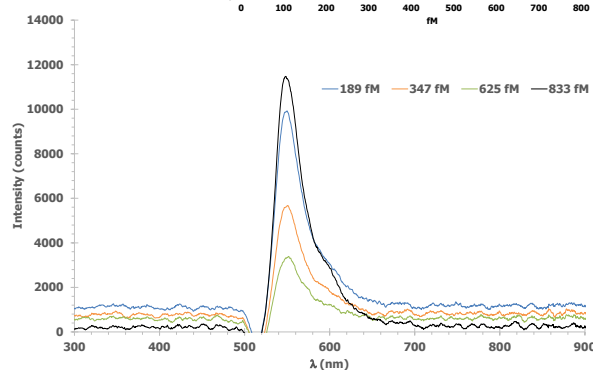
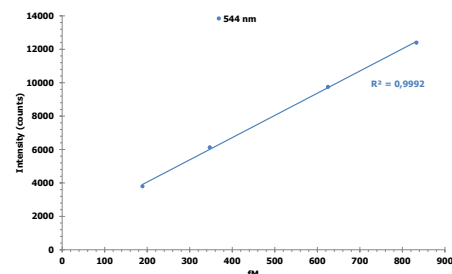
SPEC SENSE+ FL

- The best option for High Sensitivity Fluorescence
- Wavelength range: 300-1000 nm
- Quantum Efficiency of 75% at 500 nm
- 600 grooves/mm grating blazed at 500 nm
- Order sorting filters and collecting lens included
- External trigger (IN/OUT) for easy synchronization

The SPEC SENSE+ FL was specially designed for fluorescence measurements granting the best sensitivity for experiments, even in compounds with low quantum yield. The Quantum Efficiency (75% at 500 nm) of the back thinned CCD combined with the large pixel area, 200 μm slit, collecting lens and a 600 grooves/mm grating make this spectrometers the best option within it's wavelength range.

With special focus on Fluorescence, Phosphorescence, Chemi and Bioluminescence present in biomolecules such as amino acids, proteins, amines, lipids, porphyrins, steroids, vitamins, etc.

The application on the right takes us to femtomolar concentration of Eosin Y, using the SPEC SENSE+ FL, Light Source LED (LS-LED) with a 495nm LED, multipurpose cuvette holder (MCH) and 1000 μm core diameter optical fibers (2 units). This configuration is available as a pre-configured solution FLUORESCENCE SPEC PACK CUV.



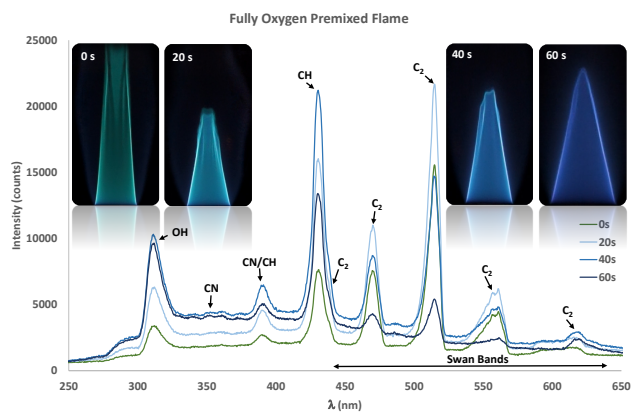
SPEC SENSE+ UV/Vis/NIR

- Wavelength range: 200-1050 nm
- Wide range and high sensitivity in one solution
- Back thinned 2048 CCD array detector
- 500 grooves/mm grating blazed at 300 nm
- 1 mm pixel height for a large detection area
- LightScan software included

The SPEC SENSE+ UV/Vis/NIR is a wide range, high sensitivity spectrometer that uses a back thinned CCD linear array from Hamamatsu with 1mm pixel height for the best sensitivity. This configuration uses a 500 grooves/mm grating blazed at 300 nm, a 200 μm slit allowing a significant amount of light collection, collecting lens, order sorting filters and SMA 905 optical fiber connector.

With minimum integration time of 1ms allows fast acquisition rates making it possible to follow with high sensitivity fast events such as Kinetics measurements in Chemistry and Biology R&D. The high dynamic range also allows determination of Absorbance on high optical density samples.

The left example shows the spectra with the variation of the gas mixture with time in spectroscopy of flames. In this case, the kinetics module from LightScan software was used to obtain spectra at 0, 20, 40 and 60 seconds.



