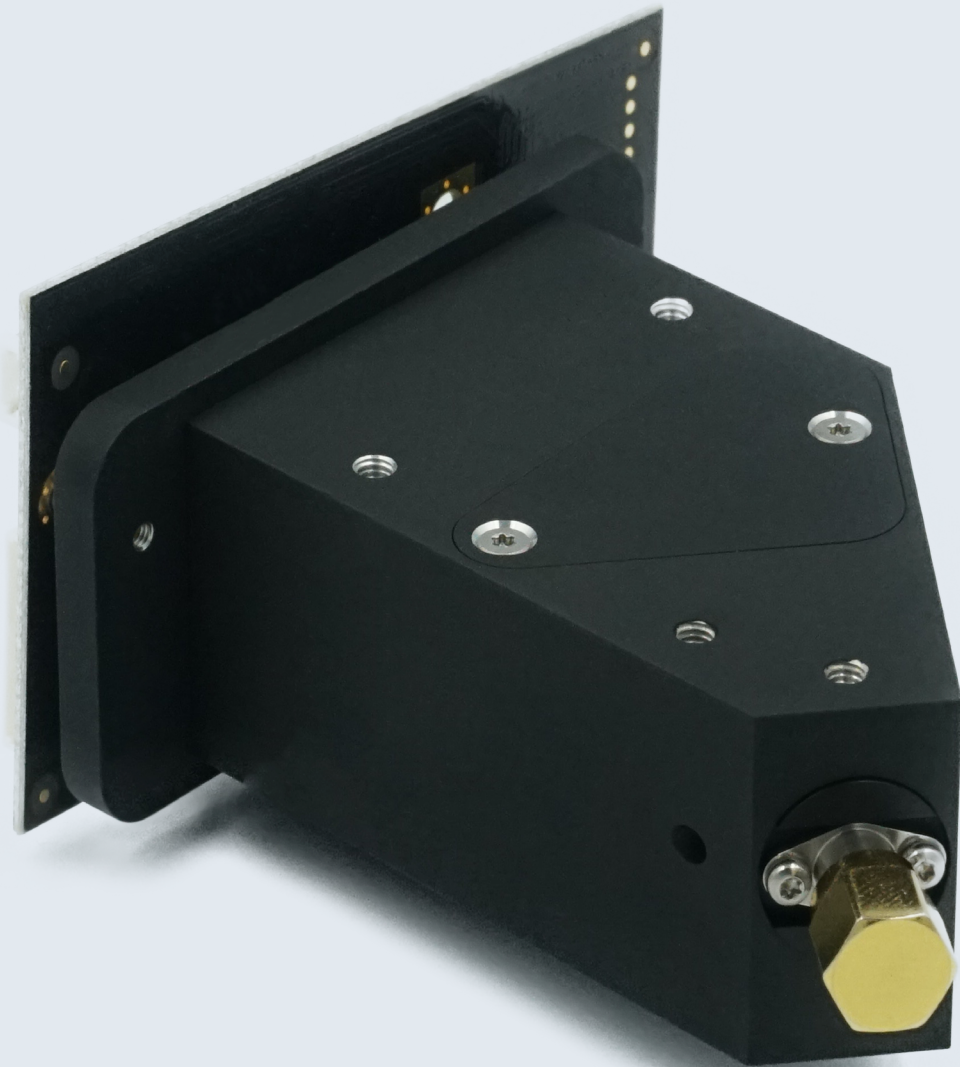




COMPACT ROCK VIS/VIS-NIR

Compact High Throughput and Robust Spectrometer from Ibsen Photonics





Compact ROCK VIS/VIS-NIR Platform - High Throughput and Athermal Design

The Compact ROCK VIS and VIS-NIR spectrometers are robust, athermal, industrial-grade diode array-based spectrometers that typically enable 4 times higher optical throughput than traditional spectrometers. This is due to a high numerical aperture of 0.2 (f/2.5) and the use of Ibsen Photonics' highly efficient transmission gratings manufactured using the company's proprietary, high-volume manufacturing process.

Key Specifications of the Compact ROCK VIS/VIS-NIR Compact Size

- High throughput due to the high numerical aperture (low f-number) of the spectrometer
- Compact size of only 75 mm x 50 mm x 30 mm
- OEM integration friendly design that allows easy adaptation to your own electronics and/or detector
- Robust and athermal design

The Compact ROCK VIS and VIS-NIR spectrometers have a form factor of 75 mm x 50 mm x 30 mm, high throughput, and low stray light.

