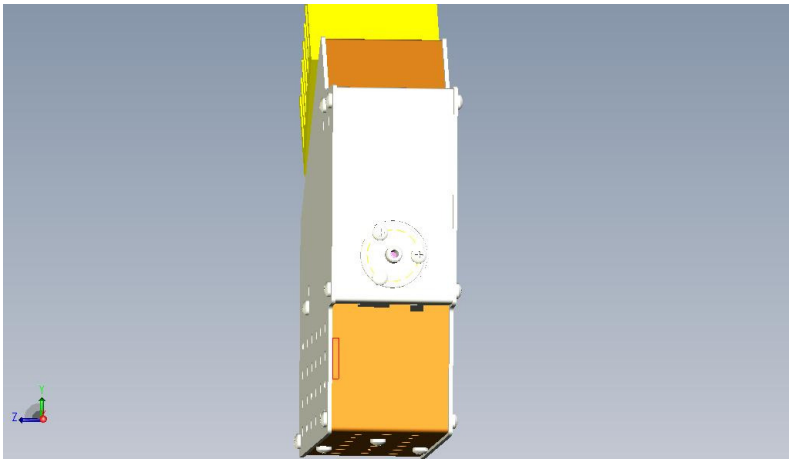
ROCK NIR

Product Specification



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1 Introduction

The ROCK NIR is a robust, athermal, industrial grade diode array based spectrometer. The key benefits of the product are:

- a high throughput due to the high numerical aperture (low f-number) of the spectrometer and the use of Ibsen's in-house manufactured high efficiency diffraction gratings
- an OEM integration friendly design that allows easy adaptation to your own electronics and/or detector
- a robust and athermal design

See also Table 1 for more details on the specifications of the ROCK NIR spectrometer.

This document is a detailed product specification describing the ROCK NIR modes of operation (see Chap. 2) and the ROCK NIR principle of operation (see Chap. 4). Additionally this document describes the electrical interface in Chap. 5 and summarizes the specifications in Chap. 6. A quick guide to installing the drivers and evaluation software is given in Chap. 3. However, for more details about the control electronics and software operation the VersaSpec, TEC, and Firmware User's Manuals should be used.

2 Modes of operation

2.1 Operation with PC Evaluation Software

The ROCK NIR is supplied with a PC Evaluation Software on a CD-ROM. The software packages are described in their respective manuals supplied on the CD's. The purpose of the Evaluation Software is to demonstrate the basic functionality of the ROCK NIR in an easy manner without the need for tedious programming from the user and to enable the user to use the ROCK NIR for basic spectral measurements including absorbance and transmission measurements.

2.2 Device drivers for USB and RS-232

The Software CD's supplied with the ROCK NIR includes drivers to enable communication with the ROCK NIR over a USB or RS-232 interface on a PC.

2.3 Developing own measurement programs

The ROCK NIR is also supplied with a command list (Firmware User's Manual), enabling the user to develop own measurement programs for OEM integration in Labview, Visual C, etc. The function specifications are described in the manuals supplied on the CD with the ROCK NIR.

2.4 PC requirements

See the individual Manuals for details on the PC requirements.

2.5 Operation of TEC software

If the detector in the ROCK NIR spectrometer can be cooled using a Thermo-Electric cooling element mounted inside the detector package, the ROCK NIR spectrometer is supplied with a second CD which includes software for controlling the Thermo-Electric cooling of the detector array used

3 Software installation quick guide (Windows)

1) Install VersaSpec V3.x from the CD-ROM as described on page 13 in the “VersaPic and “software VersaSpec V3.x” User’s Manual.
2) Turn off your PC
3) Plug in the USB-cable in your PC (regular USB) and the ROCK NIR (mini USB)
4) Turn on your PC
5) When Windows asks for drivers for your new USB device, insert the CD-ROM and choose the “Install from CD” option. You will be asked for drivers twice since there are two sets of drivers to be installed)
6) Wait for the drivers to be installed.
7) Start the VersaSpec software by double-clicking on the Ibsen icon.
8) Wait for the software to connect to the spectrometer
9) In the VersaSpec software – set x-axis to “wavelength” (using the “AXIS”-tab at the top of the screen)
10) In the VersaSpec software – set start wavelength and end wavelength using the fields in the lower left corner.