SPEC SENSE+ Specifications Table

	SPEC SENSE+ UV/Vis/NIR	SPEC SENSE+ UV	SPEC SENSE+ FL	SPEC SENSE+ UV/Vis
Wavelength Range	200-1050 nm	200-400 nm	300-1000 nm	200-880 nm
Slit	200 μm	200 μm	200 μm	200 μm
Grating	500 lines @ 300 nm	1800 lines @ 250 nm	600 lines @ 500 nm	600 lines @ 300 nm
Resolution	6.5 nm	1.8 nm	5.4 nm	5.4 nm
Detector	2048 pixels CCD array Back Thinned Hamamatsu	2048 pixels CCD array Back Thinned Hamamatsu	2048 pixels CCD array Back Thinned Hamamatsu	2048 pixels CCD array Back Thinned Hamamatsu
Pixel width x height	14 x 1000 μm	14 x 1000 μm	14 x 1000 μm	14 x 1000 μm
Optical design	Symmetrical Czerny-Turner	Symmetrical Czerny-Turner	Symmetrical Czerny-Turner	Symmetrical Czerny-Turner
Order Sorting Filters	Included	-	Included	Included
LongPass Filters	-	-	-	-
Collecting Lens	Included	Included	Included	Included
Focal length	50 mm	50 mm	50 mm	50 mm
Dark Noise (RMS)	19	19	19	19
Dynamic Range	3450	3450	3450	3450
Signal/Noise	509	509	509	509
Linearity	99.99 %	99.99 %	99.99 %	99.99 %
Integration time	1 ms-2.8 s	1 ms-2.8 s	1 ms-2.8 s	1 ms-2.8 s
QE (%) @ peak	78%	78%	78%	78%
Peak Wavelength	600 nm	600 nm	600 nm	600 nm
Pixel Well Depth	200 000	200 000	200 000	200 000
PRNU	3%	3%	3%	3%
A/D Converter	16 bits	16 bits	16 bits	16 bits
Interface	Mini USB 2.0	Mini USB 2.0	Mini USB 2.0	Mini USB 2.0
Trigger	In/Out	In/Out	In/Out	In/Out
Trigger Delay	Out	Out	Out	Out
Fiber Connector	SMA 905	SMA 905	SMA 905	SMA 905
Weight	660 g	660 g	660 g	660 g
Dimensions	119 (L) x 90 (D) x 60 (H)	119 (L) x 90 (D) x 60 (H)	119 (L) x 90 (D) x 60 (H)	119 (L) x 90 (D) x 60 (H)
Part Number	SP-SENSE-UV-Vis-NIR	SP-SENSE-UV	SP-SENSE-FL	SP-SENSE-UV-Vis



**FASTEST
SPECTROMETER**

SPEC SPEED+

- **Fast acquisition rate up to 2857 spectra per second using burst mode**
- **2 μ s integration time with electronic shutter**
- **Back thinned CCD array detector with 2048 pixels**
- **Largest sensitive area, using 1000 μ m height pixels**
- **Detection from 200-1100 nm**
- **Great sensitivity and quantum efficiency up to 78%**
- **Trigger functions for easy integration and synchronization**
- **SMA 905 fiber connector, no optical alignment required**
- **High speed mini USB for full control of the spectrometer**
- **Software LightScan+ Included**
- **Fully built in Aluminium with LED backlight indicator**

Ultimate Speed

With minimum integration time of 2 μ s the SPEC SPEED+ is faster than any other spectrometer available using a CCD array. It was specially built for microseconds events including fast kinetics in chemical reactions, ignition processes and fluorescence monitoring among a large number of applications that need fast analysis. This new model from Sarspec allows acquisition speeds up to 2857 spectra per second using the full 2048 pixels from the back thinned CCD array detector.

LightScan Plus Software With Burst Mode

Light Scan Plus has all the great specifications of LightScan version with additional control of the spectrometer and a special feature named Burst Mode which is an high speed acquisition mode, where maximum speed is reached in available CCD spectrometers SPEC SPEED+.

In Burst Mode, up to 100 spectra are stored in the spectrometer memory and then downloaded into LightScan+ software. The recorded sequence can be visualized with adjustable speed or simply frame by frame. Average function is also available, that convert all spectra into an average spectrum. Each spectrum can be saved individually for viewing and a global file can be created with all spectra for easy data analysis.

LightScan Plus software is free with the acquisition of any SPEC SPEED+ Spectrometer.

Enhanced Sensitivity

As an option to all standard configurations it can be added a Sarspec's design collecting lens that increase the sensitivity up to 6 times in the full wavelength range, depending on the used optical fiber.

Advanced Electronics with flexible triggering functions

Triggering functions are important when working at high acquisition rates for the correct synchronization with external devices like light sources. For that, the SPEC SPEED+ includes flexible triggering functions (In/Out and delay).

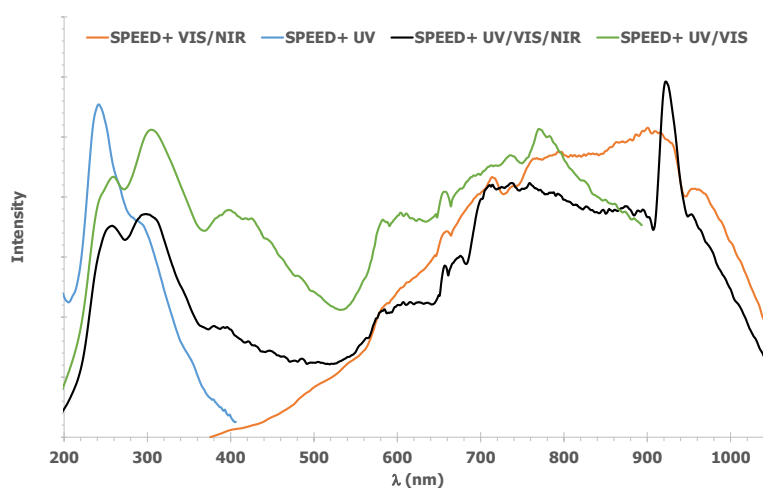
All Sarspec's spectrometers offer 16 bits advanced electronics controlled by mini USB 2.0.

Small, Robust, Portable and it looks good!

SPEC SPEED+ spectrometers are small and robust, totally built in aluminum and with no moving parts.

Also the small size make it ideal to move it from one side to another inside your organization.

With a LED backlight indicator that light the Sarspec logo when power is ON and a slick design it looks good on any laboratory!