With the Compact ROCK VIS and VIS-NIR spectrometers, manufacturers of handheld and portable instruments for applications, such as blood gas analysis and food sorting applications, can enjoy the benefit of a smaller form factor while still being able to achieve excellent signal quality.

Layout and Design

The Compact ROCK VIS and VIS-NIR spectrometers are based on Ibsen Photonics' LGL platform utilizing a collimating lens, a transmission grating, and a focusing lens. This spectrometer uses a high diffraction efficiency fused silica transmission grating produced by Ibsen Photonics internally.

If you are familiar with our older ROCK version, this narrowed model maintains the beneficial high throughput of the old version but in a compact design. This provides a compact form factor with the same signal quality, which means you have more flexibility in the design of your instrument and expand your market reach.

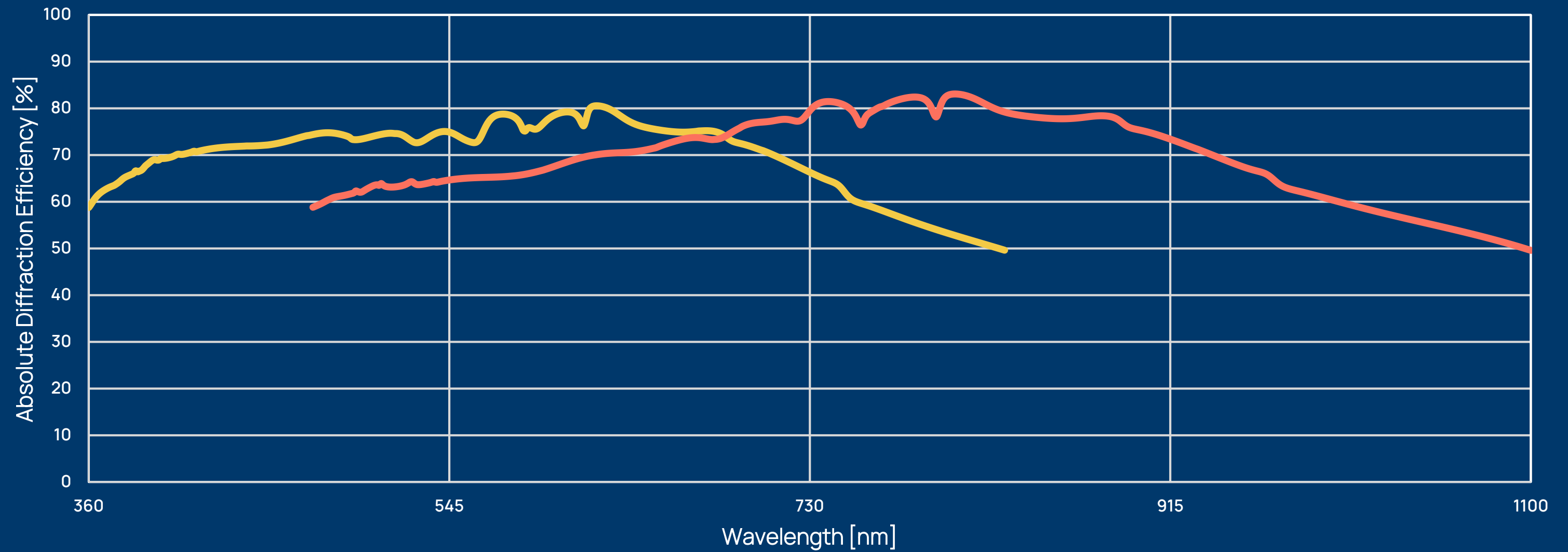
The numerical aperture of the spectrometer is 0.2 (equivalent to an f-number of 2.5), which means that the spectrometer can accept a wide cone of light. For instance, the high NA of 0.2 matches the NA of typical multimode fibers, thereby ensuring maximum coupling from the fiber to the spectrometer.

