OtO Photonics

Dubhe Series Product Sheet

Introduction

The **Dubhe (DB) Series** spectrometers are designed for the high-resolution, high-sensitivity measurements required by Optical Coherence Tomography (OCT) applications. This new series features a new transmissive optical design with an improved integrated body, employing patented alignment mechanism to deliver ultra-high (0.04nm) optical resolution. It is available in two versions with different CMOS camera max line rates: 80kHz or 20kHz, catering to different application needs.

The DB series uses a transmission grating and a fully transmissive Czerny-Turner optical design to deliver high optical resolution, high sensitivity, low dispersion, and high-speed spectrum response.

The DB series can be powered by USB and connected to a computer via USB.

This document provides detailed information on the DB Series and how to work with it.

This document is intended for sales and marketing purposes only and may not serve as a product specification document for shipping or contracts. If a customer requires a formal document for product approval or incoming quality control (IQC), OtO can discuss the specification details with the customer and provide a formal document for such purposes.

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Dubhe Series Product Sheet

Overview

► 1.1 DB Series Products

Model	Wavelength range (nm)	Camera max line rate	Camera resolution	Dynamic range	SNR	Pixel size	Bit depth
	NIRT1						
	800 ~ 880						
DB1020	√	20 kHz	2048 Pixels	69 dB	51 dB	10 x 200 µm	10, 11, 12 bits
DB1080	√	80 kHz					

