

# Fiberoptic Spectrometer マルチスペクトル分光器システム

Avantes社(オランダ)は小型高性能ファイバー入射型分光器を開発して25年以上経ち、さらに進化した高性能型、超小型高分解能型等、次世代に対応する進化型分光器を開発し続けています。新開発のエレクトロニクスボード(AS-7010)により、USB3.0超高速通信・ギガビットEthernet伝送等が実現し、今後このEVOシリーズが中心となります。最新のCMOS技術を駆使したCMOSディテクタを採用し、EVOシリーズと組み合わせたCMOS制御・超高速分光器が登場し、EVOとCMOSが主流となりました。また超小型近赤外分光器が開発され、高性能なコンパクト型も注目され、更に超高速マルチチャンネル分光器(<10ch)は産業用プロセスコントロール等の広帯域や多角的な計測のニーズに有効です。つまりAvaSpecは各種のアプリケーションに対応できるマルチスペクトル分光器システムなのです。全ての分光器本体に標準ソフトが付属する他、用途に応じたアプリケーション専用ソフト等を取り揃えています。また豊富な校正用光源やファイバー、アクセサリは勿論のこと、カスタム反射プローブ等の特注も一本から承り最適な測定システムを構成することが可能です。

## AvaSpec ファイバー入射型分光器

## 新開発・次世代進化型

**3.0超高速 /1GbpsETH EVO シリーズ**  
最新の高性能 CMOS ディテクター

高感度・高波長分解能・高速応答・低ノイズ

### AvaSpec SensLine

ユーザーのリクエストに応える形で創られた分光器で、蛍光計測、ルミネッセンス計測、ラマン計測等、通常より高いパフォーマンスを要求されるアプリケーションに対応。

- 波長域 : 200-1160nm
- 迷光 : 0.04-1%
- UV量子効率 : 60% (200-300nm)
- S/N比 : 1200:1 (HERO)
- 最小波長分解能 : 0.06-20nm



- AvaSpec-ULS2048XL-EVO (175x127x44, 5mm, 1180g)
- AvaSpec-HS2048XL-EVO (175x165x85mm, 1950g)
- AvaSpec-HERO (HSC1024x58TEC-EVO) (185x161x185mm, 3.5kg)
- AvaSpec-ULS2048x64-EVO (177x127x44, 5mm, 1180g)
- AvaSpec-ULS2048x64TEC-EVO **NEW** (185x145x185mm, 3.5kg)

### AvaSpec StarLine

標準万能型しかも高波長分解能が得られ、カラー・反射・発光・膜厚等各種計測に対応。EVO+CMOS制御の最新型は高速多チャンネルシステムにて産業用プロセス制御に最適。

- 波長域 : 200-1100nm
- 迷光 : 0.04-1%
- S/N比 : 300:1
- 最短露光時間 : 9μs (4096CL-EVO)
- 最小波長分解能 : 0.05-20nm



- AvaSpec-ULS2048CL-EVO (177x127x44, 5mm, 1135g)
- AvaSpec-Dual Channel (175x165x85mm, 1.8kg)
- AvaSpec-ULS4096CL-EVO (177x127x44, 5mm, 1135g)
- AvaSpec-Fast (175x110x44mm, 716g)
- AvaSpec-Multi Channel (315x235x135mm, 1-4ch) (315x445x135mm, 5-10ch)

### AvaSpec NIR Line

新開発のTEC冷却ディテクターによりノイズが飛躍的に削減し、光の少ない環境下での計測や蛍光計測、プラスチック成分分析、太陽光発電用モニターの発光測定等に対応。

- 波長域 : 900(1000)-2500nm
- 迷光 : <1%
- S/N比(LN) : 5000:1
- 最短露光時間 : 10μs
- ダイナミックレンジ : 9000:1 (1.7-EVO)



- AvaSpec-NIR256/512-1.7-EVO (185x100x184mm, 2.7kg)
- AvaSpec-Mini-NIR **NEW** (95x68x20mm, 185g)
- AvaSpec-NIR256/512-1.7-HSC-EVO (185x160x184mm, 3.6kg)
- AvaSpec-NIR256/512-2.5-HSC-EVO (185x145x185mm, 3.5kg)

### AvaSpec-CompactLine

4096(2048)ピクセルの最新CMOSリニアディテクタ制御と高性能光学ベンチで高パフォーマンス実現！更に256ピクセルのInGaAsディテクタと組合わせた超小型近赤外分光器が新登場！温度安定性に優れたLIBSや研究開発用OEM、食品分別に最適。

- 波長域 : 200-1100nm
- 最小波長分解能 : 0.09nm
- ダイナミックレンジ : 3000:1
- 迷光 : <0.2%
- 最短露光時間 : 30μs

- AvaSpec-Mini4096CL (200-1100nm)
- AvaSpec-Mini-NIR (900-1750nm)
- 665,000(感度)
- 7500:1
- 1%
- 10μs



AvaSpec-Mini2048/4096CL (95x68x20mm, 174g)



AvaSpec-Mini-NIR **NEW** (95x68x20mm, 185g)

### OEM Spectrometers

光学ベンチはUV/VIS用、NIR用の各種計測に対応。マイクロプロセッサボードは測定に応じてディテクターやソフトウェアと組合わせて自在な使用が可能。

- 光学ベンチ波長域 : 200-1160nm
- マイクロプロセッサボード : 16ビットA/D, コンバータ USB3.0/1GbpsETH, 100 Mpixel メモリー保存 (AS-7010)

- AvaBench-75-ULS/ULSTEC (120x91x21mm, 350g)
- AvaBench-100HSC (120x125x109mm, 1500g)
- AvaBench-37.5-HS (95x152x42mm, 722g)
- AvaBench-50/100TEC (100x130x40mm, 875g)
- AvaBench-75-MN **NEW** (95x68x20mm, 175g)



- AS-5216 (162.5x100mm, 97g)
- AS-7010 (162.5x100mm, 97g)
- Developer kits (AS-5216/7010 用回路付)

### AvaSpec-RS (slit kit)

測定用途に応じてスリット幅の変更ができて正しい計測が可能な究極の分光器。感度とスループットのどちらかを優先するかをスリットの交換で測定毎に選択可能。

- AvaSpec-ULSの各タイプ, AvaSpec-HERO, AvaSpec-NIRの各タイプに対応
- スリットサイズ : 25, 50, 100, 200, 500 μm

### AvaSpec-Multi-Ch

産業用プロセス制御や多角的・広域計測に最適。

- 最大10ch構築可能、Ch毎に独立稼働
- Ch毎に違う波長や露光時間の設定が可能



AvaSpec-EVO-Multi-Ch 3-4ch (315x235x135mm) desktop 5-10ch (315x445x135mm) Rackmount

# 次世代進化型分光器 (EVO/CMOS)

EVO シリーズ

CMOS 制御

新開発エレクトロニクスボード (AS-7010) により USB3.0(5Gbps) 高速通信、LAN 経由 1GbpsETH 直接遠距離データ伝送、メモリー (100Mpixel) 内部保存機能、外部トリガー機能、多チャンネル構築など実現  
最新の CMOS 技術でブルーミングやスマア現象が生じることなく、高度な信号処理により低ノイズで CCD センサと同等の感度や波長分解能が得られ費用効果も大きい

## AvaSpec-Mini2048/4096CL

超小型 CMOS 制御・高パフォーマンス型



(200~1100nm)

4096(2048)pixels の最新 CMOS リニアディテクタ制御と迷光の少ない光学ベンチで高パフォーマンスを実現。温度安定性・波長安定性に優れ、研究開発用 OEM や組み込みに最適で応用は無量大

- 光学ベンチ : F=75mm-MN, 迷光<0.2%
- ダイナミックレンジ : 3300 : 1
- 波長分解能 : 0.09-nm
- S/N値 : 330 : 1
- 露光時間 : 30 μs~50s
- 寸法 : 95 x 68 x 20 mm, 174g

- ◆カラー計測 ◆環境計測 ◆ラマン分光 ◆化学実験 ◆応用計測

## AvaSpec-Mini-NIR256-1.7

超小型 InGaAs 制御・近赤外高感度型



(900~1750nm)

256pixels の InGaAs ディテクタと迷光の少ない光学ベンチをコンパクトに統合し、超小型で近赤外高パフォーマンスを実現。温度安定性・波長安定性に優れ、研究開発用 OEM や組み込みに最適

- 光学ベンチ : F=75mm-MN
- ダイナミックレンジ : 7500 : 1 (LN)
- 感度 : 665,000(count/μW per ms) (HS)
- S/N値 : 5000 : 1 (LN)
- 露光時間 : 10 μs~5s (LN)
- 寸法 : 95 x 68 x 20 mm, 185g

- ◆食品分析 ◆産業用リサイクル分別 ◆微弱光計測 ◆プラスチックの分析

## AvaSpec-ULS2048/4096CL-EVO

CMOS 制御・高速・高波長分解能型



(200~1100nm)

高速の標準万能型で高パフォーマンスが得られ基本的な計測は勿論のこと多チャンネルシステムに対応。高解像度 4096pixels の CMOS ディテクタを搭載して迷光の殆どない環境で最小露光時間に計測が可能

- 光学ベンチ : F=75mm, 迷光<0.2%
- ダイナミックレンジ : 4000 : 1
- 波長分解能 : 0.05~20nm
- 迷光 : 0.19~1.0%
- 露光時間 : 9 μs~40s (4096CL)
- S/N値 : 335 : 1

- ◆産業用プロセスコントロール ◆光分析 ◆環境計測 ◆化学実験 ◆ラマン分光 ◆LIBS ◆プラズマ計測

## AvaSpec-HERO (-EVO)

高速・高感度・高波長分解能型



(200~1160nm)

EVO と高性能 TE 冷却 CCD 背面照射型ディテクタ制御とのコンビで低ノイズ・高 S/N 値・高ダイナミックレンジを実現

- 光学ベンチ : F=100mm, NA : 0.13
- ダイナミックレンジ : 40000 : 1
- 波長分解能 : 0.2~7nm
- 迷光 : 0.5~1.0%
- 露光時間 : 5.2ms~60s
- S/N値 : 1200 : 1

- ◆光の少ない環境での蛍光計測 ◆ラマン応用分光

## AvaSpec-ULS2048x64-EVO

高速・UV・NIR 超高感度型



(200~1160nm)

EVO と 2048x64pixels の CCD 背面照射型ディテクタ制御により UV&NIR 域にて超高感度実現。同 TEC 型より低コスト

- 光学ベンチ : F=75mm,
- 波長分解能 : 0.09~20nm
- 感度 : 650,000(counts/μW per ms)
- UV量子効率 : 60%
- 露光時間 : 2.4ms~600s
- S/N値 : 450 : 1

- ◆UV放射線測定 ◆蛍光計測 ◆ラマン計測

## AvaSpec-NIR256/512-1.7-EVO

非冷却近赤外高速・高感度型



(900~1750nm)

EVO と InGaAs リニアアレイディテクタにより 1700nm 迄の近赤外にて超高感度・高ダイナミックレンジ・最短露光時間を実現

- 光学ベンチ : F=50mm, NA : 0.24
- ダイナミックレンジ : 9000 : 1 (LN)
- 感度 : 8,200,000(count/μW per ms) (HS)
- S/N値 : 5000 : 1 (LN)
- 露光時間 : 10 μs~20s (LN)
- HSモードとLNモード切換えが可能

- ◆水分含有量の計測 ◆液体・個体・粉体のインライン計測

## AvaSpec-NIR256/512-2.5-HSC-EVO

近赤外高速・高感度型



(1000~2500nm)