Technical Specifications

		ROCK VIS	ROCK VIS-NIR
Spectral range		360 - 830 nm	500 - 1100 nm
Wavelength accuracy		< 0.4 nm	< 0.4 nm
Resolution*	Slit width		
	12.5 µm	0.8 nm	1.0 nm
	35 µm	2.0 nm	2.2 nm
	50 µm	2.8 nm	3.4 nm
	70 µm	3.8 nm	4.7 nm
Slit height		250 µm (750 µm for the 305 and 380 detectors)	250 µm (750 µm for the 305 and 380 detectors)
Numerical aperture		0.2	0.2
Stray light	Monochromatic input	< 0.03 % (at +/- 10 x FWHM from peak)	< 0.03 % (at +/- 10 x FWHM from peak)
Detector			
101 (109)	CMOS	Hamamatsu S11639N-01 (Hamamatsu S13496) 2048 (4096) x 1 pixels 14 (7) x 200 µm pixel size SNR 380:1 Dynamic range 2150:1	Hamamatsu S11639N-01 (Hamamatsu S13496) 2048 (4096) x 1 pixels 14 (7) x 200 µm pixel size SNR 380:1 Dynamic range 2150:1
305	BT-CCD	Hamamatsu S10420-1006 1024 x 64 pixels 14 x 14 µm pixel size SNR 542:1 Dynamic range 4800:1	Hamamatsu S10420-1006 1024 x 64 pixels 14 x 14 µm pixel size SNR 542:1 Dynamic range 4800:1
380	BT-CCD	Hamamatsu S11156-2048-02 2048 x 1 pixels (1000 used pixels) 14 x 1000 µm pixel size SNR 350:1 Dynamic range 3000:1	Hamamatsu S11156-2048-02 2048 x 1 pixels (1000 used pixels) 14 x 1000 µm pixel size SNR 350:1 Dynamic range 3000:1
Interface		SPI or USB 2.0	SPI or USB 2.0
Temperature induced drift		< 0.02 nm/°C	< 0.02 nm/°C
Operating temperature range	Non-condensing	0 to +50 °C	0 to +50 °C
Storage temperature range	Non-condensing	-40 to +65 °C	-40 to +65 °C
Dimensions		75 mm x 50 mm x 30 mm	75 mm x 50 mm x 30 mm
Weight	Including electronics	121 grams	121 grams grams

* Typical values with the Hamamatsu S11639 detector (12.5 µm is with the Hamamatsu 13496 detector)

— VIS — VIS-NIR



Transmission Gratings

The Compact ROCK VIS and VIS-NIR spectrometers utilize the Ibsen Photonics VIS and VIS-NIR transmission gratings. The grating provides a high even diffraction efficiency, as evident by the absolute diffraction efficiency graph displayed above.

Additionally, the transmission grating itself ensures impressive wavelength stability due to the inherent self-correction nature of transmission gratings, compensating for misalignment, shock, or vibrations that the spectrometer may experience.

The design also provides very low polarization dependence as an added benefit.

Every grating used in the Compact ROCK VIS and VIS-NIR spectrometer platform is a master grating fabricated at Ibsen Photonics' clean-room facility in Denmark.

Electronics

Every Compact ROCK spectrometer can be supplied with one of three different electronic configurations depending on the desired level of integration.

The spectrometer can be purchased without any accompanying electronics, giving direct access to the pins on the chosen detector. Alternatively, Ibsen Photonics can supply its Digital Image Sensor Boards (**DISB**), designed to operate the detector of choice via hardware commands over a Serial Peripheral Interface (**SPI**). The DISB electronics can also be supplied with a **DISB to USB Bridge** board, which converts the SPI connection to a standard USB 2.0 for convenient connection to a PC.

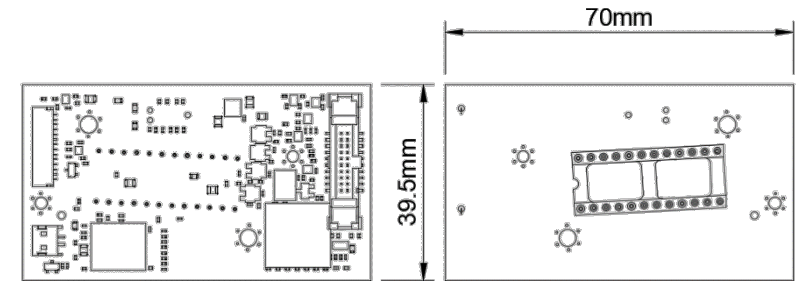
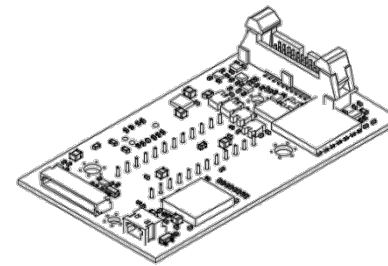
DISB electronics

Three different DISB board options are available to accommodate the series of detectors offered as standard for the Compact ROCK spectrometer platform. For S11639N-01 / S13496 (101/109), DISB-101T can be supplied. Detector S10420-1006 (305) utilizes DISB-315 and finally, S11156-2048-02 (380) should be used with DISB-380.