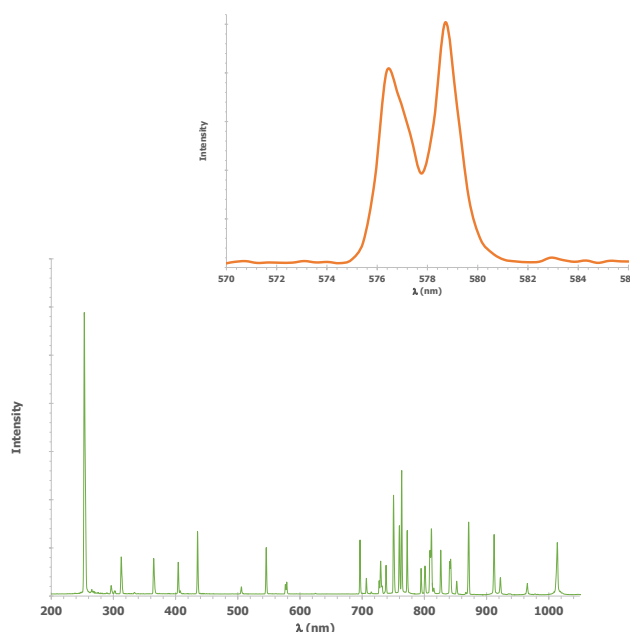
Continuous spectra for all the four standard configurations from SPEC SPEED+ range spectrometers, obtained with Sarspec's LS-DW Deuterium Tungsten light source

SPEC SPEED+ UV/Vis/NIR

- **Wavelength range: 200-1050 nm**
- **Fast acquisition: 2857 full spectra per second**
- **Back thinned 2048 CCD array detector**
- **500 grooves/mm grating blazed at 300 nm**
- **Enhanced sensitivity option**
- **LightScan+ software included**

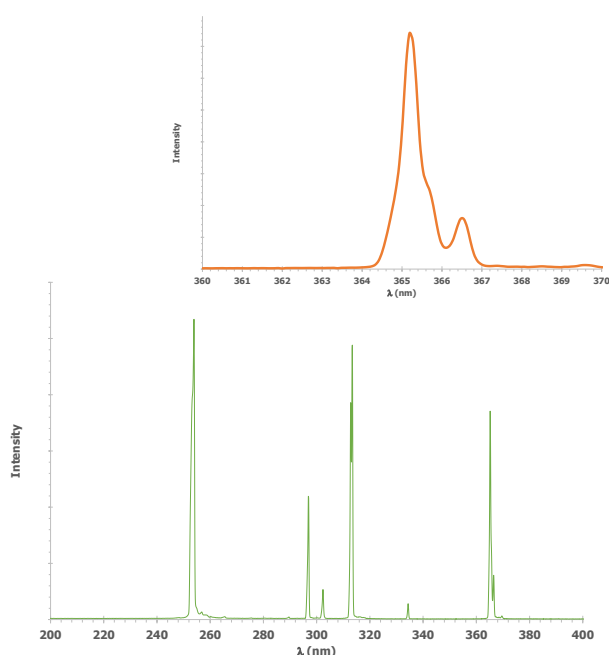
The SPEC SPEED+ UV/Vis/NIR is a wide range, high speed spectrometer that uses a back thinned CCD linear array from Hamamatsu allowing up to 2857 spectra per second. The full configuration includes a 25 μm slit, 500 grooves/mm grating blazed at 300 nm, order sorting filters and SMA 905 optical fiber connector.

This standard configuration has great specifications either for its wide wavelength range (200-1050 nm) and resolution (1.7 nm), for its speed and for the possibility to control additional parameters with LightScan+ software. The spectrum on the right shows the full range obtained with a Mercury Argon light source. Even with a wide range configuration, the separation between the doublet 576.960 and 579.066 is achieved.



SPEC SPEED+ UV

- **Wavelength range: 200-400 nm**
- **Optical Resolution: 0.5nm**
- **Back thinned 2048 CCD array detector**
- **1800 grooves/mm grating blazed at 250 nm**
- **Enhanced sensitivity option**
- **LightScan+ software included**



Covering the entire UV range the SPEC SPEED+ UV offers high acquisition rate and also the optimized optical configuration with 25 μm slit, 1800 grooves/mm grating blazed at 250 nm allows a great resolution of 0.5 nm.

The detector is an Hamamatsu back thinned CCD array with 2048 pixels with 1 mm pixel height for high sensitivity. Software LightScan+ allows the best flexibility for time and sensitivity control of the spectrometer.

On the left the full spectrum obtained with a Mercury lamp. The great resolution can be seen in the insert spectrum showing mercury lines 365.015 and 366.328nm. Even a "shoulder" in the 365.015 that is related to the 365.484nm line can be observed.

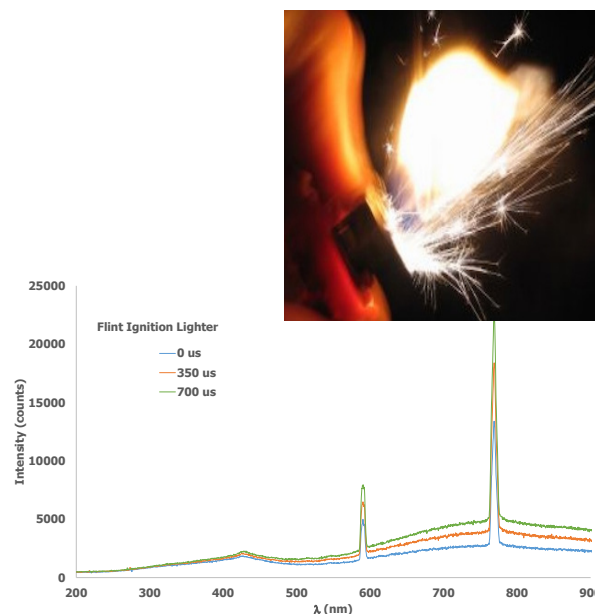
SPEC SPEED+ UV/Vis

- **Wavelength range: 200-880 nm**
- **Optical Resolution: 1.4 nm**
- **Fast acquisition: 2857 full spectra per second**
- **600 grooves/mm grating blazed at 300 nm**
- **Enhanced sensitivity option**
- **LightScan+ software included**