EVO と TE 冷却 InGaAs リニアアレイ 2 ステージディテクタにより 2500nm 迄の中赤外域で低ノイズ・高感度の計測を実現

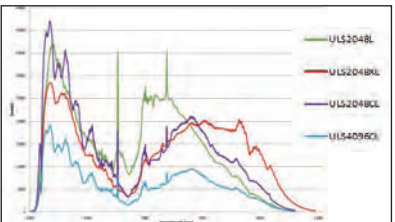
- 光学ベンチ : F=100mm, NA : 0.13
- ダイナミックレンジ : 5100 : 1 (LN)
- 感度 : 990,000(count/μW per ms) (HS)
- S/N値 : 3700 : 1 (LN)
- 露光時間 : 10 μs~100ms (LN)
- HSモードとLNモード切換えが可能

- ◆プラスチックの成分分析 ◆太陽光発電用モニターの発光測定

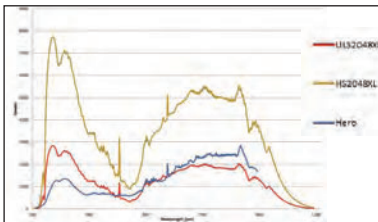
## ディテクター

ディテクタのタイプにより各モデルの特長があり用途に応じた計測が可能

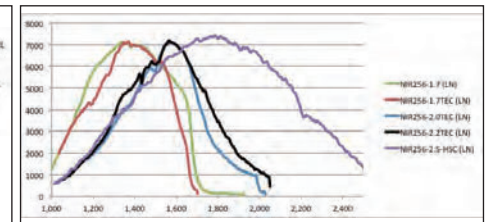
感度 (counts/μW per ms) 曲線 (StarLine)



感度曲線 (SensLine)



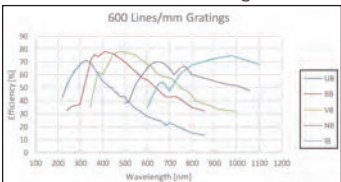
感度曲線 (NIR Line)



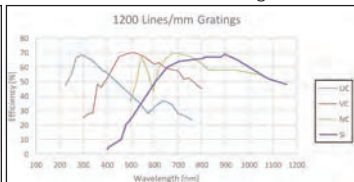
## グレーティング効率

スペクトルレンジとグレーティングを選ぶことで最適な計測が可能

600 Line/mm Grating



1200 Line/mm Grating



## AvaSpec-ULS4096CL-EVO 標準・万能型

ULS75mm 光学ベンチ, CMOS ディテクタの EVO タイプにより高速で高波長分解能の計測が可能な万能型 (200~1100nm)

- 波長分解能 : 0.05 ~ 20nm
- S/N 比 : 335 : 1
- 露光時間 : 9 μs ~ 40s
- 迷光 : 0.19 ~ 1.0%
- 感度 : 218,000(counts/μW per ms)

波長分解能 (Grating & Slit)

mm	Slit size (μm)					
	10	2.5	50	100	200	500
300	0.50-0.70	1.20-1.30*	2.17	4.6	9.00	20.0
600	0.30-0.36*	0.58-0.60	1.17	2.20	4.5	10.0
830	0.25	0.48	0.93	1.7	3.4	8.0
1200	0.14-0.18*	0.30	0.62	1.08	2.2	5.0
1800	0.09-0.11*	0.18	0.36-0.40*	0.78	1.5	3.7
2400	0.07-0.09*	0.13-0.15*	0.25-0.32*	0.40-0.64*	1.1	2.7
3600	0.05-0.06*	0.10	0.19	0.4	0.8	2.0

グレーティングは波長間の間隔を決め、スリットは光が通過する幅を制限するのでファイバーコア径と共に波長分解能に影響する



# EVO SERIES

THE NEXT EVOLUTIONARY STEP FOR SPECTROMETRY



# AVANTES' EVO SERIES

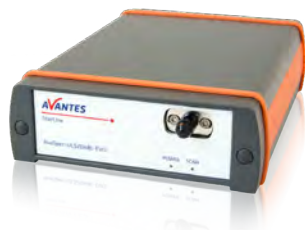
## EVO series; why?

With the introduction of the AS-7010 electronics board, Avantes brought new and improved functionality to their spectrometers. This circuit board brings USB3 and Ethernet communication options to you. These options offer faster data speeds, longer distances and network integration for your application. Our improved electronics deliver more noise-free signals for your measurements and the on-board memory capabilities ensure plenty of capacity for future features. Spectrometers using this AS7010 electronics platform are the next EVOLutionary step in spectrometry. Avantes bundled these spectrometers in the EVO line of products, which are described in this brochure.

## CMOS and CCD

Avantes offers a broad range of spectrometers with different detector technologies. For our Starline spectrometers, the standard Si CCD technology was the dominant technology for years. However, this dominant position is losing ground to CMOS technology. Wanting to be prepared for the future, Avantes embraced the CMOS technology at an early stage and now offers this latest, state-of-the-art technology as the new standard for our spectrometers. In the NIRline spectrometers we use InGaAs detectors and in the SensLine we use back-thinned CCD detectors.

Avantes is proud to announce the latest additions to our EVO-series spectrometers in the UV/VIS and NIR range.



## EVO Series; UV/VIS spectrometer

Offers GigaEthernet and USB3.0 communication, more memory and fast data processing. Using the latest CMOS technology, these spectrometers are ready for the next decade!

## Timing and Triggering

Numerous applications require for a spectrometer to be triggered at a timesensitive moment. For example when measuring in production lines, or with pulsed or flashed events like solar simulators or led measurements. Our state-of-the-art electronics, in combination with the right detector choice will provide you with an excellent instrument for continuous, repetitive, stable measurements. For decades, Avantes spectrometers have been well known for their excellent timing and trigger performance.



## AvaSpec-HERO

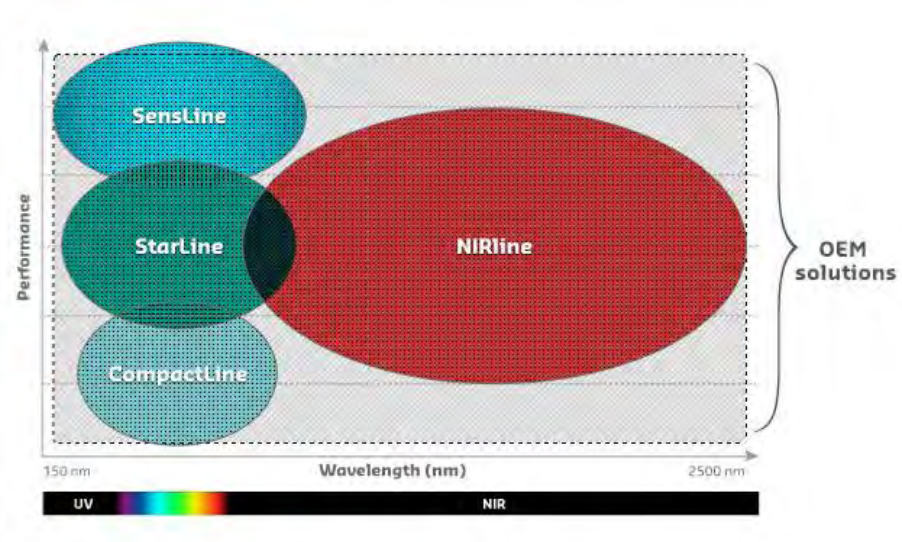
The AvaSpec-HERO is the answer for those in need of high resolution and high sensitivity! It combines high-end, cooled back-thinned detector technology, a 100mm symmetrical Czerny-Turner optical bench and state-of-the-art electronics to enable noise-free signal measurement in the most demanding environment. The ideal choice in the EVO series. A real HERO for your application!

### EVOLutionary spectroscopy:

- Speed
- Network integration
- Multi-channel benefits

# AVANTES' EVO SERIES

## Product line overview



## EVO series in our product lines

Product lines		
Starline	Sensline	NIRline
AvaSpec-ULS2048CL-EVO	AvaSpec-HERO	AvaSpec-NIR256/512-1.7-EVO
AvaSpec-ULS4096CL-EVO	AvaSpec-ULS2048XL-EVO AvaSpec-HS2048XL-EVO	AvaSpec-NIR256/512-1.7-HSC-EVO
	AvaSpec-ULS2048x64-EVO AvaSpec-ULS2048x64TEC-EVO	AvaSpec-NIR256/512-2.5-HSC-EVO



**USB 3.0**



**Gigabit Ethernet**



**More memory**



# AvaSpec-ULS2048CL-EVO

## StarLine CMOS Spectrometer

### AvaSpec-ULS2048CL-EVO



Using CMOS instead of the conventional CCD detectors, this spectrometer offers you the latest technology.

In combination with our latest AS-7010 electronics, it offers you a versatile device including USB3.0 communication with 10x higher speed compared to USB2, and a second communication port which offers Gigabit Ethernet for integration in your company network and possibility for long distance communication.

Besides the high-speed communication options, the EVO series offers a fast microprocessor and increased memory to help you store more

spectra onboard and realize more functionality.

Options include a detector collection lens to enhance sensitivity in the 200 to 1100 nm range and an order-sorting filter to reduce second-order effects. The AvaSpec-ULS2048CL-EVO is available with a wide range of slit sizes, gratings and fiber-optic entrance connectors as well.

It comes complete with AvaSoft-Basic software, USB cable and an extensive manual.

The AvaSpec-ULS2048CL-EVO is also available as OEM unit, bench only or Rackmount version.

### Technical Data

<b>Optical bench</b>	ULS symmetrical Czerny-Turner, 75 mm focal length
<b>Wavelength range</b>	200 - 1100 nm
<b>Resolution</b>	0.06 - 20 nm, depending on configuration (see table)
<b>Stray light</b>	0.19 - 1.0%, depending on the grating
<b>Sensitivity</b>	375,000 counts/ $\mu$ W per ms integration time
<b>Detector</b>	CMOS linear Image Sensor
<b>Signal/noise</b>	300:1
<b>AD converter</b>	16-bit, 6 MHz
<b>Integration time</b>	30 $\mu$ s - 59 s
<b>Interface</b>	USB 3.0 high speed, 5 Gbps Gigabit Ethernet 1 Gbps
<b>Digital IO</b>	HD-26 connector, 2 Analog in, 2 Analog out, 13 Digital bidirectional, trigger, sync., strobe, laser
<b>Power supply</b>	Default USB3 power, 500 mA Or 12VDC, 300 mA
<b>Dimensions, weight</b>	177 x 127 x 44,5 mm (1 channel), 1135 grams

### Timing and Triggering

<b>Sample speed with on-board averaging</b>	0.38 ms/scan
<b>Data transfer speed</b>	0.38 ms/scan (USB3), 1.0 ms (ETH)
<b>Min. delay / jitter</b>	0.9 / 0.02 $\mu$ s

### Detector Specifications

Sensitivity photons/ count @ 600 nm	Sensitivity in cts/ $\mu$ W per ms int. time	QE (%) @ peak	Signal/ noise	Dark noise (counts RMS)	Dynamic range
2	375,000	80%	300:1	16	4000



## Grating Selection Table

Use	Useable range (nm)	Spectral range (nm)	Lines/mm	Blaze (nm)	Order code
UV/VIS/NIR	200 - 1100**	891**	300	300	UA
UV/VIS/NIR	200 - 1100**	891**	300	300/1000	UNA-DB
UV/VIS	200 - 850	515	600	300	UB
UV	200 - 750	247 - 218*	1200	250	UC
UV	200 - 650	163 - 143*	1800	UV	UD
UV	200 - 580	113 - 69*	2400	UV	UE
UV	200 - 400	69 - 45*	3600	UV	UF
UV/VIS	250 - 850	515	600	400	BB
VIS/NIR	300 - 1100**	792**	300	500	VA
VIS	360 - 1000	495	600	500	VB
VIS	300 - 800	247 - 218*	1200	500	VC
VIS	350 - 750	142 - 89*	1800	500	VD
VIS	350 - 640	74 - 49*	2400	VIS	VE
NIR	500 - 1050	495	600	750	NB
NIR	500 - 1050	218 - 148*	1200	750	NC
NIR	600 - 1160	346 - 297	830	800	SI
NIR	600 - 1100**	495**	300	1000	IA
NIR	600 - 1100	495	600	1000	IB