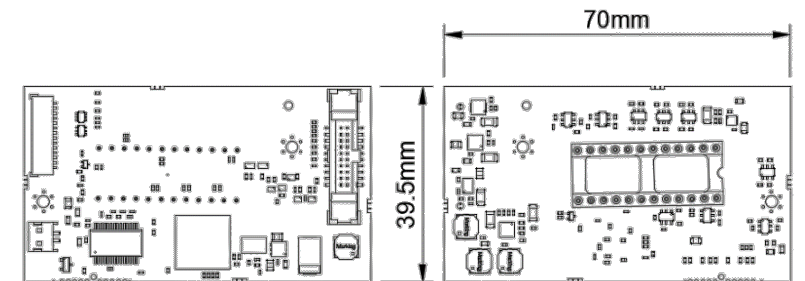
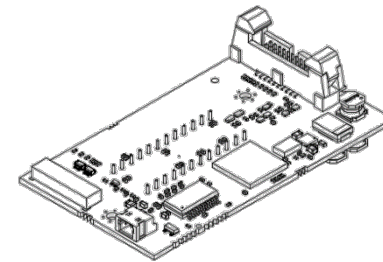
All DISB platforms utilize the same SPI communication protocol, making it straightforward to move from one platform to another without having to change the hardware interface or code.

	DISB-101T	DISB-315	DISB-380
Read-out speed	600 Hz 2048 pixels	300 Hz 4096 pixels	600 Hz (2048 pixels)
A/D bit depth	16-bit	16-bit	16-bit
Communication interface	SPI	SPI	SPI
Software trigger	Yes	Yes	Yes
Ext. hardware trigger	Yes	Yes	Yes
Min. trigger delay	1.2 μ s	2.939 ms	360 ns
Trigger jitter	10 ns	20 ns	10 ns
Time increments	200 ns	2 μ s	200 ns
Exposure time	10.8 μ s – 859 s	2.939 ms – 8589.9 s	2 μ s – 859 s
On-Board calibration data	Yes	Yes	Yes
On-Board averaging	Yes	Yes	No
GPIO pinout	Yes	Yes	No
Programmable lamp control	Yes	Yes	No
Region of interest	Yes	Yes	No
Temperature sensor	Yes	Yes	Yes

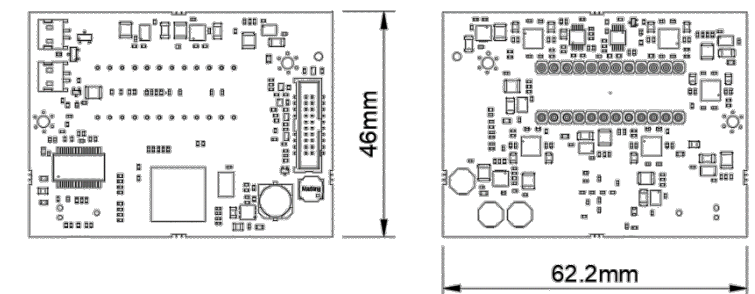
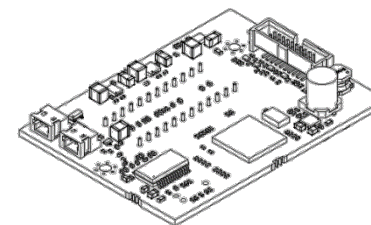
DISB - 101T



DISB - 315



DISB - 380



Detectors

The Compact ROCK spectrometer platform supports three different types of detectors as standard, to cater to whichever requirements a particular application might have. These different detectors are referred to via the last three numbers of the spectrometer product name, namely 101, 305, or 380.

101/109 - Hamamatsu S11639N-01/ Hamamatsu S13496

Hamamatsu S11639N-01 and S13496 detectors provide well-rounded performance in a cost-effective package, making them a popular choice.