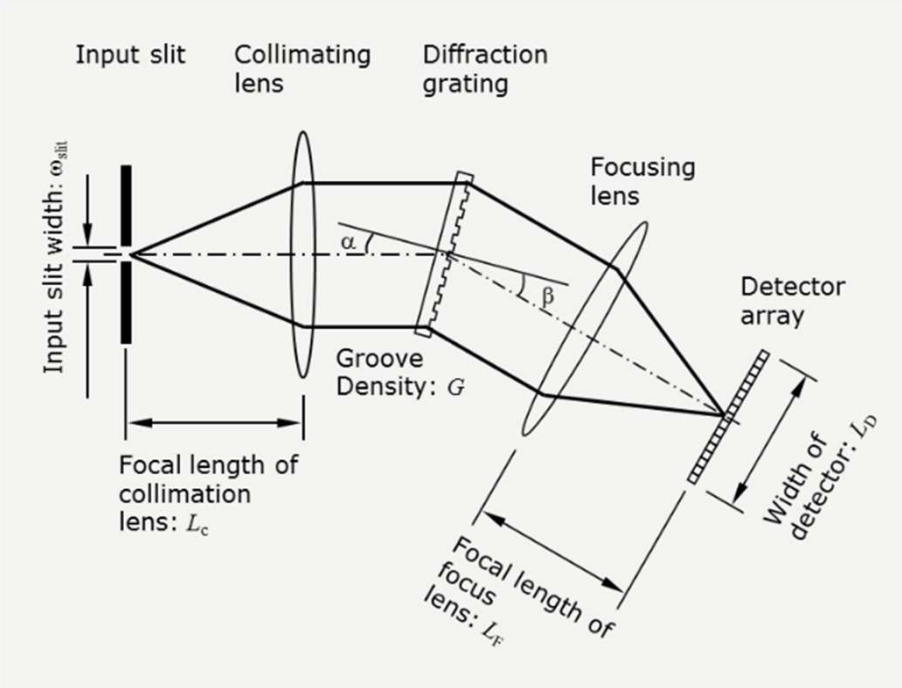


Figure 1. T-T-T Czerny-Turner full transmissive light path

► 1.2 Response Curves

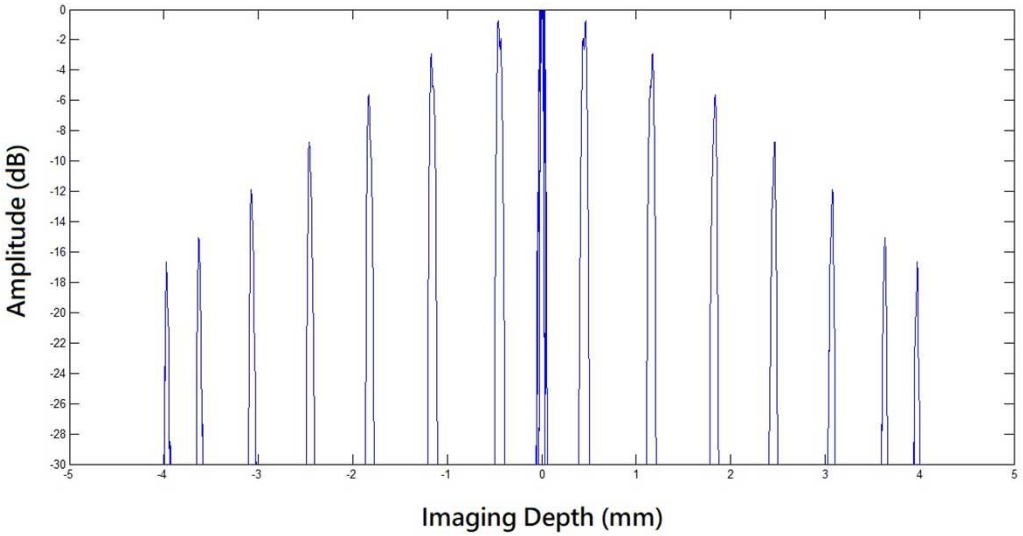


Figure 2. DB1080 OCT test chart

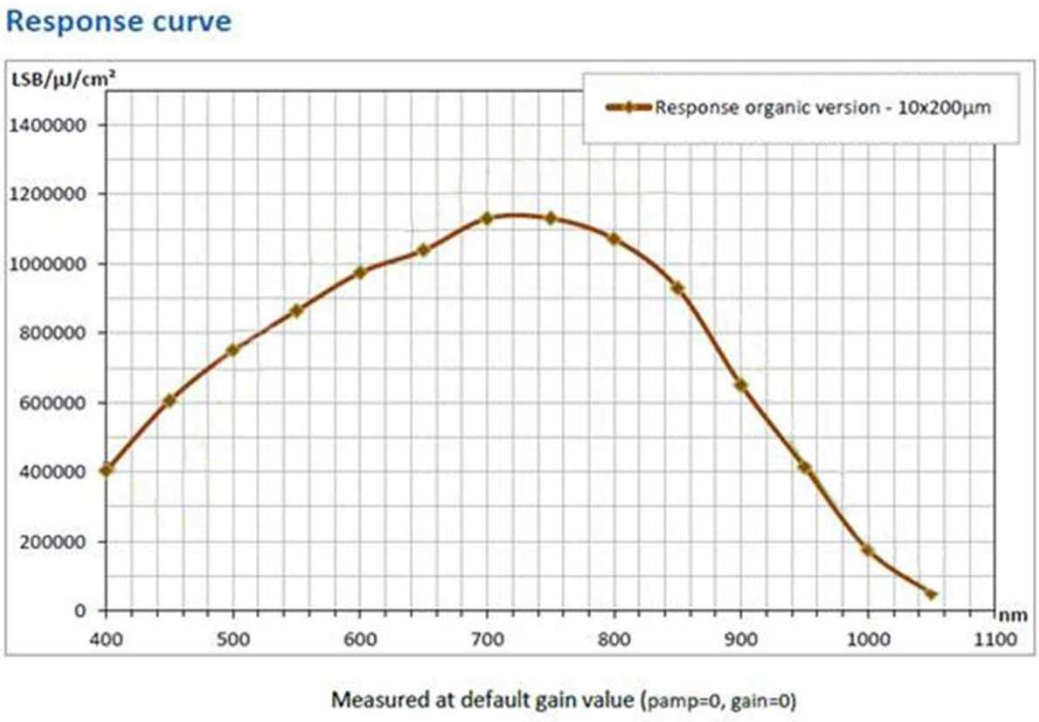


Figure 3. e2v Camera response curve diagram

Key Features

► 2.1 Characteristics

- Optical Coherence Tomography (OCT) is a 3D imaging technique that faithfully captures high-resolution images from within the scattering medium, requiring no contact or coupling media. It is able to achieve micrometer resolution across the medium and penetrate a few millimeters deep into the medium. This fixes the problem of insufficient resolution in ultrasound and MRI imaging. The major use of OCT is currently in ophthalmology, such as glaucoma and retina imaging. OCT is especially useful for tissue analysis in cases where biopsy is not desirable, such as skin disease analyses.