4 Principle of operation

4.1 Spectroscopy

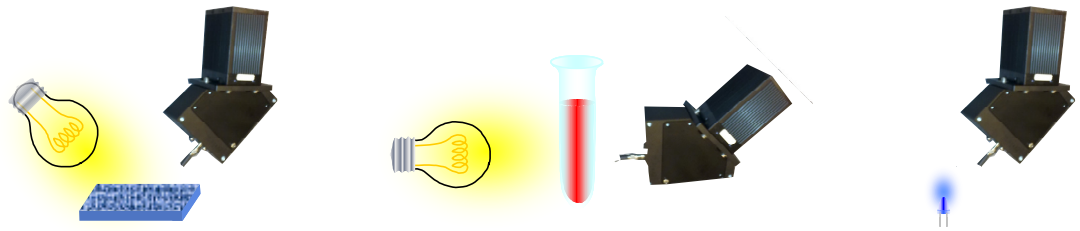

Figure 1: Using the ROCK NIR in typical spectroscopic applications.

Figure 1 illustrates how the ROCK NIR can be used in various spectroscopic applications.

In most applications either a transmission or a reflection geometry is used. A broadband light source like a lamp is used to illuminate the sample under test and the spectrometer is then used to collect the transmitted/reflected light. The spectrometer will measure a spectrum which in turn can be used to determine certain characteristics of the sample.

As indicated on Figure 1 c) the ROCK NIR spectrometer can also be used for determining the spectral content of a light source – for instance a LED as shown here.

4.2 ROCK NIR

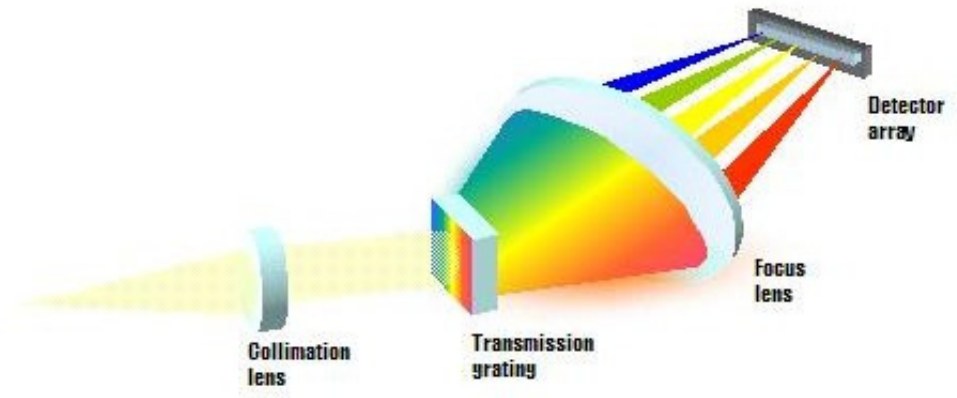

Figure 2: Optics schematic diagram.

The schematic diagram for the optics of the ROCK NIR spectrometer is illustrated in Figure 2. The ROCK NIR is based on Ibsen Photonics' LGL platform utilizing a collimating lens, a transmission grating and a focusing lens. The ROCK NIR use a very high diffraction efficiency fused silica transmission grating produced by Ibsen Photonics internally as shown on Figure 3.