The S11639N-01 has a 2048 x 1 pixels layout, with 14 x 200 μm tall pixels to allow for better coupling with the spectrometer slit's dimensions. The S13496 used twice as many pixels, 4096, at half the width, 7 x 200 μm . The response curve, noise and general performance is virtually identical between the two detectors, with pixels count and size being the only difference. The larger number of pixels of the S13496 is ideally used in spectrometers with a 12.5 μm slit.

The quantum efficiency remains high, even down into the deep UV spectral region, while a high conversion factor and shallow well depth makes this particular detector especially sensitive. Combined with fast exposure times of down to 10.8 μs , robust nature, and simple CMOS readout logic, it makes it the detector of choice for most applications.

305 - Hamamatsu S10420-1006

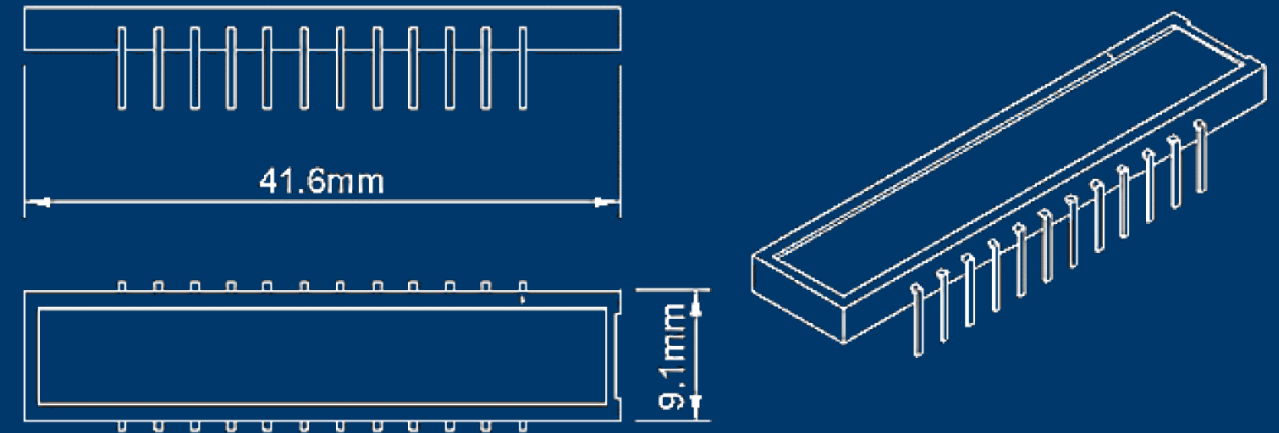
This Hamamatsu S10420-1006 detector is optimized towards low read-out noise, making it the detector of choice when working with applications where either signal strength is low or the signal-to-noise ratio is the primary concern. The back-thinned CCD provides an excellent and smooth quantum efficiency throughout its entire spectral range while being optimized to exhibit a significantly reduced etalon effect compared to most back-thinned CCDs.

The detector has a 1024 x 64 pixels array, with square 14 x 14 μm pixels, creating an active array size of 14.336 x 0.896 mm.