- In addition to OCT, a spectrometer also requires the following key elements:

  1. Volume phase holographic grating
  2. Collimating lens design
  3. Focusing lens design
  4. Diffraction system optical design
  5. Wavelength calibration algorithms
  6. Precise spectrometer calibrating techniques
  7. Precise optical component alignment techniques (alignment pins)

All these elements in the DB Series are developed independently by OtO Photonics.

► 2.2 Spectrometer Specifications

Features		Specifications	
		DB1020	DB1080
Camera module		2048 pixels CMOS Line scan camera (20kHz)	2048 pixels CMOS Line scan camera (80kHz)
Readout noise		55 e-	
Dynamic range		69 dB	
Max SNR		51 dB	
Wavelength range		800 - 880 nm	
Optical system characteristics		f/#: 3.6 NA: 0.14 Focal length(R1-R2): 60 -89 @840nm	
Optical design		T-T-T fully transmissive Czerny-Turner light path	
Spectrometer size (without the camera)		180 (L) x 120 (W) x 63 (H) mm	
Grating		1800 lp/mm VPH @840nm	
Input slit type*1		5-um mode field diameter (MFD) @840nm	
Spectrometer fiber optic interface*1		FC/PC	
Pixel resolution		0.035 - 0.04 nm	
Optical resolution		0.04 - 0.07 nm	
Environmental requirements	Storage temperature	-30˚C to +70˚C	
	Operating temperature	5˚C to +40˚C	
	Relative Humidity	0% - 85% non-condensing	
Data transfer interface		USB 3.0	
Power specifications		Power supply: 6-15V GPI input voltage: 6V (max)	

*1 : For DB Series spectrometer, 5um single mode FC/PC fiber is recommended

► 2.3 Camera Specifications

Resolution	2048 pixels	
Pixel size	10 x 200 µm	
Camera version	BA0	BA1
Max line rate	20 kHz	80 kHz
Bit depth	10, 11, 12 bits	
Full well capacity (typical)	140 ke-	
Response non-linearity	±1 %	
Photo response non-uniformity	0.5 %	
Integration dead time in maximum exposure time	0.6 µs	
Quantum efficiency (QE) @850nm/890nm	54 % / 41 %	
Analog gain / Digital gain	x1 x2 and x4 / x1 to x7.996	
Offset	-4096 to +4095 LSB in 12 bit pixel format	
Trigger mode	1. Internal line trigger with programmable exposure time and line period 2. Internal line trigger with max exposure time and programmable line period 3. External line trigger with programmable exposure time 4. External line trigger with maximum exposure time 5. External mixed line and frame trigger with programmable exposure time 6. External mixed line and frame trigger with maximum exposure time	
Size (WxHxL)	60 x 60 x 31.1 mm	
Weight	<150 g	
Power supply	Single 6V DC to 15V DC	
Power consumption	<3.6 W (USB3 compliant)	
Operating temperature	0 to 50 °C (front face), 70 °C (internal)	
Operating relative humidity	85 %	
Storage temperature	-40 to 70 °C	
Certifications	CE, FCC , Reach, RoHS	

* For more information on TELEDYNE e2v camera specifications, please visit https://octoplus-oct.com/