The SPEC SPEED+ UV/Vis combines high speed, good resolution and high sensitivity in one spectrometer. Using a 25 μm slit, 600 lines/mm grating blazed at 300 nm, order sorting filter and a back thinned CCD detector array with 2048 pixels.

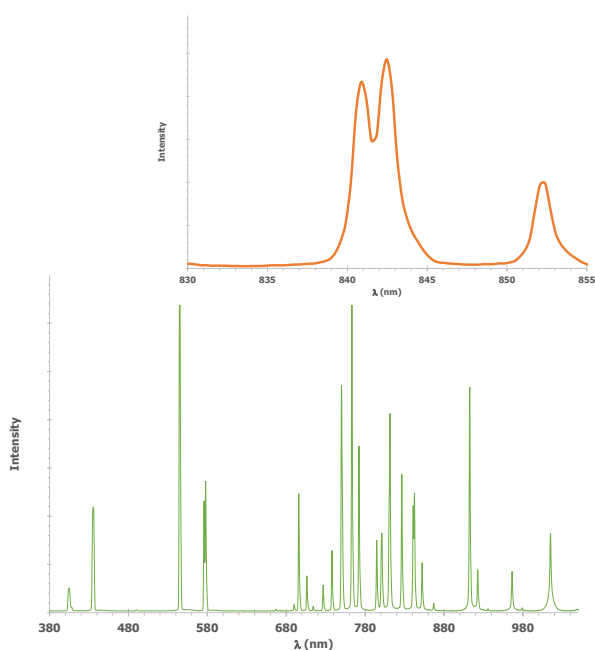
How fast can a spectrometer acquire in full range? The answer is in the spectrum on the right.

At Sarspec we acquired the spectra of a lighter ignition using the SPEC SPEED+ UV/Vis with LightScan+ Software in Burst Mode. This mode allows acquisition of full spectrum every 350 microseconds making it ideal for monitoring ultra fast processes.



SPEC SPEED+ Vis/NIR

- **Wavelength range: 380-1050 nm**
- **Optical Resolution: 1.4 nm**
- **Back thinned 2048 CCD array detector**
- **600 grooves/mm grating blazed at 750 nm**
- **Enhanced sensitivity option**
- **LightScan+ software included**



For high speed acquisition in the Vis/NIR range the SPEC SPEED+ Vis/NIR is the best option available. Configured with a 25 μm slit, 600 lines/mm grating blazed at 750 nm, order sorting filter and a back thinned CCD detector array with 2048 pixels

The spectrum on the left shows the full range obtained with a Mercury Argon light source. We can clearly identify two peaks in the NIR region that are, normally, difficult to separate: 840.821 and 842.465nm.

SPEC SPEED+ Specifications Table

	SPEC SPEED+ UV/Vis/NIR	SPEC SPEED+ UV	SPEC SPEED+ UV/Vis	SPEC SPEED+ Vis/NIR
Wavelength Range	200-1050 nm	200-400 nm	200-880 nm	380-1050 nm
Slit	25 μm	25 μm	25 μm	25 μm
Grating	500 lines @ 300 nm	1800 lines @ 250 nm	600 lines @ 300 nm	600 lines @ 750 nm
Resolution	1.7 nm	0.5 nm	1.4 nm	1.4 nm
Detector	2048 pixels CCD Sony Back Thinned Hamamatsu	2048 pixels CCD Sony Back Thinned Hamamatsu	2048 pixels CCD Sony Back Thinned Hamamatsu	2048 pixels CCD Sony Back Thinned Hamamatsu
Pixel width x height	14 x 1000 μm	14 x 1000 μm	14 x 1000 μm	14 x 1000 μm
Optical design	Symmetrical Czerny-Turner	Symmetrical Czerny-Turner	Symmetrical Czerny-Turner	Symmetrical Czerny-Turner
Order Sorting Filters	Included	-	Included	Included
LongPass Filters	-	-	-	-
Collecting Lens	Optional (ES version)	Optional (ES version)	Optional (ES version)	Optional (ES version)
Focal length	50 mm	50 mm	50 mm	50 mm
Dark Noise (RMS)	19	19	19	19
Dynamic Range	3450	3450	3450	3450
Signal/Noise (low noise ON/OFF)	450/340	450/340	450/340	450/340
Linearity	99.99 %	99.99 %	99.99 %	99.99 %
Integration time	2 μs - 2.8 s	2 μs - 2.8 s	2 μs - 2.8 s	2 μs - 2.8 s
QE (%) @ peak	78%	78%	78%	78%
Peak Wavelength	600 nm	600 nm	600 nm	600 nm
Pixel Well Depth (e ⁻)	200 000	200 000	200 000	200 000
PRNU	3%	3%	3%	3%
A/D Converter	16 bits	16 bits	16 bits	16 bits
Interface	Mini USB 2.0	Mini USB 2.0	Mini USB 2.0	Mini USB 2.0
Trigger	In/Out	In/Out	In/Out	In/Out
Trigger Delay	Out	Out	Out	Out
Fiber connector	SMA 905	SMA 905	SMA 905	SMA 905
Weight	660 g	660 g	660 g	660 g
Dimensions	119 (L) x 90 (D) x 60 (H)	119 (L) x 90 (D) x 60 (H)	119 (L) x 90 (D) x 60 (H)	119 (L) x 90 (D) x 60 (H)
Part Number	SP-SPEED-UV-Vis-NIR	SP-SPEED-UV	SP-SPEED-UV-Vis	SP-SPEED-Vis-NIR
Enhanced Sensitivity Option				
Part Number	SP-SPEED-UV-Vis-NIR-ES	SP-SPEED-UV-ES	SP-SPEED-UV-Vis-ES	SP-SPEED-VIS-NIR-ES