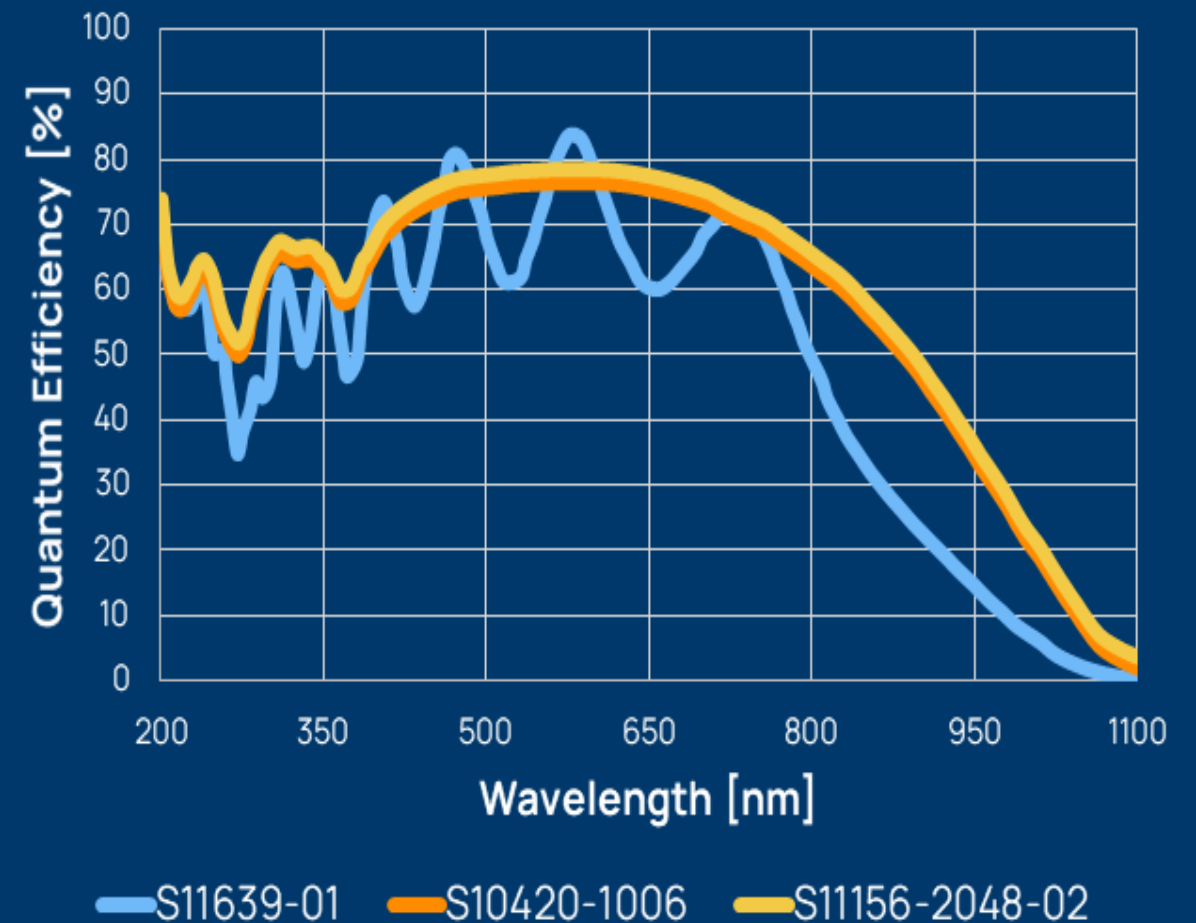
380 - Hamamatsu S11156-2048-02

The Hamamatsu S11156-2048-02 is the fastest detector available as a standard detector for the Compact ROCK spectrometer platform. The back-thinned CCD, has a 1D array of 2048 x 1 pixels with very tall 14 x 1000 μm pixels, allowing for more light to be captured per pixel. The detector electronics layout is comprised of a double side horizontal shift register, that allows for the tall pixels to be read impressively fast, with exposure times all the way down to 2 μs possible. This makes the S11156-2048-02 ideal for applications that require short and precise time-gating of the collected signals.

The exhibited quantum efficiency is identical to that of S10420-1006, with a smooth high level throughout the bandwidth and noticeably better performance at longer wavelengths compared to S11639N-01.