Mechanical Designs

3.1 Spectrometer Outlines and Dimensions

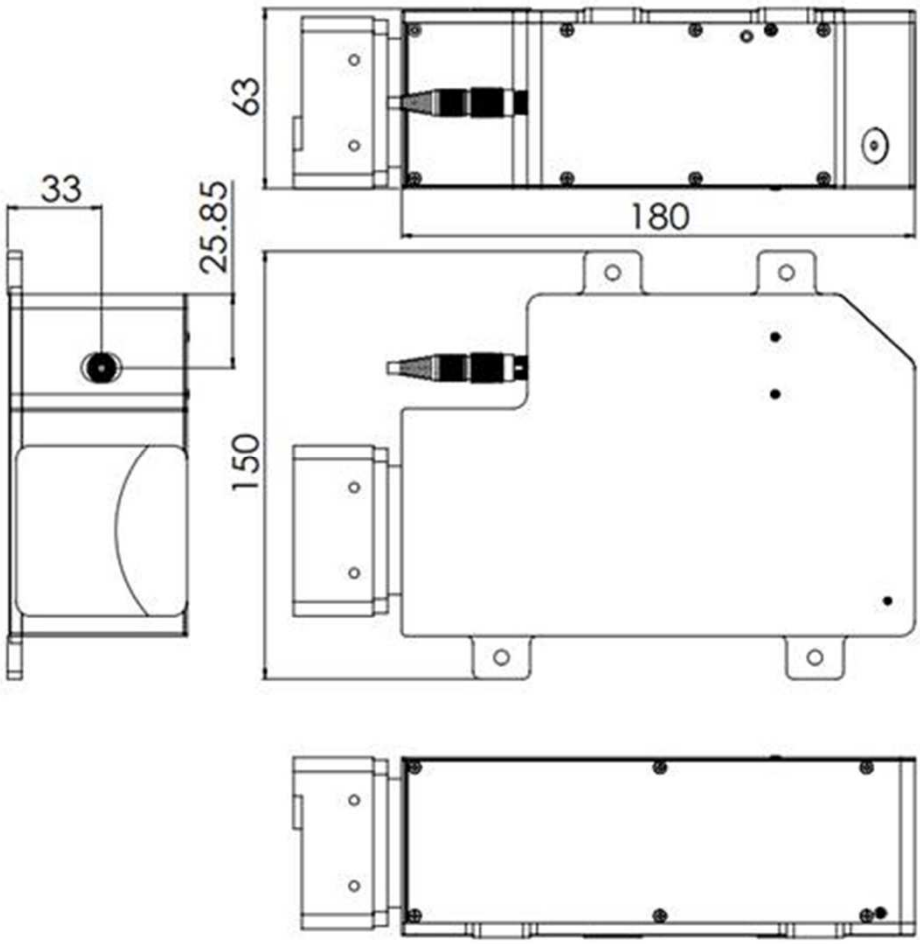


Figure 4. DB10x0 outlines and dimensions

Mechanical Designs

► 3.2 Camera Outlines and Dimensions

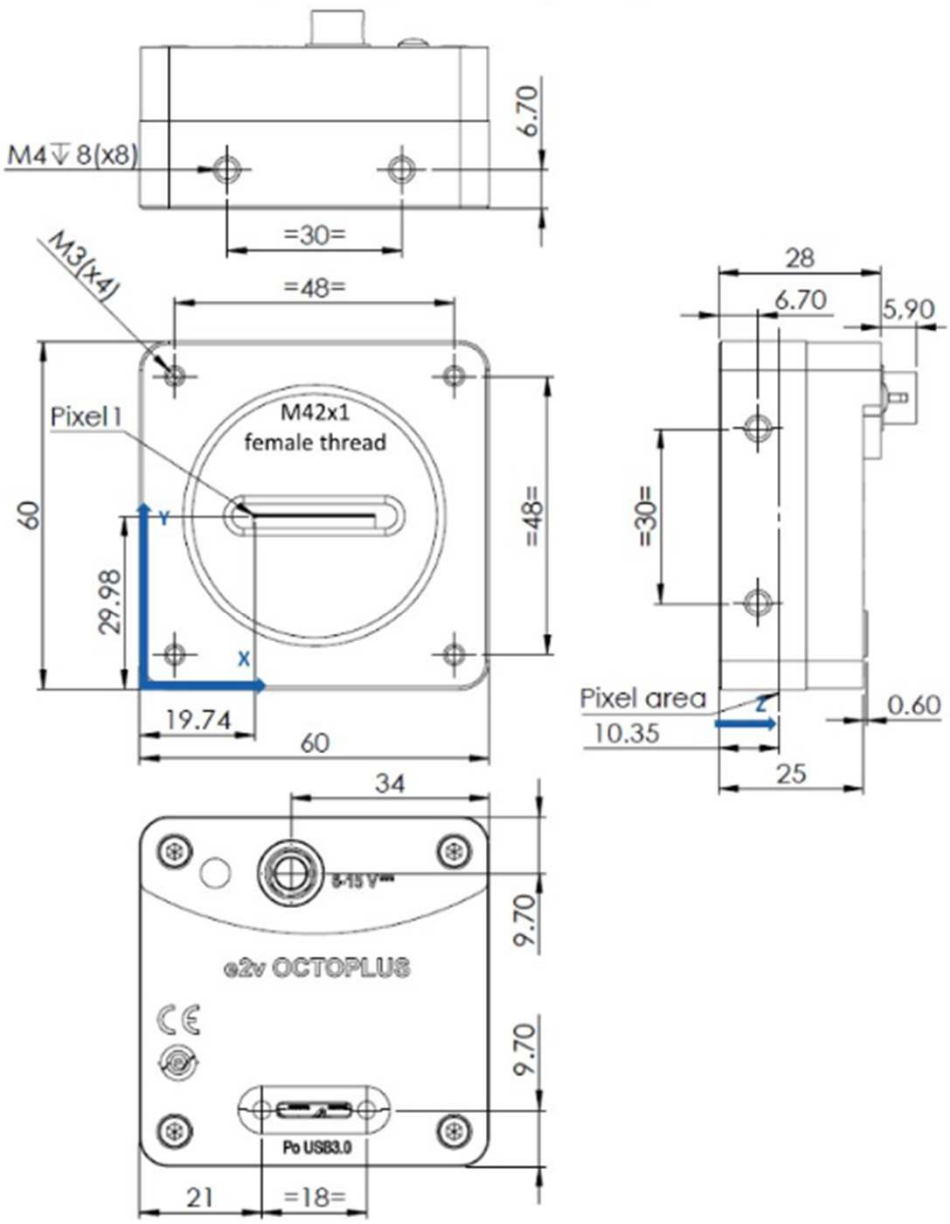


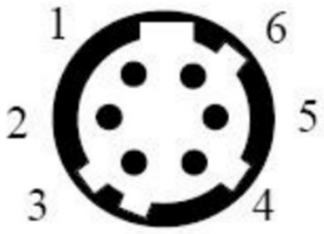
Figure 5. e2v camera outlines and dimensions

► 3.3 Camera Connector Pin Assignments

This section provides the pin assignments for the external connector on the DB Series.

Connector type: Hirose HR10A-7P-6S (female)

The camera is compliant with USB 3.0 power specifications.



Pin	Signal
1	PWR
2	GPO
3	GPO
4	GND
5	GPI
6	GPI

Note: Power supply: 6-15V

GPI input voltage: 6V (max)

Figure 6. DB Series camera external connector front view

Using the DB Series

► 3.4 Camera Software Development Kit (SDK)

To use the camera, users need to develop their own software with the latest SDK, API, and other tools provided by TELEDYNE e2v for developers. Please visit https://octoplus-oct.com/ for user registration and software download.

- UMA_OCTOPLUS-USB3_Mono_RevB9

This document contains camera specifications and operating instructions. Developers can refer to chapter 4 of this document to learn how to install the SDK and develop software for this camera.

- SetupCameraCmosOctUsb3_x64: SDK installation package for 64-bit operating systems
- SetupCameraCmosOctUsb3_x86: SDK installation package for 32-bit operating systems

Developers can choose which SDK to install according to the operating systems they use. Device drivers for the camera will also be installed with the SDK. For more information on installation and how to integrate the SDK into your software, please refer to *Sections 4.2* and *4.3* of the *UMA_OCTOPLUS-USB3_Mono_RevB9* document.