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

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

## Resolution Table (FWHM in nm)

Grating (lines/mm)	Slit size (µm)					
	10	25	50	100	200	500
300	1.0	1.4	2.5	4.8	9.2	21.3
600	0.40 - 0.53*	0.7	1.2	2.4	4.6	10.8
830	0.32	0.48	0.93	1.7	3.4	8.5
1200	0.20 - 0.28*	0.27 - 0.38*	0.52 - 0.66*	1.1	2.3	5.4
1800	0.10 - 0.18*	0.20 - 0.29*	0.34 - 0.42*	0.8	1.6	3.6
2400	0.09 - 0.13*	0.13 - 0.17*	0.26 - 0.34*	0.44 - 0.64*	1.1	2.7
3600	0.06 - 0.08*	0.10	0.19	0.4	0.8	1.8

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

## Options

<b>-RS</b>	• Replaceable slit
<b>DCL-UV/VIS-200</b>	• Quartz detector collection lens (200 - 1100 nm)
<b>SLIT-XX</b>	• Slit size, please specify XX = 5, 10, 25, 50, 100, 200 or 500 µm
<b>SLIT-XX-RS</b>	• Replaceable slit with SMA connector , specify slit size XX = 25, 50, 100, 200 or 500 µm. Only available for AvaSpec-ULS2048CL-EVO-RS
<b>SLIT-XX-RS-FCPC</b>	• As SLIT-XX-RS, but with FC/PC connector
<b>OSF-YYY</b>	• Order-sorting filter for reduction of second-order effects please specify YYY = 305, 395, 475, 515, 550 or 600 nm
<b>OSC</b>	• Order-sorting coating with 600 nm long-pass filter for BB (>305 nm) and VB gratings, recommended with OSF-305
<b>OSC-UA</b>	• Order-sorting coating with 350 and 600 nm linear variable filter for UA, VA gratings
<b>OSC-UB</b>	• Order-sorting coating with 350 and 600 nm long-pass filter for UB or BB (<350 nm) gratings
<b>-FCPC</b>	• FC/PC fiber-optic connector

# AvaSpec-ULS4096CL-EVO

## StarLine CMOS Spectrometer

### AvaSpec-ULS4096CL-EVO



The AvaSpec-ULS4096CL-EVO uses the latest CMOS technology instead of the conventional CCD detectors, which means this spectrometer is completely up to date and ready for the next decade.

The dominant position of CCD detectors in the spectrometer field is fading and new technologies like CMOS have evolved and become a suitable alternative.

In combination with our latest AS-7010 electronics it offers you a versatile device including USB3 communication with 10 times higher speed compared to USB2 and a second communication port that offers Gigabit Ethernet.

Besides the high speed communication options, the EVO series also offers a fast microprocessor and improved memory which can help you to store more spectra onboard and realize more functionality.

The AvaSpec-ULS4096CL-EVO is available with a wide range of slit sizes, gratings and fiber-optic entrance connectors as well. The AvaSpec-ULS4096CL-EVO is also available as OEM unit, bench only or Rackmount version.

With its 4096 pixels, this spectrometer is tailored for high-resolution applications like plasma monitoring and LIBS.

### Technical Data

<b>Optical bench</b>	ULS symmetrical Czerny-Turner, 75 mm focal length
<b>Wavelength range</b>	200 - 1100 nm
<b>Resolution</b>	0.05 - 20 nm, depending on configuration (see table)
<b>Stray light</b>	0.19 - 1.0%, depending on the grating
<b>Sensitivity</b>	218,000 counts/ $\mu$ W per ms integration time
<b>Detector</b>	CMOS linear Image Sensor
<b>Signal/noise</b>	335:1
<b>AD converter</b>	16-bit, 6 MHz
<b>Integration time</b>	9 $\mu$ s - 40 s
<b>Interface</b>	USB 3.0 high speed, 5 Gbps Gigabit Ethernet 1 Gbps
<b>Digital IO</b>	HD-26 connector, 2 Analog in, 2 Analog out, 13 Digital bidirectional, trigger, sync., strobe, laser
<b>Power supply</b>	Default USB3 power, 500 mA Or 12VDC, 300 mA
<b>Dimensions, weight</b>	177 x 127 x 44,5 mm (1 channel), 1135 grams

### Timing and Triggering

<b>Sample speed with on-board averaging</b>	0.7 ms/scan
<b>Data transfer speed</b>	0.7 ms/scan (USB3), 1.0 ms (ETH)
<b>Min. delay / jitter</b>	0.9 / 0.02 $\mu$ s

### Detector Specifications

Sensitivity photons/count @ 600 nm	Sensitivity in cts/ $\mu$ W per ms int. time	QE (%) @ peak	Signal/noise	Dark noise (counts RMS)	Dynamic range
2	218,000	80%	325:1	16	4000



## Grating Selection Table

Use	Useable range (nm)	Spectral range (nm)	Lines/mm	Blaze (nm)	Order code
UV/VIS/NIR	200 - 1100**	891**	300	300	UA
UV/VIS/NIR	200 - 1100**	891**	300	300/1000	UNA-DB
UV/VIS	200 - 850	515	600	300	UB
UV	200 - 750	247 - 218*	1200	250	UC
UV	200 - 650	163 - 143*	1800	UV	UD
UV	200 - 580	113 - 69*	2400	UV	UE
UV	200 - 400	69 - 45*	3600	UV	UF
UV/VIS	250 - 850	515	600	400	BB
VIS/NIR	300 - 1100**	792**	300	500	VA
VIS	360 - 1000	495	600	500	VB
VIS	300 - 800	247 - 218*	1200	500	VC
VIS	350 - 750	142 - 89*	1800	500	VD
VIS	350 - 640	74 - 49*	2400	VIS	VE
NIR	500 - 1050	495	600	750	NB
NIR	500 - 1050	218 - 148*	1200	750	NC
NIR	600 - 1160	346 - 297	830	800	SI
NIR	600 - 1100**	495**	300	1000	IA
NIR	600 - 1100	495	600	1000	IB

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

\*\* please note that not all 4096 pixels will be used for the useable range.

## Resolution Table (FWHM in nm)

Grating (lines/mm)	Slit size (µm)					
	10	25	50	100	200	500
300	0.50 - 0.70	1.20 - 1.30*	2.17	4.6	9.00	20.0
600	0.30 - 0.36*	0.58 - 0.60	1.17	2.20	4.5	10.0
830	0.25	0.48	0.93	1.7	3.4	8.0
1200	0.14 - 0.18*	0.30	0.62	1.08	2.2	5.0
1800	0.09 - 0.11*	0.18	0.36 - 0.40*	0.78	1.5	3.7
2400	0.07 - 0.09*	0.13 - 0.15*	0.26 - 0.32*	0.40 - 0.64*	1.1	2.7
3600	0.05 - 0.06*	0.10	0.19	0.4	0.8	2.0

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

## Options

<b>-RS</b>	• Replaceable slit
<b>DCL-UV/VIS-200</b>	• Quartz detector collection lens (200 - 1100 nm)
<b>SLIT-XX</b>	• Slit size, please specify XX = 5, 10, 25, 50, 100, 200 or 500 µm
<b>SLIT-XX-RS</b>	• Replaceable slit with SMA connector, specify slit size XX = 25, 50, 100 or 200 µm. Only available with AvaSpec-ULS4096CL-EVO-RS
<b>SLIT-XX-RS-FCPC</b>	• As SLIT-XX-RS, but with FC/PC connector
<b>OSF-YYY</b>	• Order-sorting filter for reduction of second-order effects please specify YYY = 305, 395, 475, 515, 550 or 600 nm
<b>OSC</b>	• Order-sorting coating with 600 nm long-pass filter for BB (>305 nm) and VB gratings, recommended with OSF-305
<b>OSC-UA</b>	• Order-sorting coating with 350 and 600 nm linear variable filter for UA, VA gratings
<b>OSC-UB</b>	• Order-sorting coating with 350 and 600 nm long-pass filter for UB or BB (<350 nm) gratings
<b>-FCPC</b>	• FC/PC fiber-optic connector

# AvaSpec-HERO

## SensLine Back-thinned CCD Spectrometer

### AvaSpec-HSC1024x58TEC-EVO



The AvaSpec-Hero is our top-of-the-line spectrometer! Based on our High-Sensitivity Compact optical (HSC) bench ( $f=100\text{mm}$ ;  $NA=0.13$ ) and a 1024x58 back-thinned CCD detector, it offers the best of both worlds: high sensitivity and resolution!

The instrument is equipped with a TE Cooling enabling long integration times in low light applications. In conjunction with our AS7010 electronics, including a high end AD converter, noise is kept to a minimum, which offers you an excellent Signal to Noise and Dynamic Range performance.

From low-light fluorescence applications to the most demanding Raman applications; the AvaSpec-Hero is your ideal companion.

Of course the Digital IO ports enabling external triggering, control of shutters, and pulsed light sources from the Avantes line of instruments are compatible with the HERO as well.

The Avasespec-HERO is standard equipped for use with replaceable slits, offering optimal flexibility for a variety of applications.

### Technical Data: AvaSpec-HSC1024x58TEC-EVO

<b>Optical bench</b>	HSC symmetrical Czerny-Turner, 100 mm focal length, NA: 0.13
<b>Wavelength range</b>	200 - 1160 nm
<b>Resolution</b>	0.2 - 7 nm, depending on configuration (see table)
<b>Stray light</b>	0.5%, depending on the grating
<b>Sensitivity</b>	445,000 counts/ $\mu\text{W}$ per ms integration time
<b>Detector</b>	CCD array image sensor with one stage TE Cooled, 1024 pixels
<b>Signal/noise</b>	1200:1
<b>Dynamic range</b>	40,000
<b>AD converter</b>	16-bit, 250 kHz
<b>Integration time</b>	5.2 ms - 60 sec
<b>Interface</b>	USB 3.0 high speed, 5 Gbps Gigabit Ethernet 1 Gbps
<b>Digital IO</b>	HD-26 connector, 2 Analog in, 2 Analog out, 3 Digital bidirectional, trigger, sync., strobe, laser.
<b>Power supply</b>	12VDC, 1.5A
<b>Dimensions, weight</b>	185 x 161 x 185 mm, 3500 grams

### Timing and Triggering

<b>Sample speed with on-board averaging</b>	5.2 ms/scan
<b>Data transfer speed</b>	5.2 ms/scan (USB3 and ETH)
<b>Min. delay / jitter</b>	-5220 $\mu\text{s}$ / 5220 $\mu\text{s}$

### Detector Specifications

Sensitivity photons/count @ 600 nm	Sensitivity in cts/ $\mu\text{W}$ per ms int. time	QE (%) @ peak	Signal/noise	Dark noise (counts RMS)	Dynamic range
16	445,000	92%	1200:1	2	40,000



## Grating Selection Table

Use	Useable range (nm)	Spectral range (nm)	Lines/mm	Blaze (nm)	Order code
UV/VIS/NIR	200 - 1160	770 - 760*	300	300	HSC0300-0.30
UV/VIS/NIR	250 - 1160	770 - 760*	300	420	HSC0300-0.42
VIS/NIR	250 - 1160	577 - 553	400	550	HSC0400-0.55
UV/VIS	200 - 850	373 - 340*	600	400	HSC0600-0.40
VIS/NIR	250 - 1160	373 - 340*	600	650	HSC0600-0.65
VIS/NIR	500 - 1160	268 - 220*	830	900	HSC0830-0.90
UV/VIS	200 - 1160	182 - 130*	1200	400	HSC1200-0.40
VIS/NIR	500 - 1050	182 - 130*	1200	750	HSC1200-0.75
UV/VIS	200 - 850	84 - 61*	2400	270	HSC2400-0.27

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

## Resolution Table (FWHM in nm)

Grating (lines/mm)	Slit size (µm)					
	10	25	50	100	200	500
300	1.70	1.90	2.45	3.0	5.50	5.50
400	1.40	1.55	2.00	2.55	4.70	5.50
600	0.80	0.85	1.10	1.70	3.00	5.50
830	0.60	0.70	0.9	1.25	2.00	5.50
1200	0.32	0.35	0.48	0.80	1.30	5.50
2400	0.18	0.20	0.29	0.40	0.65	5.50

\* Above values are average values. Due to optical properties resolution will be better in the lower wavelengths than in the higher wavelength range.