Detector response curve

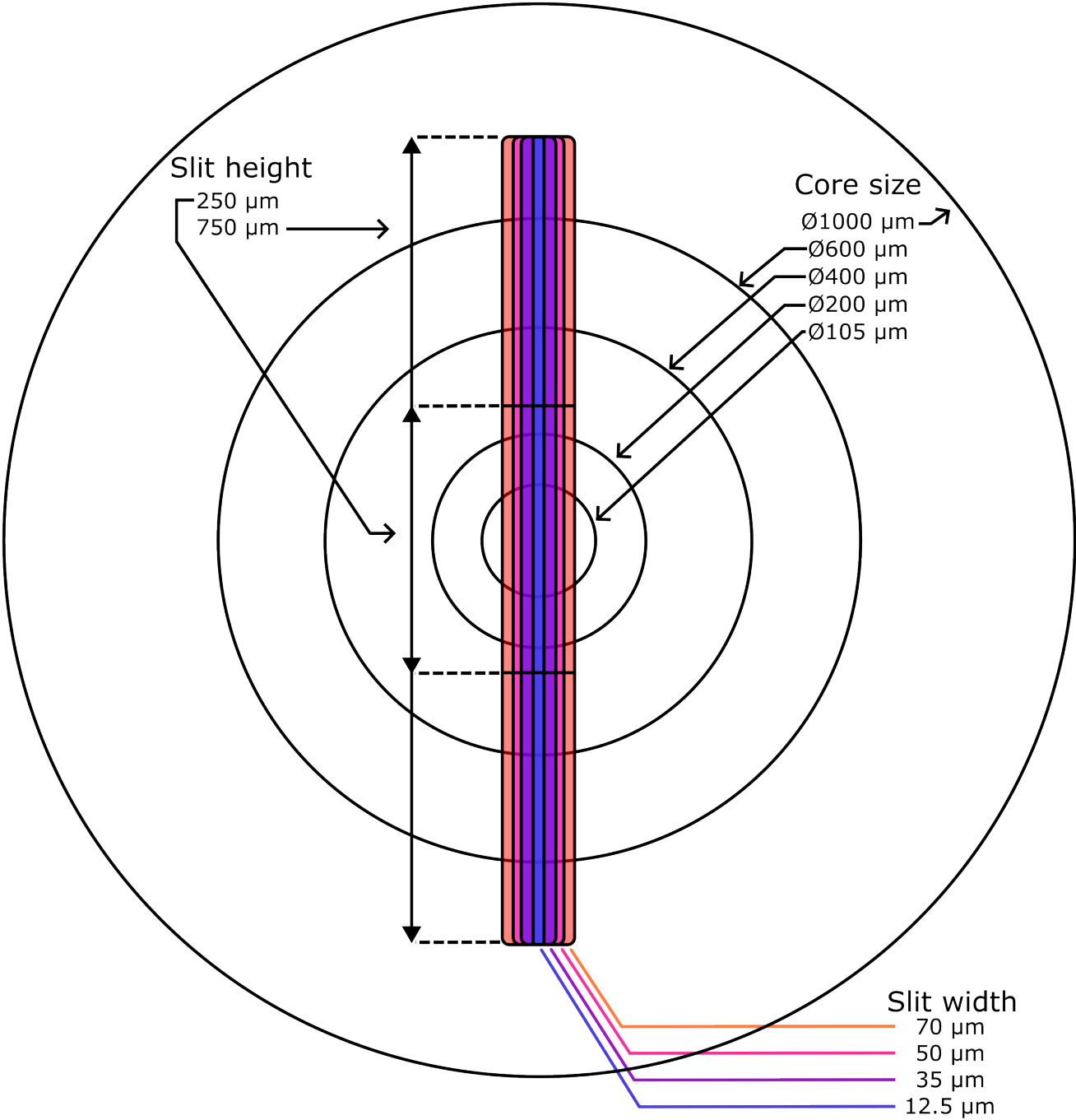


Optical Fiber Coupling

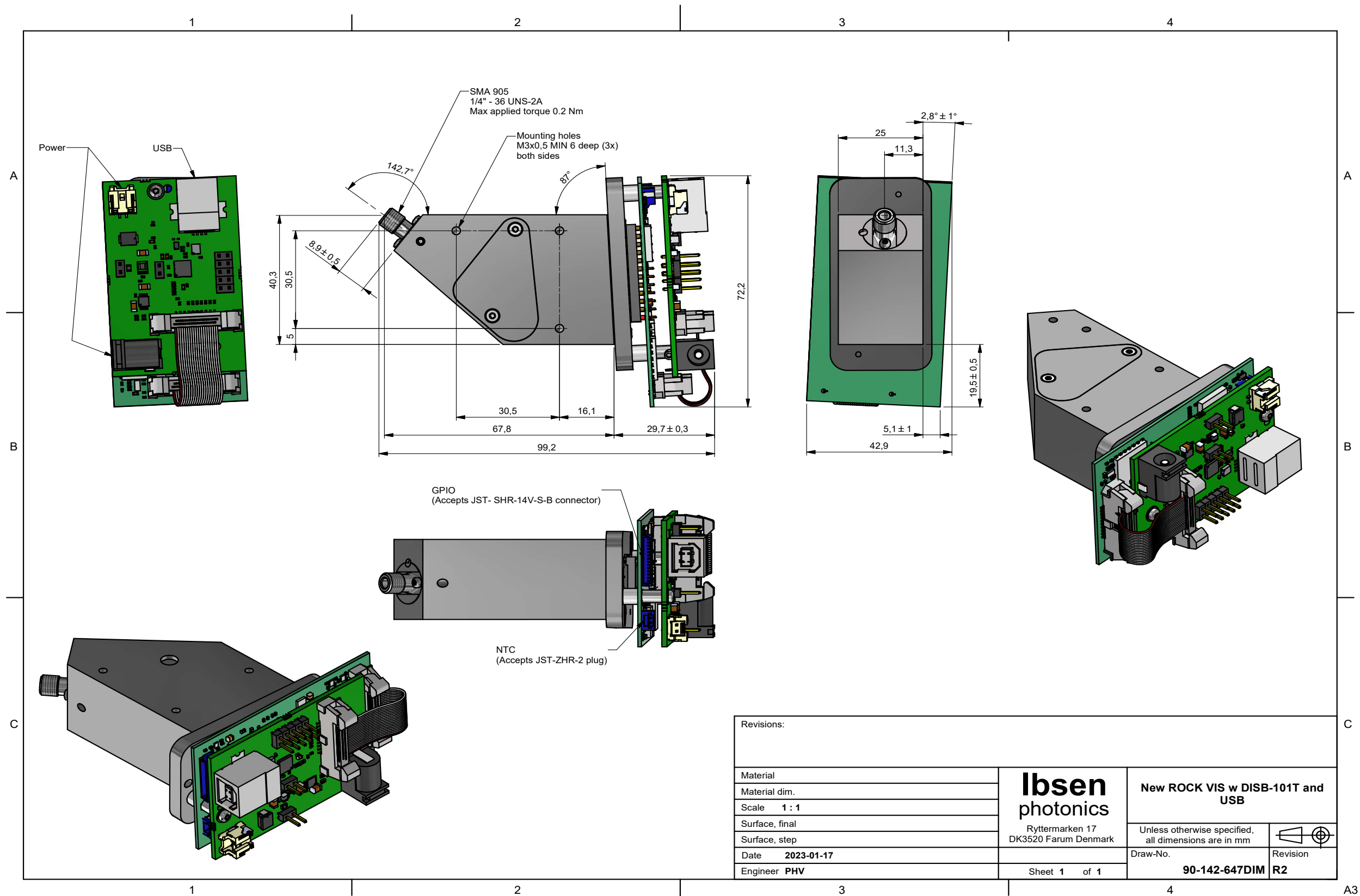
Optical fiber coupling is most often used for its convenience with regard to lack of alignment and ease of setup process. For best signal strength, the diameter of the optical fiber core should be chosen such that the entire slit is illuminated evenly.

The standard slit height of Compact ROCK spectrometers is 250 μm , and the optical fiber core size should be larger than this to ensure the best performance. The common size available would be 400 μm or 600 μm diameter core.

The below illustration shows the different optical fiber sizes concerning the series of standard slit sizes, offered for the Compact ROCK spectrometer platform.



Mechanical Drawings



About Ibsen Photonics

Ibsen was founded in 1991 by Per Ibsen under the name of Ibsen Micro Structures A/S. Today 88% of Ibsen Photonics' share is majority owned by Foss A/S, a world leader in analytical solutions for the Food and Agricultural industries. Ibsen management and employees hold the remaining 12 % of the shares.

The Ibsen spirit combines the dynamic, entrepreneurial culture of a medium size company with a disciplined, operational mentality of a large corporation. With an average employee tenure of more than 10 years, Ibsen makes for a very effective organization that builds on more than 30 years of experience as a company.

Ibsen employs more than 90 people at our R&D and manufacturing facility in Denmark and has achieved a turnover of more than 180 MDKK in 2022.

Working with Ibsen Photonics

The core expertise of Ibsen Photonics lies in the opto-mechanical design, grating technology and metrology. We master the cycle from optics, grating simulation and design, through optical and semiconductor production technologies, to high volume assembly, packaging and testing. Over the years we have developed many new designs, technologies and processes - many patented.

Our customers are large to medium-sized manufacturers of advanced optical devices and instruments, into which our products are integrated. With a highly organized production process, we are able to help customers obtain smooth instrument production, low unit-to-unit variation, high level of right first time, no field returns, and a low level of rework.

Our grating production facilities are world-class, including class 10 cleanroom facilities that we designed and built in 2000/2001, in which all environmental parameters are under continuous surveillance.

Our spectrometers are produced under strict quality control in our assembly facility in Denmark. We have been granted ISO 9001, ISO 13485, ISO 14001 and ISO 45001. This confirms Ibsen's' consistent capability to produce high quality products that meet market standards and all regulatory requirements.

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