User Configured Spectrometers

What is the best configuration?

Generally speaking a spectrometer is an instrument used to measure light intensity as a function of wavelength range, within a specific range. Sarspec's spectrometers can be configured for detection in the UV/Vis/NIR (180-1100 nm) range, with resolution down to 0.1 nm, sampling rate up to 2857 full spectra (with 2048 pixels) per second and femtomolar sensitivity, depending on the configuration. This is why configuration is so important as users may need to focus in one or more of these features for the best configuration.

Important concepts when configuring a spectrometer:

1. Wavelength range - For a given focal distance (f) and detector size, the wavelength range is determined by the grating dispersion, for wider ranges it's necessary to choose gratings with low groove density (lines/mm). The lowest groove density available from Sarspec is 500 lines/mm which corresponds to a spectral range around 850 nm and the highest is 2400 lines/mm for 175 nm spectral range. We recommend order sorting filter or longpass filters to avoid higher orders of diffraction in the detector.

2. Optical Resolution - There are three components that influence the resolution of the spectrometer: slit, grating and detector. As we increase the number of lines/mm in the grating we get shorter spectral range but better resolution. The slit width controls the "image size" on the detector and the smaller the slit width better the resolution. The number of pixels also affects the resolution, more pixels better resolution, but that is only true when the ratio between pixel and slit size are close to 1.

3. Sensitivity - Sensitivity is determined mainly by the slit size and detector. Wider the slit, more light is the detector receiving resulting in better sensitivity. With the detectors, the sensitivity increases with the quantum efficiency and pixel area. The use of collecting lens can improve the signal up to 6 times and we strongly advise them when performing low light level measurements.

4. Speed - Speed depends on the detector and electronics. It's important to understand that integration time (the time that the detector is exposed to light) is different of acquisition time (the time to acquire, transfer and save the spectra). Sarspec clearly identifies both in every configuration. All spectrometers available from Sarspec allow great acquisition speed but for ultimate performance we recommend the platform SPEC SPEED+ .



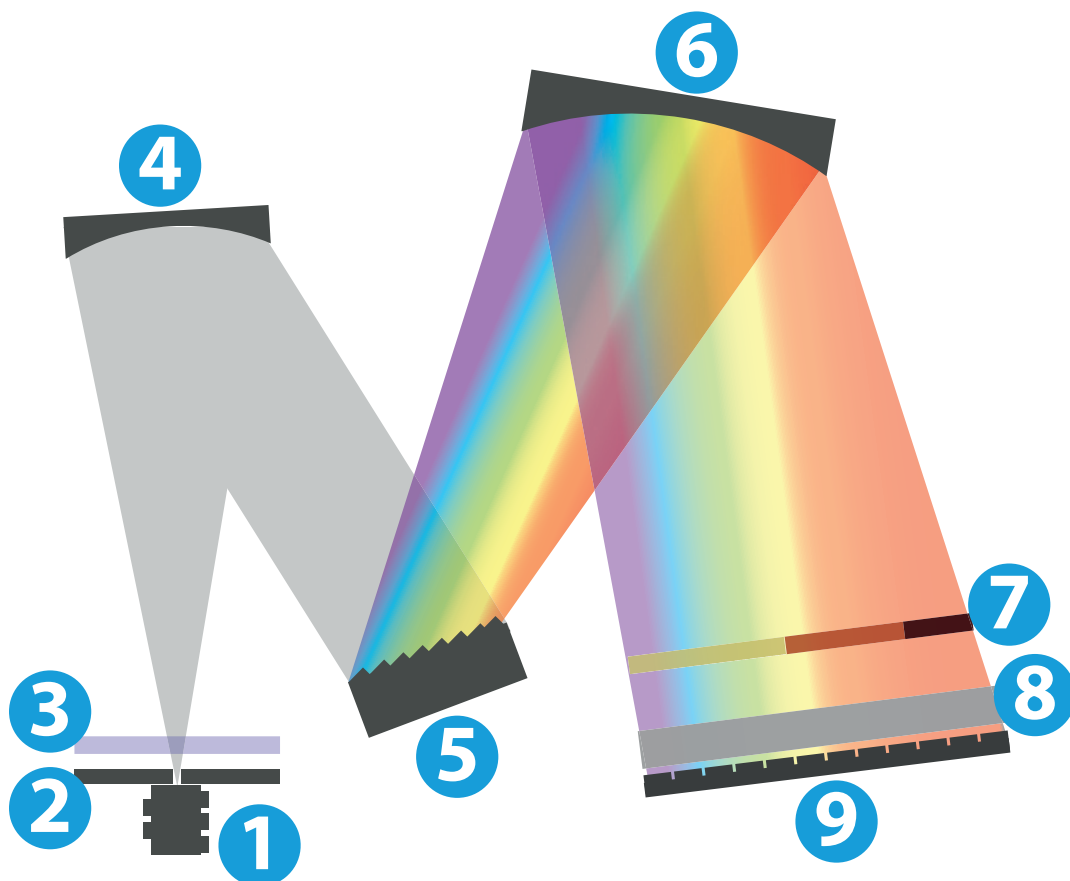
How our spectrometer works?