## Options

<b>SLIT-XX-RS</b>	<ul style="list-style-type: none"> <li>Replaceable slit with SMA connector, specificity slit size XX = 10, 25, 50, 100, 200 or 500 µm.</li> </ul>
<b>SLIT-XX-RS-FCPC</b>	<ul style="list-style-type: none"> <li>As SLIT-XX-RS, but with FC/PC connector</li> </ul>
<b>SLITKIT-SMA</b>	<ul style="list-style-type: none"> <li>Slit kit containing 25, 50, 100, 200 or 500 µm slits, and the tools to replace the slit. SMA-connectors</li> </ul>
<b>SLITKIT-FCPC</b>	<ul style="list-style-type: none"> <li>As SLITKIT-SMA, but with FC/PC connectors</li> </ul>
<b>OSF-YYY-3</b>	<ul style="list-style-type: none"> <li>Order sorting filter for reduction of second-order effects, 3 mm thick, please specify YYY = 305, 395, 475, 515, 550, 600 nm</li> </ul>
<b>OSC-HSC300</b>	<ul style="list-style-type: none"> <li>Order sorting coating for use with grating HSC0300-xx</li> </ul>
<b>OSC-HSC600</b>	<ul style="list-style-type: none"> <li>Order sorting coating for use with grating HSC0600-xx and HSC0400-xx</li> </ul>

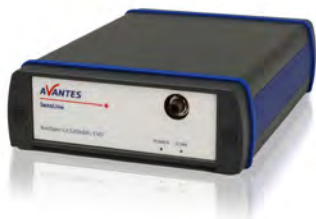
The new AvaSpec-HERO is the answer for those in need of high resolution and high sensitivity!



# AvaSpec-ULS2048XL-EVO

## SensLine Back-thinned CCD Spectrometer

### AvaSpec-ULS2048XL-EVO



Combining exceptional quantum efficiency with high speed is the value proposition of the AvaSpec-ULS2048XL-EVO spectrometer.

Unlike many back-thinned CCD spectro-meters with two dimensional arrays, the AvaSpec-ULS2048XL-EVO has large, monolithic pixels of 14x500 microns with exceptional efficiency in the UV range, from 200 to 400 nm, and the NIR range, from 950 to 1160 nm.

The instrument has an electronic shutter, which enables integration times as low as 2 microseconds.

To further enhance sensitivity, a detector collection lens is available to improve sensitivity up to 60% when combined with larger core fibers.

Options include an order-sorting filter to reduce second-order effects and purge ports for deep-UV measurements. The AvaSpec-ULS2048XL-EVO comes with a wide range of slit sizes, gratings and may be configured with SMA or FC/PC fiberoptic entrance connectors.

Connection to your PC is handled via a USB3-connection or Ethernet, delivering a scan every 2 milliseconds.

### Technical Data

<b>Optical bench</b>	ULS, Symmetrical Czerny-Turner, 75 mm focal length
<b>Wavelength range</b>	200 - 1160 nm
<b>Resolution</b>	0.09 -20 nm, depending on configuration (see table)
<b>Stray light</b>	< 0.5%
<b>Sensitivity</b>	460,000 counts/ $\mu$ W per ms int. time
<b>UV quantum efficiency</b>	60% (200-300 nm)
<b>Detector</b>	Back-thinned CCD image sensor 2048 pixels
<b>Signal/noise</b>	525:1
<b>AD converter</b>	16-bit, 1 MHz
<b>Integration time</b>	2 $\mu$ s - 20 seconds
<b>Interface</b>	USB 3.0 high speed, 5 Gbps Gigabit Ethernet 1 Gbps
<b>Readout noise</b>	9.8 cnt RMS
<b>Dark noise</b>	4.5 cnt RMS
<b>Dynamic range</b>	13,700
<b>Digital IO</b>	HD-26 connector, 2 Analog in, 2 Analog out, 3 Digital in, 12 Digital out, trigger, synchronization
<b>Power supply</b>	Default USB power, 700 mA. Or external 12VDC, 360 mA
<b>Dimensions, weight</b>	175 x 127 x 44,5 mm (1 channel), 1180 grams

### Timing and Triggering

<b>Sample speed with on-board averaging</b>	2.44 ms/scan
<b>Data transfer speed</b>	2.44 ms/scan (USB3)
<b>Min. Delay / Jitter</b>	0.37 / 25 ns

### Detector Specifications

Sensitivity photons/count @ 600 nm	Sensitivity in cts/ $\mu$ W per ms int. time	QE (%) @ peak	Signal/noise	Dark noise (counts RMS)	Dynamic range
4	460,000	78%	525:1	5	13,700



## Grating Selection Table

Use	Useable range (nm)	Spectral range (nm)	Lines/mm	Blaze (nm)	Order code
UV/VIS/NIR	200 - 1160**	960**	300	300	UA
UV/VIS/NIR	200 - 1100**	900**	300	300/1000	UNA-DB
UV/VIS	200 - 850	520	600	300	UB
UV	200 - 750	250 - 220*	1200	250	UC
UV	200 - 650	165 - 145*	1800	UV	UD
UV	200 - 580	115 - 70*	2400	UV	UE
UV	200 - 400	70 - 45*	3600	UV	UF
UV/VIS	250 - 850	520	600	400	BB
VIS/NIR	300 - 1160**	860**	300	500	VA
VIS	360 - 1000	500	600	500	VB
VIS	300 - 800	250 - 200*	1200	500	VC
VIS	350 - 750	145 - 100*	1800	500	VD
VIS	350 - 640	75 - 50*	2400	VIS	VE
NIR	500 - 1050	500	600	750	NB
NIR	500 - 1050	220 - 150*	1200	750	NC
NIR	600 - 1160	350 - 300	830	800	SI
NIR	600 - 1160**	560**	300	1000	IA
NIR	600 - 1160	500	600	1000	IB

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

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

## Resolution Table (FWHM in nm)

Grating (lines/mm)	Slit size (µm)					
	10	25	50	100	200	500
300	1.40	1.50	2.5	4.8	9.2	21.3
600	0.70 - 0.80*	0.75 - 0.85*	1.2	2.4	4.6	10.8
830	0.42 - 0.48*	0.50 - 0.58*	0.93	1.7	3.4	8.5
1200	0.25 - 0.31*	0.37 - 0.43*	0.52 - 0.66*	1.1	2.3	5.4
1800	0.17 - 0.21*	0.26 - 0.32*	0.34 - 0.42*	0.8	1.6	3.6
2400	0.12 - 0.18*	0.18 - 0.24*	0.26 - 0.34*	0.44 - 0.64*	1.1	2.7
3600	0.09 - 0.12*	0.11 - 0.15*	0.19	0.4	0.8	1.8

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

## Options

<b>-RS</b>	• Replaceable slit
<b>DCL-UV/VIS-200</b>	• Quartz detector collection lens (200 - 1100 nm)
<b>SLIT-XX</b>	• Slit size, please specify XX = 10, 25, 50, 100, 200 or 500 µm
<b>SLIT-XX-RS</b>	• Replaceable slit with SMA connector, specify slit size XX = 25, 50, 100, 200 or 500 µm. Only available with AvaSpec-ULS2048XL-EVO-RS
<b>SLIT-XX-RS-FCPC</b>	• As SLIT-XX-RS, but with FC/PC connector
<b>OSF-YYY</b>	• Order-sorting filter for reduction of second-order effects, 1 mm thick, please specify YYY= 305, 395, 475, 515, 550 or 600 nm
<b>OSC</b>	• Order-sorting coating with 600 nm long-pass filter for BB (>350 nm) and VB gratings, recommended with OSF-305
<b>OSC-UA</b>	• Order-sorting coating with 350 and 600 nm linear variable filter for UA, VA gratings
<b>OSC-UB</b>	• Order-sorting coating with 350 and 600 nm long-pass filter for UB or BB (<350 nm) gratings
<b>-FCPC</b>	• FC/PC fiber-optic connector

# AvaSpec-HS2048XL-EVO

## SensLine Back-thinned CCD Spectrometer

### AvaSpec-HS2048XL-EVO



For high-sensitivity applications where high resolution is not of paramount concern, the AvaSpec-HS2048XL-EVO is an exceptional instrument. Featuring Avantes' HS optical bench which has a full 0.22 numerical aperture for superior throughput, the AvaSpec-HS2048XL has a back-thinned CCD detector with 2048 pixels measuring 14X500 microns.

Unlike many back-thinned CCD spectrometers, which have two dimensional arrays, the HS2048XL has large monolithic pixels with exceptional efficiency in the UV, from 200-400 nm, and the NIR, from 950-1160 nm, while retaining sensitivity in the visible range.

The unique optical design features torroid collimating and focusing mirrors to control image magnification and enhance efficiency. The instrument also features an electronic shutter, which enables integration times as low as 2 microseconds.

For configurations that require second-order filtering, order-sorting filters are available. The AvaSpec-HS2048XL is available with a wide range of slit sizes, gratings and may be configured with SMA or FC/ PC fiber-optic entrance connectors.

### Technical Data

<b>Optical bench</b>	High-sensitivity asymmetrical design, 37.5 mm focal length; NA - 0.22, f/2.27
<b>Wavelength range</b>	200 - 1160 nm
<b>Resolution</b>	1 - 20 nm, depending on configuration (see table)
<b>Stray light</b>	< 1 %
<b>Sensitivity</b>	1,250,000 counts/ $\mu$ W per ms int. time
<b>Detector</b>	Back-thinned CCD image sensor 2048 pixels
<b>Signal/noise</b>	525:1
<b>AD converter</b>	16-bit, 1 MHz
<b>Integration time</b>	2 $\mu$ s - 600 seconds
<b>Interface</b>	USB 3.0 high-speed, 5 Gbps Gigabit Ethernet, 1 Gbps
<b>Dynamic range</b>	14,900
<b>Digital IO</b>	HD-26 connector, 2 Analog in, 2 Analog out, 3 Digital in, 12 Digital out, trigger, synchronization
<b>Power supply</b>	Default USB power, 700 mA. or external 12VDC, 360 mA
<b>Dimensions, weight</b>	175 x 165 x 85 mm, 1950 grams

### Timing and Triggering

<b>Sample speed with on-board averaging</b>	2.44 ms/scan
<b>Data transfer speed</b>	2.44 ms/scan (USB3)
<b>Min. delay / jitter</b>	0.37 $\mu$ s / 25 ns

### Detector Specifications

Sensitivity photons/ count @ 600 nm	Sensitivity in cts/ $\mu$ W per ms int. time	QE (%) @ peak	Signal/ noise	Dark noise (counts RMS)	Dynamic range
4	1,250,000	78%	525:1	5	14,900





## Grating Selection Table

Use	Useable range (nm)	Spectral range (nm)	Lines/mm	Blaze (nm)	Order code
UV/VIS/NIR	200 - 1160	900	500	330	HS500-0.33
UV/VIS	200 - 660	440	1000	250	HS1000-0.25
UV	200 - 850	520	600	300	HS600-0.30
UV/VIS	200 - 850	520	600	400	HS600-0.40
UV/VIS	300 - 1160	860	500	560	HS500-0.56
VIS	360 - 1000	500	600	500	HS600-0.50
NIR	500 - 1050	500	600	750	HS600-0.75
VIS	350 - 850	460	900	550	HS900-0.55
VIS	400 - 722	322	1200	500	HS1200-0.5
NIR	600 - 1100	500	600	1000	HS600-1.0
NIR	600 - 1160	350	830	900	HS830-0.9
NIR	750 - 990	240	1200	1000	HS1200-1.0