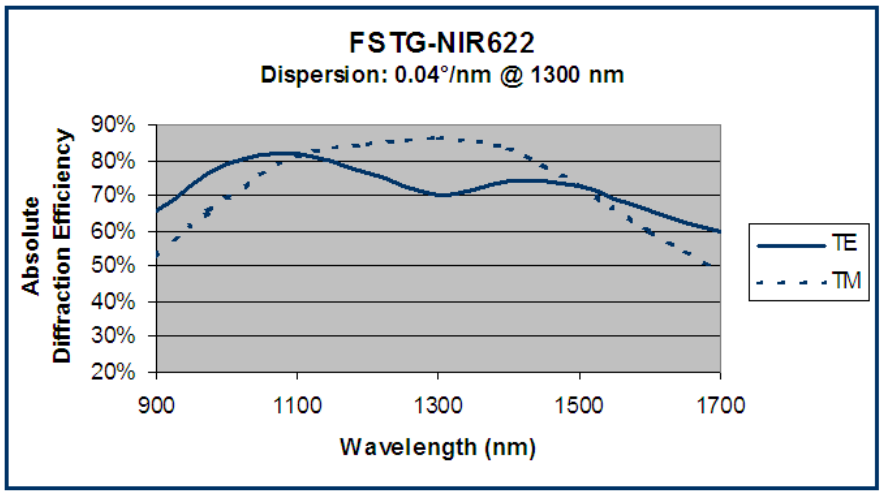

Figure 3: Typical diffraction efficiency of Ibsen transmission grating**.**

Also, the numerical aperture of the spectrometer is 0.22 (equivalent to an f-number of 2.2), which means that the spectrometer can accept a wide cone of light. For instance, the high NA of 0.22 matches the NA of typical multimode fibers thereby ensuring maximum coupling from a fiber to the spectrometer. This is in contrast to many other mini spectrometers that has lower NA and thereby does not couple nearly as much light into the spectrometer as the ROCK NIR.

The ROCK spectrometers can be configured by Ibsen Photonics with a range of input slits providing the optical FWHM resolution that best suits your needs. Since a slit will limit the amount of available light on the detector we always recommend that you work with the largest possible optical resolution that is acceptable in your application.

5 Electrical interface

The ROCK NIR spectrometers include a detector array and control electronics that allows the spectral data to be read from a PC over USB 2.0 / RS-232.

The ROCK NIR can be powered via the USB interface or via an external power supply. Furthermore, the TE-cooling must be powered through connector P6 on the controller board. Please see the Software Manuals for the VersaSpec for details on the electrical interface.

Attention: Please read the operating instructions manual before use. The power supply must be switched ON before connecting to connector P6 on the spectrometer control board.

Please note: Minimum detector temperature is –12 °C when the spectrometer is operated at room temperature without forced cooling.

Ibsen Photonics can offer customized version of the ROCK NIR spectrometers where the control electronics is left out and a low level video interface via a ribbon connector (AMP) to the detector array as interface. Please contact Ibsen Photonics for more information about this option.

6 Specifications

Table 1: **ROCK NIR specifications**

Parameter	RSN-445		RSN-465		Comment
Wavelength range	1065 – 1700 nm		1065 – 1870 nm		
Numerical aperture	0.11	0.22	0.11	0.22	
Minimum optical resolution	2.0 nm	6.0 nm	2.0 nm	6.0 nm	FWHM (with a 25 micron wide slit)
Grating efficiency	> 50 %		> 50 %		
Stray light	< 0.03 %		< 0.03 %		At +/- 40 nm from peak
Detector	Hamamatsu G9214-512 TE-cooled InGaAs		Hamamatsu G9206-256 TE-cooled InGaAs		
Minimum integration time	10 µs		10 µs		
Maximum spectral scan frequency	60 Hz		60 Hz		Using VersaPIC Electronics and USB 2.0
Dynamic range	9000:1		9000:1		
S/N	4000:1		4000:1		
Interface	USB 2.0 / RS-232		USB 2.0 / RS-232		
Dimensions	144 x 181 x 52 mm x mm x mm		144 x 181 x 52 mm x mm x mm		
Operating temperature interval	-10 to + 45 °C		-10 to + 45 °C		Non condensing
Temperature drift	< 0.02 nm / °C		< 0.02 nm / °C		

Specifications are subject to change without prior notice.

6.1 Measurement definitions:

6.1.1 Wavelength range

The wavelength range is defined as the range of wavelengths that is captured by the detector.

6.1.2 Numerical aperture (NA)

The numerical aperture of the spectrometer defines the range of angles by which the spectrometer can accept light.

6.1.3 Minimum optical resolution

The resolution is defined as the FWHM peak width as measured by the spectrometer when the input is a single wavelength (i.e. a monochromatic light source). The minimum resolution is the smallest resolution that can be obtained with the spectrometer.