Flexible optical configuration

Sarspec's SPEC spectrometers use a symmetrical Czerny-Turner optical configuration. In a simple way, the Czerny-Turner optical bench has the following components: entrance slit (2), collimating mirror (4), grating (5), focusing mirror (6) and detector (9). The light from a source enters through the slit which is placed in the focus of a collimating mirror that collimates the light to the diffraction grating which "separates" the light into different wavelengths. The light diffracted from the grating reaches a second mirror, the focusing mirror, which will focus the spectrum into the detector. The representation at the end of this page illustrates several components of this configuration.

In a traditional spectrophotometer, the detector has only a single element and the wavelength detected changes with the rotation of the grating (moving part) allowing scanning the desired spectral range. In Sarspec's SPEC series spectrometers the grating is fixed and instead of a single element Sarspec uses linear array elements (pixels), each pixel from the detector works as an individual detector, with an individual signal, allowing the acquisition of a full spectrum in real time and making a more robust instrument because there's no mechanical wear due to grating rotation.

To optimize the final solution with respect to range, sensitivity and stray light, Sarspec introduced some improvements to the standard Czerny-Turner configuration. As a result there are Longpass Filters (3), order sorting Filters (7) and Collecting Lens (8) available to add and optimize each configuration to meet user's requirements. All instruments from Sarspec use SMA 905 connectors (1) for easy optical fiber coupling, without the need of any alignment.



1. SMA 905 Connector

Connects the optical fiber to the spectrometer allowing a precise alignment with the entrance slit. Offers good position reproducibility and mechanical strength, and as a universal optical connector it supports fibers diameters from 8 μm to 2000 μm .



2. Slit

First optical element, limits the amount of light entering the spectrometer. Rectangular geometry, with standard 1 mm height and variable width from 10 μm to 200 μm (pre-selected and factory installed). The slit width is crucial in the determination of the spectrometer resolution and sensitivity. The table below shows the resolutions obtained with different detectors, grating and slits available from Sarspec.



Grating	*Resolution (14 μm x 2048 pixels detector / 8 μm x 3648 pixels detector) nm					
	Slit 10 μm	Slit 25 μm	Slit 50 μm	Slit 100 μm	Slit 150 μm	Slit 200 μm ,
500	1.1 / 0.8	1.7 / 1.3	2.6 / 1.8	3.8 / 3.5	4.8 / 4.8	6.5 / 6.1
600	0.9 / 0.6	1.4 / 1.1	2.2 / 1.5	3.2 / 3.0	3.9 / 4.0	5.4 / 5.1
1200	0.5 / 0.3	0.7 / 0.6	1.1 / 0.8	1.6 / 1.5	2.0 / 2.0	2.7 / 2.6
1800	0.3 / 0.2	0.5 / 0.4	0.7 / 0.5	1.0 / 1.0	1.3 / 1.3	1.8 / 1.7
2400	0.2 / 0.2	0.4 / 0.3	0.6 / 0.4	0.8 / 0.7	1.0 / 1.0	1.4 / 1.3
3600	0.2 / 0.1	0.2 / 0.2	0.4 / 0.3	0.5 / 0.5	0.7 / 0.7	0.9 / 0.9
Part Number	SLIT-10	SLIT-25	SLIT-50	SLIT-100	SLIT-150	SLIT-200

*Measured values.

3. Longpass Filters (LPF)

Longpass filters are placed after the slit to reject shorter wavelengths than the range of interest. Useful to avoid higher orders of diffraction from the grating and reduce the stray light radiation reaching the detector.



Part Number	Description
SPEC-LPF-280	Longpass filter $\lambda_c = 280$ nm (@ T=50%)
SPEC-LPF-320	Longpass filter $\lambda_c = 320$ nm (@ T=50%)
SPEC-LPF-395	Longpass filter $\lambda_c = 395$ nm (@ T=50%)
SPEC-LPF-515	Longpass filter $\lambda_c = 515$ nm (@ T=50%)
SPEC-LPF-630	Longpass filter $\lambda_c = 630$ nm (@ T=50%)

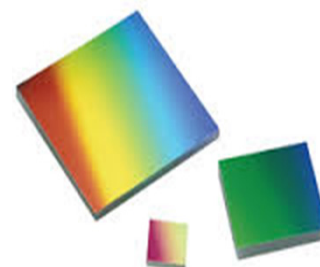
Other filters available under request: longpass, shortpass and bandpass.

4. Collimating Mirror

Concave mirror with high reflectivity coating (protected or UV enhanced aluminium, silver or gold) placed at the focal distance from the entrance slit allowing the incident light to emerge as a collimated beam directed to the grating.