## Resolution table (FWHM in nm)

Grating (lines/mm)	Slit size (μm)					
	10	25	50	100	200	500
500	2.6	4.5	5.5	6.5	10.0	22.0
600	2.2	3.8	4.5	5.5	7.5	18.0
830*	2.1	3.6	4.0	5.0	7.0	15.0
900*	2.0	3.5	3.8	4.8	6.8	14.5
1000*	1.9	3.3	3.6	4.6	6.6	14.0
1200*	1.8	3.0	3.3	4.3	6.2	13.5

\* theoretical values

## Options

<b>SLIT-XX</b>	• Slit size, please specify XX = 10, 25, 50, 100, 200 or 500 μm
<b>OSF-YYY</b>	• Order-sorting filter for reduction of second-order effects, 1 mm thick, please specify YYY = 305, 385, 475, 515, 550 or 600 nm
<b>OSC-HS500</b>	• Order-sorting coating with 350 and 600 nm long-pass filter for HS500 gratings in AvaSpec-HS
<b>OSC-HS600</b>	• Order-sorting coating with 350 and 600 nm long-pass filter for HS600 gratings in AvaSpec-HS
<b>OSC-HS900</b>	• Order-sorting coating with 600 nm long-pass filter for HS900 gratings in AvaSpec-HS
<b>OSC-HS1000</b>	• Order-sorting coating with 350 nm long-pass filter for HS1000 gratings in AvaSpec-HS
<b>FCPC</b>	• FC/PC fiber optic connector

The AvaSpec-HS2048XL-EVO is ideally suited for diffuse reflection (UV, VIS, NIR) measurements and fluorescence

# AvaSpec-ULS2048x64TEC-EVO SensLine Thermoelectrically Cooled Fiber-Optic Spectrometer

## AvaSpec-ULS2048x64TEC-EVO



### Available soon:

The AvaSpec-ULS2048x64TEC-EVO is an updated version of our AvaSpec-ULS2048x64TEC spectrometer, with improved electronics and cooling.

This instrument enhances the Sensline series with its cooled, back-thinned detector. The back-thinned detector has good sensitivity in the UV and IR region. The 64 pixelheight (0.89 mm) enables catching as many photons as possible while the cooling enables long integration times up to 120 seconds with low-noise levels.

The instrument features Peltier cooling device integrated into our exclusive ultra-low stray light optical bench, which can

reduce the temperature of the CCD chip to  $-30^{\circ}\text{C}$  against ambient, improving the dark baseline and PRNU level significantly. The detector cooling also reduces the dark noise by a factor of 2-3.

The AvaSpec-ULS2048x64TEC-EVO uses a special low-noise version of the 2048x64 detector with integrated cooling.

All the features mentioned above make this instrument ideally suited for measuring low-light applications, such as fluorescence or low-light Raman measurements.

Optimal flexibility is guaranteed with the replaceable slit, making the instrument suitable for various kinds of applications.

## Technical Data

<b>Optical bench</b>	ULS Symmetrical Czerny-Turner, 75 mm focal length
<b>Wavelength range</b>	200 - 1160 nm
<b>Resolution</b>	0.09 - 20 nm, depending on configuration (see table)
<b>Stray light</b>	<1%, depending on the grating
<b>Sensitivity</b>	300,000 counts/ $\mu\text{W}$ per ms integration time
<b>Detector</b>	Backthinned CCD, 2048x64 pixels, low noise, integrated cooling
<b>Temperature-cooled CCD</b>	Max. $\Delta T = -30^{\circ}\text{C}$ versus ambient. Optimal setting: $5^{\circ}\text{C}$
<b>Signal/noise</b>	550:1
<b>AD converter</b>	16-bit, 500 KHz
<b>Dynamic range</b>	19,000
<b>Dark noise</b>	5 cnts
<b>Integration time</b>	9.7 ms - 120 s
<b>Interface</b>	USB 3.0 high speed, 5 Gbps Gigabit Ethernet 1 Gbps
<b>Digital IO</b>	HD-26 connector, 2 Analog in, 2 Analog out, 13 Digital bidirectional, trigger, sync., strobe, laser
<b>Power supply</b>	12 VDC, 1.5 A
<b>Dimensions, weight</b>	185 x 145 x 185 mm, 3500 grams

## Timing and Triggering

<b>Sample speed with on-board averaging</b>	9.7 ms/scan
<b>Data transfer speed</b>	9.7 ms/scan
<b>Min. delay / jitter</b>	9.7 ms

## Detector Specifications

Sensitivity photons/count @ 600 nm	Sensitivity in cts/ $\mu\text{W}$ per ms int. time	QE (%) @ peak	Signal/noise	Dark noise (counts RMS)	Dynamic range
5.9	300,000	78%	550:1	5	19,000

## Grating Selection Table

Use	Useable range (nm)	Spectral range (nm)	Lines/mm	Blaze (nm)	Order code
UV/VIS/NIR	200-1160**	960**	300	300	UA
UV/VIS/NIR	200-1100**	900**	300	300/1000	UNA-DB
UV/VIS	200-850	520	600	300	UB
UV	200-750	250-220*	1200	250	UC
UV	200-650	165-145*	1800	UV	UD
UV	200-580	115-70*	2400	UV	UE
UV	200-400	70-45*	3600	UV	UF
UV/VIS	250-850	520	600	400	BB
VIS/NIR	300-1160**	860**	300	500	VA
VIS	360-1000	500	600	500	VB
VIS	300-800	250-200*	1200	500	VC
VIS	350-750	145-90*	1800	500	VD
VIS	350-640	75-50*	2400	VIS	VE
NIR	500-1050	500	600	750	NB
NIR	500-1050	220-150*	1200	750	NC
NIR	600-1160	350-300	830	800	SI
NIR	600-1160**	560**	300	1000	IA
NIR	600-1160	500	600	1000	IB

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

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

## Resolution Table (FWHM in nm)

Grating (lines/mm)	Slit size (µm)					
	10	25	50	100	200	500
<b>300</b>	1.40	1.50	2.5	4.8	9.2	21.3
<b>600</b>	0.70-0.80*	0.75-0.85*	1.2	2.4	4.6	10.8
<b>830</b>	0.42-0.48*	0.50-0.58*	0.93	1.7	3.4	8.5
<b>1200</b>	0.25-0.31*	0.37-0.43*	0.52-0.66*	1.1	2.3	5.4
<b>1800</b>	0.17-0.21*	0.26-0.32*	0.34-0.42*	0.8	1.6	3.6
<b>2400</b>	0.12-0.18*	0.18-0.24*	0.26-0.34*	0.44-0.64*	1.1	2.7
<b>3600</b>	0.09-0.12*	0.11-0.15*	0.19	0.4	0.8	1.8

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

## Options

<b>DCL-UV/VIS-200</b>	• Detector Collection Lens to enhance sensitivity, Quartz, 200-1100 nm
<b>SLIT-XX-RS</b>	• Replaceable slit with SMA connector. Specify slit size XX= 10, 25, 50, 100, 200 or 500 µm
<b>SLIT-XX-RS-FCPC</b>	• As SLIT-XX-RS, but with FC/PC connector
<b>OSF-YYY</b>	• Order-sorting filter for reduction of 2 <sup>nd</sup> order effects, 1 mm thick, please specify YYY= 305, 395, 475, 515, 550 or 600 nm
<b>OSC</b>	• Order-sorting coating with 600 nm long-pass filter for BB (>350 nm) and VB gratings, recommended with OSF-305
<b>OSC-UA</b>	• Order-sorting coating with linear variable filter for UA, VA gratings
<b>OSC-UB</b>	• Order-sorting coating with 350 and 600 nm long-pass filter for UB or BB (<350 nm) gratings



# AvaSpec-ULS2048x64-EVO SensLine High UV and NIR Sensitivity Spectrometer

## AvaSpec-ULS2048x64-EVO



Alongside the cooled AvaSpec-ULS2048x64TEC-EVO with low-noise detector, Avantes also offers the more cost-effective, uncooled AvaSpec-ULS2048x64-EVO. With its standard 2048x64 backthinned CCD detector, this spectrometer is perfect for less demanding applications in the UV and NIR range.

For applications that require integration times lower than 2 seconds, the cooling option is often not needed. For example, this uncooled AvaSpec-ULS2048x64-EVO has an established track record in various DOAS applications all over the world because of its high UV response and 0.9 mm detector height that enables detecting the wavelengths of interest.

Options include an order-sorting filter, to reduce second-order effects and purge ports for deep-UV measurements. The AvaSpec-ULS2048x64-EVO comes with a wide range of slit sizes, gratings and can be configured with SMA or FC/PC fiber-optic entrance connectors.

The AvaSpec-ULS2048x64-EVO uses the AS7010 electronics board offering USB3 (10 times faster than USB2), Gigabit Ethernet and better signal processing.

Connection to your PC is handled via USB3-connection or Ethernet, delivering a scan every 2 milliseconds. The instrument comes complete with AvaSoft-basic software, USB cable and an extensive manual.

### Technical Data

<b>Optical bench</b>	ULS, Symmetrical Czerny-Turner, 75 mm focal length
<b>Wavelength range</b>	200 - 1160 nm
<b>Resolution</b>	0.09 - 20 nm, depending on configuration (see table)
<b>Stray light</b>	< 1%, depending on the grating
<b>Sensitivity</b>	650,000 counts/ $\mu$ W per ms int. time
<b>Detector</b>	Back-thinned CCD image sensor 2048x64 pixels (height: 0.89 mm)
<b>Signal/noise</b>	450:1
<b>AD converter</b>	16-bit, 1.33 MHz
<b>Integration time</b>	2.4 ms - 25 seconds
<b>Interface</b>	USB 3.0 high-speed, 5 Gbps Gigabit Ethernet 1 Gbps
<b>Readout noise</b>	7.5 cnt RMS
<b>Dark noise</b>	11.5 cnt RMS
<b>Dynamic range</b>	6100
<b>Digital IO</b>	HD-26 connector, 2 Analog in, 2 Analog out, 13 Digital bidirectional, trigger, sync., strobe, laser
<b>Power supply</b>	Default USB power, 885 mA. Or external 12VDC, 420 mA
<b>Dimensions, weight</b>	175 x 127 x 44,5 mm (1 channel), 1180 grams

### Timing and Triggering

<b>Sample speed with on-board averaging</b>	2.4 ms/scan
<b>Data transfer speed</b>	2.4 ms/scan
<b>Min. delay / jitter</b>	2.4 ms

### Detector Specifications

Sensitivity photons/count @ 600 nm	Sensitivity in cts/ $\mu$ W per ms int. time	QE (%) @ peak	Signal/noise	Dark noise (counts RMS)	Dynamic range
3.9	650,000	78%	450:1	11.5	1600

## Grating Selection Table

Use	Useable range (nm)	Spectral range (nm)	Lines/mm	Blaze (nm)	Order code
UV/VIS/NIR	200-1160**	960**	300	300	UA
UV/VIS/NIR	200-1100**	900**	300	300/1000	UNA-DB
UV/VIS	200-850	520	600	300	UB
UV	200-750	250-220*	1200	250	UC
UV	200-650	165-145*	1800	UV	UD
UV	200-580	115-70*	2400	UV	UE
UV	200-400	70-45*	3600	UV	UF
UV/VIS	250-850	520	600	400	BB
VIS/NIR	300-1160**	860**	300	500	VA
VIS	360-1000	500	600	500	VB
VIS	300-800	250-200*	1200	500	VC
VIS	350-750	145-100*	1800	500	VD
VIS	350-640	75-50*	2400	VIS	VE
NIR	500-1050	500	600	750	NB
NIR	500-1050	220-150*	1200	750	NC
NIR	600-1160	350-300	830	800	SI
NIR	600-1160**	560**	300	1000	IA
NIR	600-1160	500	600	1000	IB