6.1.4 Grating efficiency

The grating efficiency is the absolute diffraction efficiency for the transmission grating including AR-coating.

6.1.5 Stray light

Stray light is measured as the light at wavelengths of +/- 40 nm on each side of the peak recorded, when the input is a monochromatic light source.

6.1.6 Minimum integration time

Minimum integration time is the shortest time the detector array can accumulate light for a single spectral measurement. Please note that data in the detector array has to be read out before a new integration can start.

6.1.7 Maximum spectral scan frequency

The minimum integration time, the control electronics and the number of pixels in the detector array determine the maximum frequency by which contiguous spectra can be ready from the spectrometer over the USB 2.0/RS-232 interface. A complete scan interval will take longer than the actual integration time set by the user because the time for A/D converter sampling and the time for communication over USB 2.0/RS-232 must be added to the integration time.

6.1.8 Dynamic range

The dynamic range is defined as the spectrometer count at full signal divided by the RMS counts with no signal (Dark).

6.1.9 Signal-to-noise ratio (S/N)

The S/N is defined as the full signal count divided by the RMS noise count at full signal.

6.1.10 Wavelength drift

The wavelength drift is defined as a wavelength shift per degree C.

6.2 Package dimensions

The package dimensions are shown in Figure 5 for ROCK NIR. Note that all dimensions are given in mm.

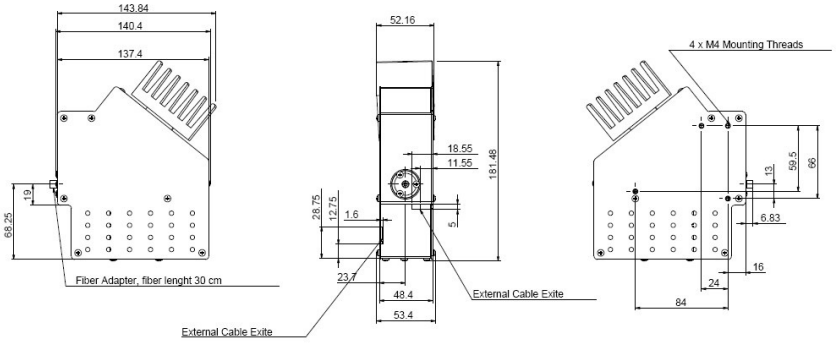

Figure 5: Package dimensions of ROCK NIR

6.3 Wavelength calibration

The ROCK NIR is wavelength calibrated at a fixed temperature of 25 deg C according to a polynomial of 4th degree:

Eq. 1 $$\lambda[\mathrm{nm}] = A + B_1 pix + B_2 pix^2 + B_3 pix^3 + B_4 pix^4, \quad pix = 0..N_{\max}.$$

This equation describes the relation between the beam spot position (pix) on the detector array and the optical wavelength (λ). N_{max} is the number of pixels in the detector array. The beam spot position is determined be applying a Gaussian fit to the detector array response, (and the input light source is a tunable laser coupled to a reference wavelength meter. The wavelength meter is set to measure the wavelength in standard air.

The coefficients A, B_1, B_2, B_3, and B_{4n} are measured for each ROCK NIR unit and are stored in a EEPROM on the VersaPic board during manufacturing. The coefficients are used by the VersaSpec Windows software to display the measured power versus wavelength directly. If you need to write your own software it is possible to read the coefficients by using the firmware commands as described in the respective manuals.

7 Related documents

ID	Document
[1]	VersaPic and software VersaSpec V3.x, Operating Instructions
[2]	Firmware Commands VERSA PIC, Operating Instructions

8 Revision history

Revision no.	Revision
0.1	Preliminary version
0.4	Updated stray light spec to 0.03 % at +/- 40 nm away from single peak Updated minimum resolution to 1 nm
0.5	Updated wavelength range for RSV-200 to 400 – 740 nm Updated scan speed for RSV-200 to 25 Hz Moved documentation for RSV-100 to separate document
0.6	Updated with VIS-NIR and XNIR Updated with resolution vs. slit for ROCK VIS
0.7	Updated with NA=0.11 version of ROCK NIR and with RSN-465 extended range version