5. Grating

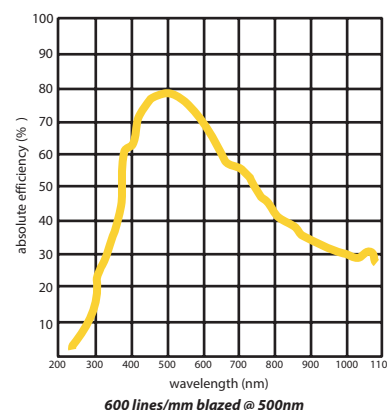
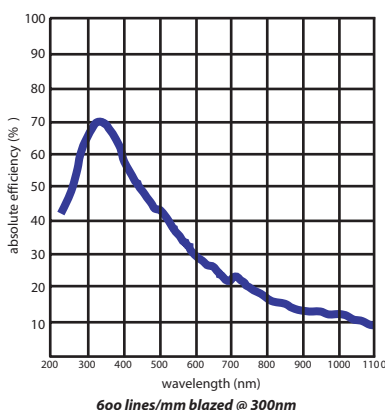
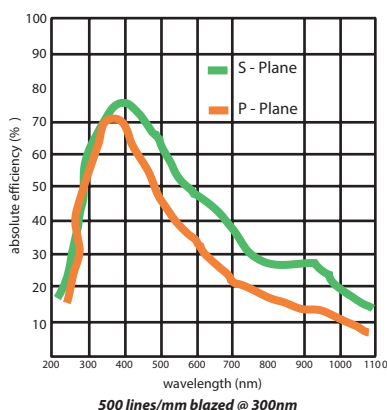
The dispersive element that “separates” the light into its spectral components allowing that each pixel of the detector receives a specific wavelength range. The grating is fixed and it is crucial for the resolution, wavelength range and sensitivity of the spectrometer. All gratings have a specific performance which can be found in the efficiency curves available on the next pages. An efficiency higher than 25% should be considered when choosing the wavelength range.

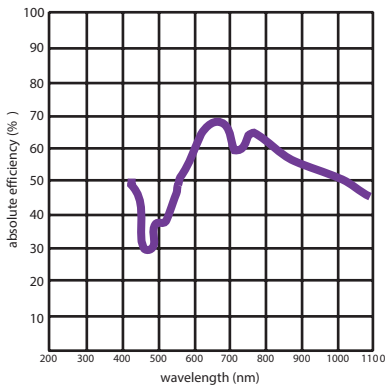


The following table contains the specifications and ordering information for the available gratings from Sarspec.

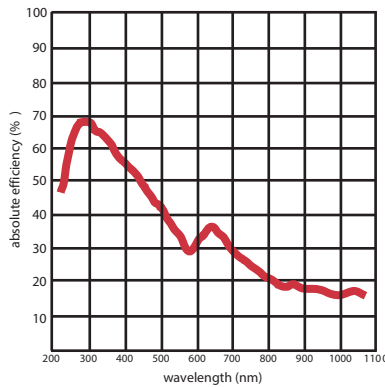
Part Number	Description	Usable range (nm)	Spectral range (nm)	Best Efficiency >25% (nm)
G500-300	Grating 500 lines/mm, blazed @ 300 nm	200 - 1100	850	250 - 750
G600-300	Grating 600 lines/mm, blazed @ 300 nm	200 - 1100	700	200 - 650
G600-500	Grating 600 lines/mm, blazed @ 500 nm	250 - 1100	700	300 - 1100
G600-750	Grating 600 lines/mm, blazed @ 750 nm	400 - 1100	670	400 - 1100
G1200-250	Grating 1200 lines/mm, blazed @ 250 nm	200 - 1100	320*	200 - 750
G1200-500	Grating 1200 lines/mm, blazed @ 500 nm	250 - 1100	280	300 - 1100
G1200-750	Grating 1200 lines/mm, blazed @ 750 nm	450 - 1100	250*	475 - 1100
G1800-250	Grating 1800 lines/mm, blazed @ 250 nm	200 - 800	220	200 - 450
G1800-500	Grating 1800 lines/mm, blazed @ 500 nm	200 - 1050	200*	320 - 1000
G2400-UV	Grating 2400 lines/mm, UV	200 - 800	150*	200 - 420
G2400-Vis	Grating 2400 lines/mm, Vis	220 - 820	100*	250 - 800
G3600-UV	Grating 3600 lines/mm, UV	200 - 500	80*	250 - 500