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

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

## Resolution Table (FWHM in nm)

Grating (lines/mm)	Slit size (μm)					
	10	25	50	100	200	500
300	1.40	1.50	2.5	4.8	9.2	21.3
600	0.70 - 0.80*	0.75-0.85*	1.2	2.4	4.6	10.8
830	0.42 - 0.48*	0.50-0.58*	0.93	1.7	3.4	8.5
1200	0.25 - 0.31*	0.37 - 0.43*	0.52-0.66*	1.1	2.3	5.4
1800	0.17 - 0.21*	0.26 - 0.32*	0.34-0.42*	0.8	1.6	3.6
2400	0.12 - 0.18*	0.18 - 0.24*	0.26-0.34*	0.44-0.64*	1.1	2.7
3600	0.09 - 0.12*	0.11 - 0.15*	0.19	0.4	0.8	1.8

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

## Options

<b>-RS</b>	• Replaceable slit
<b>DCL-UV/VIS-200</b>	• Quartz detector collection lens (200 - 1100 nm)
<b>SLIT-XX</b>	• Slit size, please specify XX = 5, 10, 25, 50, 100, 200 or 500 μm
<b>SLIT-XX-RS</b>	• Replaceable slit with SMA connector , specify slit size XX = 25, 50, 100, 200 or 500 μm. Only available for AvaSpec-ULS2048CL-EVO-RS
<b>SLIT-XX-RS-FCPC</b>	• As SLIT-XX-RS, but with FC/PC connector
<b>OSF-YYY</b>	• Order-sorting filter for reduction of second-order effects please specify YYY = 305, 395, 475, 515, 550 or 600 nm
<b>OSC</b>	• Order-sorting coating with 600 nm long-pass filter for BB (>305 nm) and VB gratings, recommended with OSF-305
<b>OSC-UA</b>	• Order-sorting coating with 350 and 600 nm linear variable filter for UA, VA gratings
<b>OSC-UB</b>	• Order-sorting coating with 350 and 600 nm long-pass filter for UB or BB (<350 nm) gratings
<b>-FCPC</b>	• FC/PC fiber-optic connector

# AvaSpec-ULS2048x64-EVO SensLine High UV and NIR Sensitivity Back-thinned CCD Spectrometer

Alongside the cooled AvaSpec-ULS2048x64TEC-EVO with low-noise detector, Avantes also offers the more cost-effective, uncooled AvaSpec-ULS2048x64-EVO. With its standard 2048x64 backthinned detector, this spectrometer is perfect for less demanding applications in the UV and NIR range.

For applications that require integration times lower than 2 seconds, the cooling option is often not needed. For example, this uncooled AvaSpec-ULS2048x64-EVO has an established track record in various DOAS applications all over the world because of its high UV response and 0.9 mm detector height that enables detecting the wavelengths of interest.

Options include an order-sorting filter, to reduce second-order effects and purge ports for deep-UV measurements. The AvaSpec-ULS2048x64-EVO comes with a wide range of slit sizes, gratings and can be configured with SMA or FC/PC fiber-optic entrance connectors.

The AvaSpec-ULS2048x64-EVO uses the AS7010 electronics board offering USB3 (10 times faster than USB2), Gigabit Ethernet and better signal processing.

Connection to your PC is handled via USB3-connection or Ethernet, delivering a scan every 2 milliseconds. The instrument comes complete with AvaSoft-basic software, USB cable and an extensive manual.

**AvaSpec-ULS2048x64-EVO**



## Technical Data

<b>Optical bench</b>	ULS, Symmetrical Czerny-Turner, 75 mm focal length
<b>Wavelength range</b>	200 - 1160 nm
<b>Resolution</b>	0.09 -20 nm, depending on configuration (see table)
<b>Stray light</b>	< 1%, depending on the grating
<b>Sensitivity</b>	650,000 counts/ $\mu$ W per ms int. time
<b>Detector</b>	Back-thinned CCD image sensor 2048x64 pixels (height: 0.89 mm)
<b>Signal/noise</b>	450:1
<b>AD converter</b>	16-bit, 1.33 MHz
<b>Integration time</b>	2.4 ms - 25 seconds
<b>Interface</b>	USB 3.0 high-speed, 5 Gbps Gigabit Ethernet 1 Gbps
<b>Sample speed with on-board averaging</b>	2.4 ms/scan
<b>Readout noise</b>	7.5 cnt RMS
<b>Dark noise</b>	11.5 cnt RMS
<b>Dynamic range</b>	6100
<b>Data transfer speed</b>	2.4 ms/scan (USB3)
<b>Digital IO</b>	HD-26 connector, 2 Analog in, 2 Analog out, 13 Digital bidirectional, trigger, sync., strobe, laser
<b>Power supply</b>	Default USB power, 885 mA. Or external 12VDC, 420 mA
<b>Dimensions, weight</b>	177 x 127 x 44,5 mm (1 channel), 1180 grams



## Grating Selection Table for AvaSpec-ULS2048x64-EVO

Use	Useable range (nm)	Spectral range (nm)	Lines/mm	Blaze (nm)	Order code
UV/VIS/NIR	200-1160**	960**	300	300	UA
UV/VIS/NIR	200-1100**	900**	300	300/1000	UNA-DB
UV/VIS	200-850	520	600	300	UB
UV	200-750	250-220*	1200	250	UC
UV	200-650	165-145*	1800	UV	UD
UV	200-580	115-70*	2400	UV	UE
UV	200-400	70-45*	3600	UV	UF
UV/VIS	250-850	520	600	400	BB
VIS/NIR	300-1160**	860**	300	500	VA
VIS	360-1000	500	600	500	VB
VIS	300-800	250-200*	1200	500	VC
VIS	350-750	145-100*	1800	500	VD
VIS	350-640	75-50*	2400	VIS	VE
NIR	500-1050	500	600	750	NB
NIR	500-1050	220-150*	1200	750	NC
NIR	600-1160	350-300	830	800	SI
NIR	600-1160**	560**	300	1000	IA
NIR	600-1160	500	600	1000	IB

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

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

## Resolution Table (FWHM in nm) for AvaSpec-ULS2048x64-EVO

Grating (lines/mm)	Slit size (μm)					
	10	25	50	100	200	500
300	1.40	1.50	2.5	4.8	9.2	21.3
600	0.70 - 0.80*	0.75-0.85*	1.2	2.4	4.6	10.8
830	0.42 - 0.48*	0.50-0.58*	0.93	1.7	3.4	8.5
1200	0.25 - 0.31*	0.37 - 0.43*	0.52-0.66*	1.1	2.3	5.4
1800	0.17 - 0.21*	0.26 - 0.32*	0.34-0.42*	0.8	1.6	3.6
2400	0.12 - 0.18*	0.18 - 0.24*	0.26-0.34*	0.44-0.64*	1.1	2.7
3600	0.09 - 0.12*	0.11 - 0.15*	0.19	0.4	0.8	1.8

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

## Ordering Information

### AvaSpec-ULS2048x64-EVO

- Ultra-low Stray-light Fiber-optic Spectrometer, 75 mm AvaBench, 2048x64 pixel back-thinned CCD detector, USB powered, high-speed USB3.0 and ETH interface, incl. AvaSoft-Basic, USB interface cable.
- Specify grating, wavelength range and options

## Options

-RS	• Replaceable slit
DCL-UV/VIS-200	• Quartz detector collection lens (200 - 1100 nm)
SLIT-XX	• Slit size, please specify XX = 5, 10, 25, 50, 100, 200 or 500 μm
SLIT-XX-RS	• Replaceable slit with SMA connector, specify slit size XX = 25, 50, 100, 200 or 500 μm. Only available for AvaSpec-ULS2048CL-EVO-RS
SLIT-XX-RS-FCPC	• As SLIT-XX-RS, but with FC/PC connector
OSF-YYY	• Order-sorting filter for reduction of second-order effects please specify YYY = 305, 395, 475, 515, 550 or 600 nm
OSC	• Order-sorting coating with 600 nm long-pass filter for BB (>305 nm) and VB gratings, recommended with OSF-305
OSC-UA	• Order-sorting coating with 350 and 600 nm linear variable filter for UA, VA gratings
OSC-UB	• Order-sorting coating with 350 and 600 nm long-pass filter for UB or BB (<350 nm) gratings
-FCPC	• FC/PC fiber-optic connector

# AvaSpec-ULS2048x64TEC-EVO SensLine Thermoelectrically Cooled Fiber-Optic Spectrometer

The AvaSpec-ULS2048x64TEC-EVO is an updated version of our AvaSpec-ULS2048x64TEC spectrometer, with improved electronics and cooling.

This instrument enhances the Sensline series with its cooled, back-thinned detector. The back-thinned detector has good sensitivity in the UV and IR region. The 64 pixelheight (0.89 mm) enables catching as many photons as possible while the cooling enables long integration times up to 120 seconds with low-noise levels.

The instrument features Peltier cooling device integrated into our exclusive ultra-low stray light optical bench, which can reduce the temperature of the CCD chip to -30°C against ambient, improving the dark baseline and PRNU level significantly. The detector cooling also reduces the dark noise by a factor of 2-3.

The AvaSpec-ULS2048x64TEC-EVO uses a special low-noise version of the 2048x64 detector with integrated cooling.

All the features mentioned above make this instrument ideally suited for measuring low-light applications, such as fluorescence or low-light Raman measurements.

Optimal flexibility is guaranteed with the replaceable slit, making the instrument suitable for various kinds of applications.

The above mentioned qualities make the AvaSpec-ULS2048x64TEC-EVO an excellent choice for low light-level applications, such as fluorescence and Raman measurements, where integration times of more than 5 seconds may be needed.

## AvaSpec-ULS2048x64TEC-EVO



### Technical Data

<b>Optical bench</b>	ULS Symmetrical Czerny-Turner, 75 mm focal length
<b>Wavelength range</b>	200-1160 nm
<b>Resolution</b>	0.09 -20 nm, depending on configuration (see table)
<b>Stray light</b>	<1%, depending on the grating
<b>Sensitivity</b>	300,000 counts/μW per ms integration time
<b>Detector</b>	Backthinned CCD, 2048x64 pixels, low noise, integrated cooling
<b>Temperature-cooled CCD</b>	Max. ΔT = -30°C versus ambient. Optimal setting: 5°C
<b>Signal/noise</b>	550:1
<b>AD converter</b>	16-bit, 500 KHz
<b>Dynamic range</b>	19,000
<b>Dark noise</b>	5 cnts
<b>Integration time</b>	9.7 ms-120 s
<b>Interface</b>	USB 3.0 high speed, 5 Gbps Gigabit Ethernet 1 Gbps
<b>Sample speed with on-board averaging</b>	9.7 ms/scan
<b>Data transfer speed</b>	9.7 ms/scan (USB3) 9.7 ms/scan (ETH)
<b>Digital IO</b>	HD-26 connector, 2 Analog in, 2 Analog out, 13 Digital bidirectional, trigger, sync., strobe, laser
<b>Power supply</b>	12 VDC, 1.5 A
<b>Operating temperature</b>	0-40°C
<b>Cooling</b>	30°C versus ambient
<b>Dimensions, weight</b>	185 x 145 x 185 mm, 3500 grams

## Grating Selection Table for AvaSpec-ULS2048x64TEC-EVO

Use	Useable range (nm)	Spectral range (nm)	Lines/mm	Blaze (nm)	Order code
UV/VIS/NIR	200-1160**	960**	300	300	UA
UV/VIS/NIR	200-1100**	900**	300	300/1000	UNA-DB
UV/VIS	200-850	520	600	300	UB
UV	200-750	250-220*	1200	250	UC
UV	200-650	165-145*	1800	UV	UD
UV	200-580	115-70*	2400	UV	UE
UV	200-400	70-45*	3600	UV	UF
UV/VIS	250-850	520	600	400	BB
VIS/NIR	300-1160**	860**	300	500	VA
VIS	360-1000	500	600	500	VB
VIS	300-800	250-200*	1200	500	VC
VIS	350-750	145-90*	1800	500	VD
VIS	350-640	75-50*	2400	VIS	VE
NIR	500-1050	500	600	750	NB
NIR	500-1050	220-150*	1200	750	NC
NIR	600-1160	350-300	830	800	SI
NIR	600-1160**	560**	300	1000	IA
NIR	600-1160	500	600	1000	IB

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

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

## Resolution Table (FWHM in nm) for AvaSpec-ULS2048x64TEC

Grating (lines/mm)	Slit size (μm)					
	10	25	50	100	200	500
300	1.40	1.50	2.5	4.8	9.2	21.3
600	0.70-0.80*	0.75-0.85*	1.2	2.4	4.6	10.8
830	0.42-0.48*	0.50-0.58*	0.93	1.7	3.4	8.5
1200	0.25-0.31*	0.37-0.43*	0.52-0.66*	1.1	2.3	5.4
1800	0.17-0.21*	0.26-0.32*	0.34-0.42*	0.8	1.6	3.6
2400	0.12-0.18*	0.18-0.24*	0.26-0.34*	0.44-0.64*	1.1	2.7
3600	0.09-0.12*	0.11-0.15*	0.19	0.4	0.8	1.8

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

## Ordering Information

## AvaSpec-ULS2048x64TEC-EVO

Thermoelectrically cooled fiber-optic spectrometer, 75 mm ultra-low stray light AvaBench, 2048x64 pixel, TE-cooled and regulated low-noise CCD detector, USB3/ETH high-speed interface and replaceable slit, incl. AvaSoft-Basic, USB cable, desktop housing. Specify grating, wavelength range and options

## Options

<b>DCL-UV/VIS-200</b>	• Detector Collection Lens to enhance sensitivity, Quartz, 200-1100 nm
<b>SLIT-XX-RS</b>	• Replaceable slit with SMA connector. Specify slit size XX= 10, 25, 50, 100, 200 or 500 μm
<b>SLIT-XX-RS-FCPC</b>	• As SLIT-XX-RS, but with FC/PC connector
<b>OSF-YYY</b>	• Order-sorting filter for reduction of 2 <sup>nd</sup> order effects, 1 mm thick, please specify YYY= 305, 395, 475, 515, 550 or 600 nm
<b>OSC</b>	• Order-sorting coating with 600 nm long-pass filter for BB (>350 nm) and VB gratings, recommended with OSF-305
<b>OSC-UA</b>	• Order-sorting coating with linear variable filter for UA, VA gratings
<b>OSC-UB</b>	• Order-sorting coating with 350 and 600 nm long-pass filter for UB or BB (<350 nm) gratings

# AvaSpec-NIR256/512-1.7-EVO

## NIRLine Near-Infrared Spectrometer

### AvaSpec-NIR256/512-1.7-EVO



For measurements in the near-infrared range out to 1.7  $\mu\text{m}$ , Avantes offers a new series of uncooled spectrometer configurations. The AvaSpec-NIR256-1.7-EVO and the AvaSpec-NIR512-1.7-EVO offer the same high-sensitivity optical bench with the next generation of electronics. Both instruments deliver the same exceptional performance specifications such as a sample speed of only 0.53 ms/scan and integration times as fast as 20  $\mu\text{s}$ , as the Avantes instruments you have come to trust.

For applications where resolution is key, or more datapoints for modelling are required, the 512 pixel detector will be the best choice.

The AvaSpec-NIR256/512-1.7-EVO spectrometers pair the same trusted InGaAs array detectors with our ultra low-noise electronics board featuring USB3 and Giga-Ethernet connection port. Digital and analog I/O ports enable external triggering and control over the shutter and pulsed lightsources and choose from two distinct software-controlled gain-setting modes, high-sensitivity mode (HS, default) and the low-noise (LN) mode.

These affordable, uncooled instruments are USB powered and are available with a choice of four gratings and replaceable slits to match the bandwidth and requirements fitting your application.

### Technical Data

	AvaSpec-NIR256-1.7-EVO	AvaSpec-NIR512-1.7-EVO
<b>Optical bench</b>	Symmetrical Czerny-Turner, 50 mm focal length,	
<b>Wavelength range</b>	900-1750 nm	
<b>Resolution (slit &amp; grating dependent)</b>	2 - 50 nm	
<b>Stray light</b>	<1%	
<b>Sensitivity HS in counts /<math>\mu\text{W}</math> per ms</b>	8,200,000 (integral 1000-1750 nm)	3,800,000 (integral 1000-1750 nm)
<b>Dynamic range HS</b>	6000:1	
<b>Integration time HS</b>	20 $\mu\text{s}$ - 500 ms	
<b>Signal/noise HS</b>	1900:1	
<b>Sensitivity LN in counts /<math>\mu\text{W}</math> per ms</b>	469,000 (integral 1000-1750 nm)	222,000 (integral 1000-1750 nm)
<b>Dynamic range LN</b>	9000:1	
<b>Integration time LN</b>	20 $\mu\text{s}$ - 20 seconds	
<b>Signal/noise LN</b>	5000:1	
<b>Detector</b>	InGaAs linear array, 256 pixels, 50 $\mu\text{m}$ x 500 $\mu\text{m}$	InGaAs linear array, 512 pixels, 25 $\mu\text{m}$ x 500 $\mu\text{m}$
<b>AD converter</b>	16-bit, 500 kHz	
<b>Interface</b>	USB3.0 high speed, 5 Gbps, Gigabit Ethernet 1 Gbps	
<b>Sample speed with on-board averaging</b>	0.53 ms/scan	
<b>Data transfer speed</b>	0.53 ms/scan (USB3)	
<b>Digital IO</b>	HD-26 connector, 2 Analog in, 2 Analog out, 13 Digital IO bi-directional, trigger, synchronization, strobe, laser	
<b>Power supply</b>	Default USB power, 600 mA or external 12VDC, 320mA (4W)	
<b>Dimensions, weight</b>	185 x 100 x 184 mm, 2700 grams	



## Grating Selection Table

Use	Useable range (nm)	Spectral range (nm)	Lines/mm	Blaze (nm)	Order code
NIR	900 - 1750	850	200	1500	NIR200-1.5
NIR	1000 - 1700	340	400	1600	NIR400-1.6
NIR	900 - 1400	200	600	1200	NIR600-1.2
NIR	1300 - 1600	152	600	1600	NIR600-1.6

## Resolution Table (FWHM in nm)

Grating (lines/mm)	Slit size (μm)				
	25*	50	100	200	500
200	6	8	12	22	50
400	2.5	3	6	12	25
600	n.a.	2	4	8	18

\* only for AvaSpec-NIR512

## Options

- SLIT-XX-RS** • Replaceable slit with SMA connector, specify slit size XX = 25\*, 50, 100 or 200 μm
- SLIT-XX-RS-FCPC** • As SLIT-XX-RS, but with FC/PC connector

\* only for AvaSpec-NIR512

For external triggering, Avantes offers the AvaTrigger; featuring optical triggering, an external TTL and manual triggering through the push of a button.

# AvaSpec-NIR256/512-1.7-HSC-EVO NIRLine Near-Infrared Spectrometer

## AvaSpec-NIR256-1.7-HSC-EVO



For measurements in the near-infrared range up to 1.7  $\mu\text{m}$ , Avantes offers a new series of cooled spectrometer configurations. The AvaSpec-NIR256-1.7-HSC-EVO and the AvaSpec-NIR512-1.7-HSC-EVO offer the high-sensitivity, 100mm optical bench (HSC) with the next generation of electronics.

Both instruments deliver exceptional performance specifications, such as a high sample speed and integration times as fast as 20  $\mu\text{s}$ , as the Avantes instruments you have come to trust.

For applications where resolution is key, or more datapoints for modelling are required, the 512 pixel detector will be the best choice.

The AvaSpec-NIR256/512-1.7-HSC-EVO spectrometers pair the same

trusted InGaAs array detectors with our ultra-low-noise electronics board, featuring USB3 and Giga-Ethernet connection port.

The instruments are standard equipped with a replaceable slit. Digital and analog I/O ports enable external triggering and control over the shutter and pulsed lightsources and the choice between two distinct software-controlled gainsetting modes, high-sensitivity mode (HS, default) and the low-noise mode (LN).

Cooling ensures optimal noise condition even at longer integration times. All NIR-1.7 instruments offer four different gratings, making it possible to choose the bandwidth fitting your application.

### Technical Data

	AvaSpec-NIR256-1.7-HSC-EVO	AvaSpec-NIR512-1.7-HSC-EVO
<b>Optical bench</b>	Symmetrical Czerny-Turner, 100 mm focal length, 1 stage TE-cooled	
<b>Wavelength range</b>	900 - 1750 nm	
<b>Resolution (slit &amp; grating dependent)</b>	1.9 - 32 nm	1.7 - 32 nm
<b>Stray light</b>	<1%	
<b>Sensitivity HS in counts /<math>\mu\text{W}</math> per ms</b>	4,800,000 (integral 1000-1750 nm)	2,500,000 (integral 1000-1750 nm)
<b>Dynamic range HS</b>	4900:1	
<b>Signal/noise HS</b>	5000:1	
<b>Integration time HS</b>	20 $\mu\text{s}$ - 500 ms	
<b>Sensitivity LN in counts /<math>\mu\text{W}</math> per ms</b>	160,000 (integral 1000 - 1750 nm)	83,000 (integral 1000 - 1750 nm)
<b>Dynamic range LN</b>	7600:1	
<b>Signal/noise LN</b>	5000:1	
<b>Integration time LN</b>	20 $\mu\text{s}$ - 20 seconds	
<b>Detector</b>	TE-cooled InGaAs linear array, 256 pixels, 50 $\mu\text{m}$ x 500 $\mu\text{m}$	TE-cooled InGaAs linear array, 512 pixels, 25 $\mu\text{m}$ x 500 $\mu\text{m}$
<b>AD converter</b>	16-bit, 1,2 MHz	
<b>Interface</b>	USB3.0 high speed, 5 Gbps, Gigabit Ethernet 1 Gbps	
<b>Digital IO</b>	HD-26 connector, 2 Analog in, 2 Analog out, 13 Digital IO bi-directional, trigger, synchronization, strobe, laser	
<b>Power supply</b>	12VDC, 12W	
<b>Dimensions, weight</b>	185 x 160 x 184 mm, 3.6 kg	

### Timing and Triggering

<b>Sample speed with on-board averaging</b>	0.13 ms/scan	0.24 ms/scan (USB3)
<b>Data transfer speed</b>	0.4 ms/scan (USB3)	0.53 ms/scan (USB3)
<b>Min. delay / jitter</b>	4.92 $\mu\text{s}$ / 0.38 ns	

## Grating Selection Table

Use	Useable range (nm)	Spectral range (nm)	Lines/mm	Blaze (nm)	Order code
		256/512			
NIR	900 - 1700	800 - 660*	150	1250	NIR150-1.2
NIR	994 - 1280	278	300	1200	NIR300-1.2
NIR	950 - 1800	262 - 230*	400	1200	NIR400-1.2
NIR	960 - 1800	262 - 230*	400	1600	NIR400-1.6

\* only for AvaSpec-NIR512

## Resolution Table (FWHM in nm)

Grating (lines/mm)	Slit size (μm)				
	25*	50	100	200	500
150	4.0	5.7	7.0	12.8	32
300	1.8	2.3	3.0	4.0	10
400	1.7	1.9	2.5	3.3	8.3

## Options

- SLIT-XX-RS** • Replaceable slit with SMA connector, specify slit size XX = 25\*, 50, 100, 200 or 500 μm
- SLIT-XX-RS-FCPC** • as SLIT-XX-RS, but with FC/PC connector

\* only for AvaSpec-NIR512

For external triggering, Avantes offers the AvaTrigger; featuring optical triggering, an external TTL and manual triggering through the push of a button.

# AvaSpec-NIR256/512-2.5-HSC-EVO

## NIRLine Near-infrared Spectrometer

### AvaSpec-NIR256-2.5-HSC-EVO



The NIR spectrometers in our EVO series offer more sensitivity, low weight and small size. They are based on a 100 mm optical bench with an NA of 0.13, offering optimal balance between resolution and sensitivity.