*Estimated values

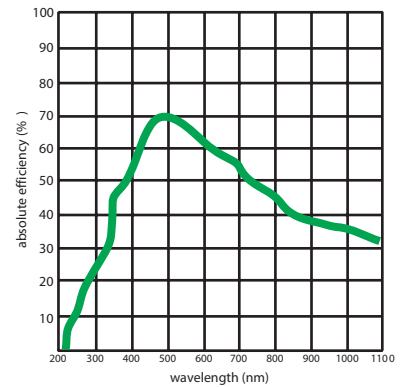




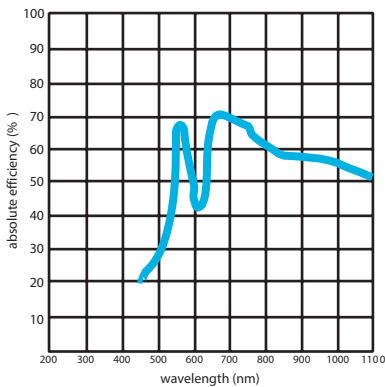
600 lines/mm blazed @ 750nm



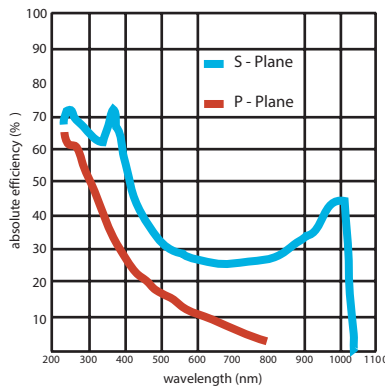
1200 lines/mm blazed @ 250nm



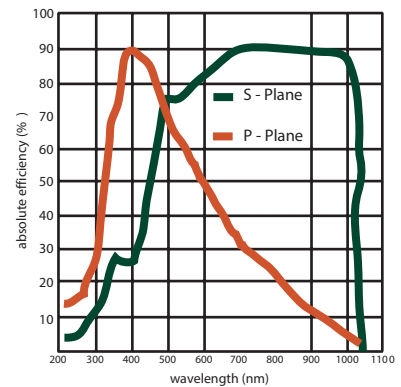
1200 lines/mm blazed @ 500nm



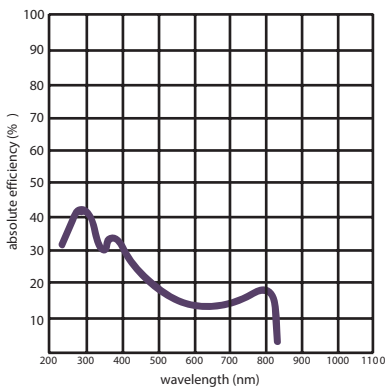
1200 lines/mm blazed @ 750nm



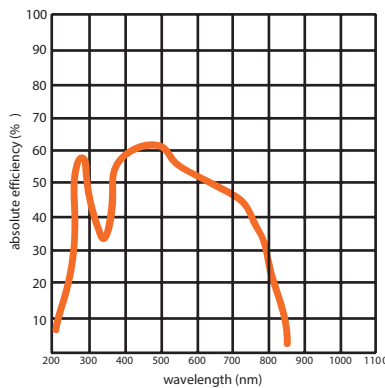
1800 lines/mm blazed @ 250nm



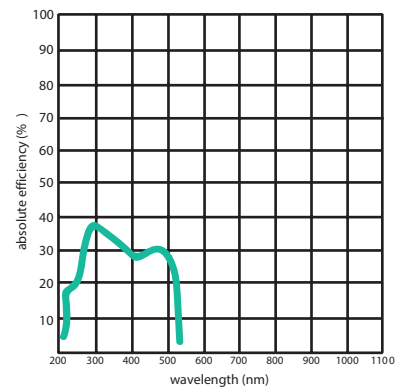
1800 lines/mm blazed @ 500nm



2400 lines/mm UV



2400 lines/mm Visible



3600 lines/mm UV

6. Focusing Mirror

Concave mirror with high reflectivity coating (protected or UV enhanced aluminium, silver or gold) that focus the diffracted beam into the detector. It is placed at the focal distance from the detector and “creates” multi-images of the entrance slit (object) with different wavelength into the pixels.

7. Order Sorting Filters

Order Sorting Filters prevents higher orders of diffraction to reach the detector. Sarspec has a wide range of solutions and selects the best option for each configuration.

Part Number	Description
OSF-CUSTOM	Order Sorting Filter - customized solution

8. Collecting Lens

The collecting lens are cylindrical lens placed on front of the detector for focusing the entire height of the beam into the height of the pixels. The special design from Sarspec results in a increase in the sensitivity up to 6 times, depending on the optical fiber and detector used.



Part Number	Description
CL-CUSTOM	Collecting lens- customized solution

9. Detector Platforms

Sarspec has four detector platforms available. The specifications and ordering information can be found in the table below. When purchasing a detector platform customers are buying a basic configuration that includes everything except slit, grating, longpass filters (if required), order sorting filters (if required) and collecting lens (if required). Those must be specified in every order.

	SPEC STD UC	SPEC RES+ UC	SPEC SENSE+ UC	SPEC SPEED+ UC
Wavelength Range	180 - 1100 nm	180 - 1100 nm	200 - 1100 nm	200 - 1100 nm
Detector	2048 pixels CCD array Sony	3648 pixels CCD array Toshiba	2048 pixels CCD array Back Thinned Hamamatsu	2048 pixels CCD array Back Thinned Hamamatsu
Pixel width x height	14 x 200 µm	8 x 200 µm	14 x 1000 µm	14 x 1000 µm
Optical design	Symmetrical Czerny-Turner	Symmetrical Czerny-Turner	Symmetrical Czerny-Turner	Symmetrical Czerny-Turner
Focal length	50 mm	50 mm	50 mm	50 mm
Dark Noise (RMS)	37	32	19	19
Dynamic Range	1771	2048	3450	3450
Signal/Noise	350	350	509	450
Linearity	99.99 %	99.94 %	99.99 %	99.99 %
Integration time	2 ms - 214 s	3 ms - 214s	1 ms - 2.8 s	2 us - 2.8 s
QE (%) @ peak	40%	40%	78%	78%
Peak Wavelength	450 nm	550 nm	600 nm	600 nm
Pixel Well Depth	90 000	120 000	200 000	200 000
PRNU	5%	5%	3%	3%
A/D Converter	16 bits	16 bits	16 bits	16 bits
Interface	Mini USB 2.0	Mini USB 2.0	Mini USB 2.0	Mini USB 2.0
Trigger	In/Out	In/Out	In/Out	In/Out
Trigger Delay	In	In	Out	Out
Fiber Connector	SMA 905	SMA 905	SMA 905	SMA 905
Weight	660 g	660 g	660 g	660 g
Dimensions	115 (L) x 85 (D) x 50 (H)	115 (L) x 85 (D) x 50 (H)	119 (L) x 90 (D) x 60 (H)	119 (L) x 90 (D) x 60 (H)
Part Number	DET-STD	DET-RES	DET-SENSE	DET-SPEED



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