The 2.5-HSC series feature 256 or 512 pixel InGaAs detectors and are available in multiple configurations. These instruments are perfect for analyzing grain, corn, wheat, soya, polymers, but also for medical uses, process monitoring and other analyses.

The 256 pixel detectors offer the best sensitivity for most applications.

For applications where resolution is key or more datapoints for modelling are required, the 512 pixel detector will be the best choice.

Also available on the –HSC is the user selectable gain-setting mode: LN (lownoise, standard setting), which gives you a longer integration time and higher signal to noise ratio, and HS mode (high-sensitivity) for measuring in low light conditions. Analog and digital IO ports enable external triggering and control of shuttered and pulsed light sources from the AvaLight series.

### Technical Data

	AvaSpec-NIR256-2.5-HSC-EVO	AvaSpec-NIR512-2.5-HSC-EVO
<b>Optical bench</b>	TE-cooled symmetrical Czerny Turner, 100 mm focal length	
<b>Wavelength range</b>	1000 - 2500 nm	
<b>Resolution</b>	4.4 - 85.0 nm	2.6 - 85.0 nm
<b>Pixel dispersion (with NIR 075-1.7 grating)</b>	6.2 nm	3.1 nm
<b>Stray light</b>	<1.0%	
<b>Sensitivity HS in counts / <math>\mu</math>W per ms (1000 - 2500 nm)</b>	990,000	480,000
<b>Signal/noise HS</b>	1800:1	1900:1
<b>Integration time HS</b>	10 $\mu$ s - 5 ms	
<b>Sensitivity LN in counts / <math>\mu</math>W per ms (1000 - 2500 nm)</b>	55,000	26,600
<b>Signal/noise LN</b>	4000:1	3700:1
<b>Integration time LN</b>	10 $\mu$ s - 100 ms	
<b>Detector</b>	InGaAs linear array with 2-stage TE-cooling, 256 pixel	InGaAs linear array with 2-stage TE-cooling, 512 pixel
<b>Pixel size (WxH)</b>	50 x 250 $\mu$ m	25 x 250 $\mu$ m
<b>AD converter</b>	16 bit, 500 kHz	
<b>Interface</b>	USB 3.0 high speed, 5 Gbps Gigabit Ethernet 1 Gbps	
<b>Sample speed with on-board averaging</b>	0.54 ms/scan (USB3)	
<b>Data transfer speed</b>	1.11 ms/scan (USB3)	
<b>Digital IO</b>	HD-26 connector, 2 Analog in, 2 Analog out, 13 Digital bi-directional, trigger, sync, strobe, laser	
<b>Power supply</b>	12 V, 40W	
<b>Operating temperature range</b>	0 - 40 $^{\circ}$ C	
<b>Cooling</b>	45 $^{\circ}$ C versus ambient	
<b>Dimensions, weight</b>	185 x 145 x 185 mm, 3.5 kg	

## Grating Selection Table

Use	Useable range (nm)	Spectral range (nm)	Lines/mm	Blaze (nm)	Order code
NIR	1000 - 2500	1500	75	1700	NIR075-1.7
NIR	1000 - 2500	1173 - 1150*	100	2500	NIR100-2.5
NIR	1000 - 2500	800 - 660*	150	2000	NIR150-2.0
NIR	1000 - 2500	815 - 700*	150	2600	NIR150-2.6
NIR	1000 - 2500	574 - 530*	200	1500	NIR200-1.5

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

## Resolution Table (FWMH in nm)

Grating (lines/mm)	Slit size (µm)				
	25*	50	100	200	500
75	8.9	12.9	16.0	33.9	84.5
100	7.2	9.5	12.0	20.0	50.0
150	4.0	5.7	7.0	12.8	32.0
200	2.6	4.4	5.2	9.3	23.3

## Options

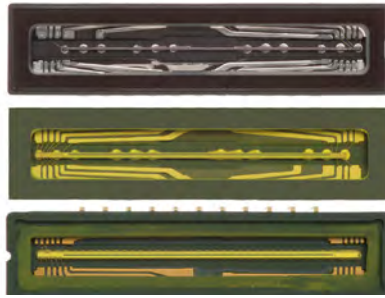
**SLIT-XX-RS** • Slit size, please specify XX = 25, 50, 100, 200 or 500 µm

This instrument is perfect for grain, corn, wheat, soya and other analyses.



# Detector Specifications

## StarLine & SensLine



StarLine and SensLine Detectors

### Detector Specifications (based on a 16-bit AD converter)

Detector	StarLine			SensLine	
	HAM-2048CL	HAM-4096CL	SONY-2048L	HAM-2048XL	HAM-1024x58
Type	CMOS linear array	CMOS linear array	CCD linear array	Back-thinned CCD array	Cooled Back-thinned CCD array
# Pixels, pitch	2048, 14 $\mu\text{m}$	4096, 7 $\mu\text{m}$	2048, 14 $\mu\text{m}$	2048, 14 $\mu\text{m}$	1024 x 58, 24 $\mu\text{m}$
Pixel width x height ( $\mu\text{m}$ )	14 x 200	7 x 200	14 x 200	14 x 500	24 x 24 (total height 1.4 mm)
Pixel well depth (electrons)	80,000	80,000	90,000	200,000	1,000,000
Sensitivity Photons/count @600 nm	2	2	4	4	16
Sensitivity in counts/ $\mu\text{W}$ per ms integration time	375,000 (AvaSpec-ULS2048CL)	218,000 (AvaSpec-ULS4096CL)	470,000 (AvaSpec-ULS2048L)	460,000 (AvaSpec-ULS2048XL)	445,000 (AvaSpec-HERO)
Peak wavelength	700 nm	700 nm	450 nm	650 nm	650 nm
QE (%) @ peak	80%	80%	40%	78%	92%
Signal/Noise	300:1	335:1	300 :1	525 :1	1200:1
Dark noise (counts RMS)	16	16	20	5	2
Dynamic Range	4000	4000	3300	3800	40000
Photo-responsive non-uniformity	$\pm 5\%$	$\pm 5\%$	$\pm 5\%$	$\pm 3\%$	$\pm 3\%$
Wavelength range (nm)	200 - 1100	200 - 1100	200* - 1100	200 - 1160	200 - 1160
Frequency	6 MHz	6 MHz	2 MHz	1 MHz	250 kHz

\* DUV coating

# Detector Specifications

## NIRLine

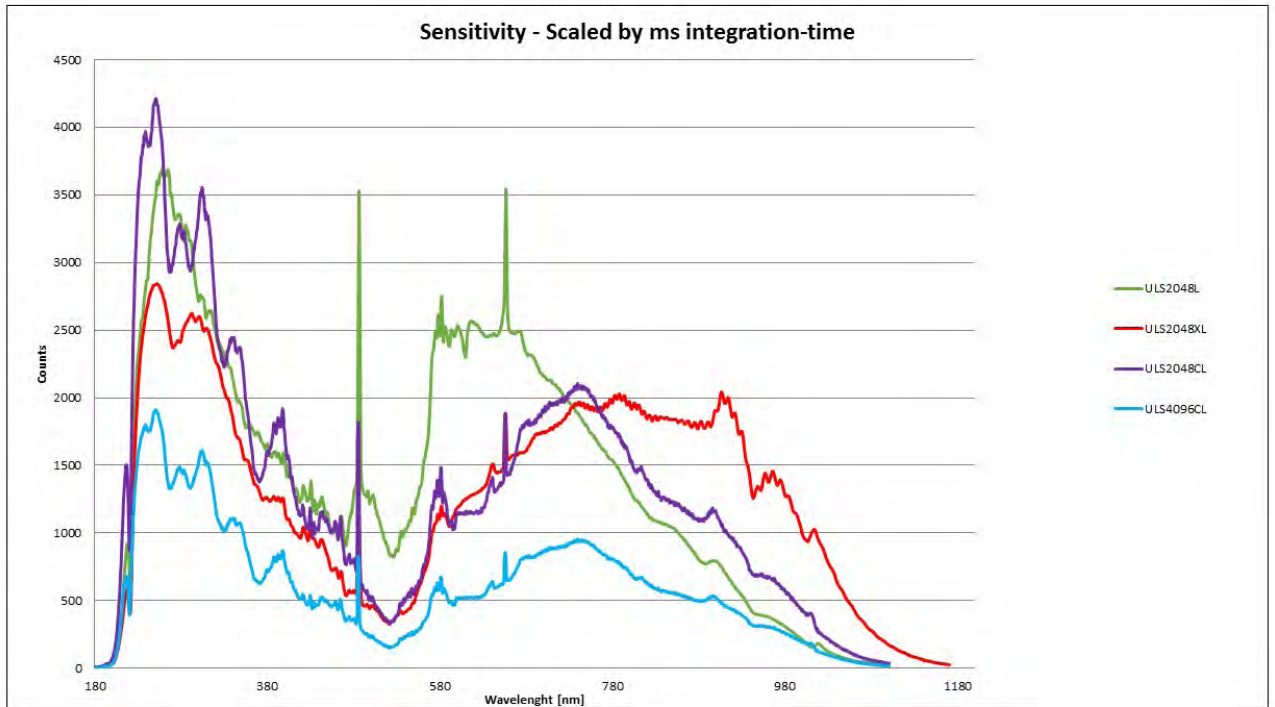


NIRLine Detectors

### Detector Specifications (NIR)

Detector	NIRLine					
	HAM-256-1.7	HAM-512-1.7	SU-256-1.7	SU-512-1.7	HAM-256-2.5	HAM-512-2.5
Type	Linear InGaAs array	Linear InGaAs array	Linear InGaAs array with 1-stage TE cooling	Linear InGaAs array with 1-stage TE cooling	Linear InGaAs array with 2-stage TE cooling	Linear InGaAs array with 2-stage TE cooling
# Pixels, pitch	256, 50 $\mu\text{m}$	512, 25 $\mu\text{m}$	256, 50 $\mu\text{m}$	512, 25 $\mu\text{m}$	256, 50 $\mu\text{m}$	512, 25 $\mu\text{m}$
pixel width x height ( $\mu\text{m}$ )	50 x 500	25 x 500	50 x 500	25 x 500	50 x 250	25 x 250
Sensitivity HS in counts/ $\mu\text{W}$ per ms	8,200,000 (integral 1000 - 1750 nm)	3,880,000 (integral 1000 - 170 nm)	4,800,000 (integral 1000 - 1750 nm)	2,500,000 (integral 1000 - 1750 nm)	990,000 (integral 1000 - 2500 nm)	480,000 (integral 1000 - 2500 nm)
Signal/Noise (HS)	1900:1	1900:1	5000:1	5000:1	1800:1	1900:1
Dark noise HS (counts RMS)	16	16	16	16	16	15
Dynamic Range HS	6000	6000	4900	4900	3500	4300
Sensitivity LN in counts/ $\mu\text{W}$ per ms	469,000 (integral 1000 - 1750 nm)	222,000 (integral 1000 - 1750 nm)	160,000 (integral 1000 - 1750 nm)	83,000 (integral 1000 - 1750 nm)	55,000 (integral 1000 - 2500 nm)	26,600 (integral 1000 - 2500 nm)
Signal/Noise (LN)	5000:1	5000:1	5000:1	5000:1	4000:1	3700:1
Dark noise LN (counts RMS)	12	12	12	12	12	13
Dynamic Range LN	9000	9000	7600	7600	4500	5100
Peak wavelength	1550 nm	1550 nm	1500 nm	1500 nm	2300 nm	2300 nm
QE (%) @ peak	90%	90%	70%	70%	65%	65%
Photo-responsive non-uniformity	$\pm 5\%$	$\pm 5\%$	10%	10%	$\pm 5\%$	$\pm 5\%$
Defective pixels (max)	0	0	0	0	12	26
Wavelength range (nm)	900 - 1750	900 - 1750	900 - 1750	900 - 1750	1000 - 2500	1000 - 2500
Frequency	500 kHz	500 kHz	1.2 MHz	1.2 MHz	500 kHz	500 kHz

### Sensitivity Curve StarLine



### Sensitivity Curve SensLine