- For a full description of functions and error codes of the SDK and API, please go to the *CamCmosOctUsb3* folder under the SDK installation folder. Help files and .h files can also be found under this folder:

  \Teledynee2v\CameraCmosOctUsb3\SDK\inc\CamCmosOctUsb3.chm

  \Teledynee2v\CameraCmosOctUsb3\SDK\inc\CamCmosOctUsb3..h

► 3.4 Camera Software Development Kit (SDK)

Teledyne e2v also provides a demo application to show you how to work with the camera. Please refer to *Section 4.4.4* of the *UMA_OCTOPLUS-USB3_Mono_RevB9* document and the following path on your system:

\Teledyne e2v\CameraCmosOctUsb3\CameraDemoApp.exe

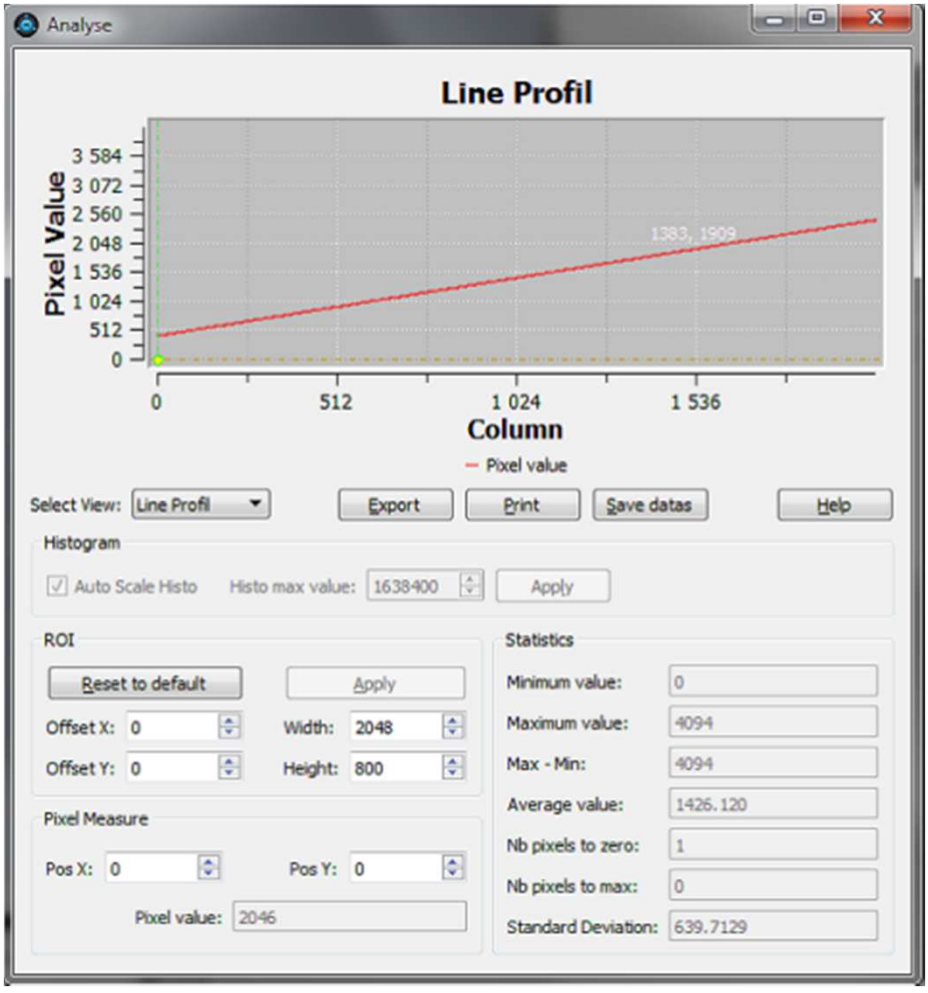


Figure 7. e2v camera demo application

► 3.5 Wavelength Calibration

You need to select an appropriate light source to use for wavelength calibration. Then, identify the peaks to create the polynomial function to calibrate the wavelength, as shown in Figure 8 below.

For each peak, use the fitting technique to obtain the pixel number and the corresponding standard peak wavelength. Use the obtained list of pixel numbers with corresponding peak wavelengths to create the calibration polynomial function.

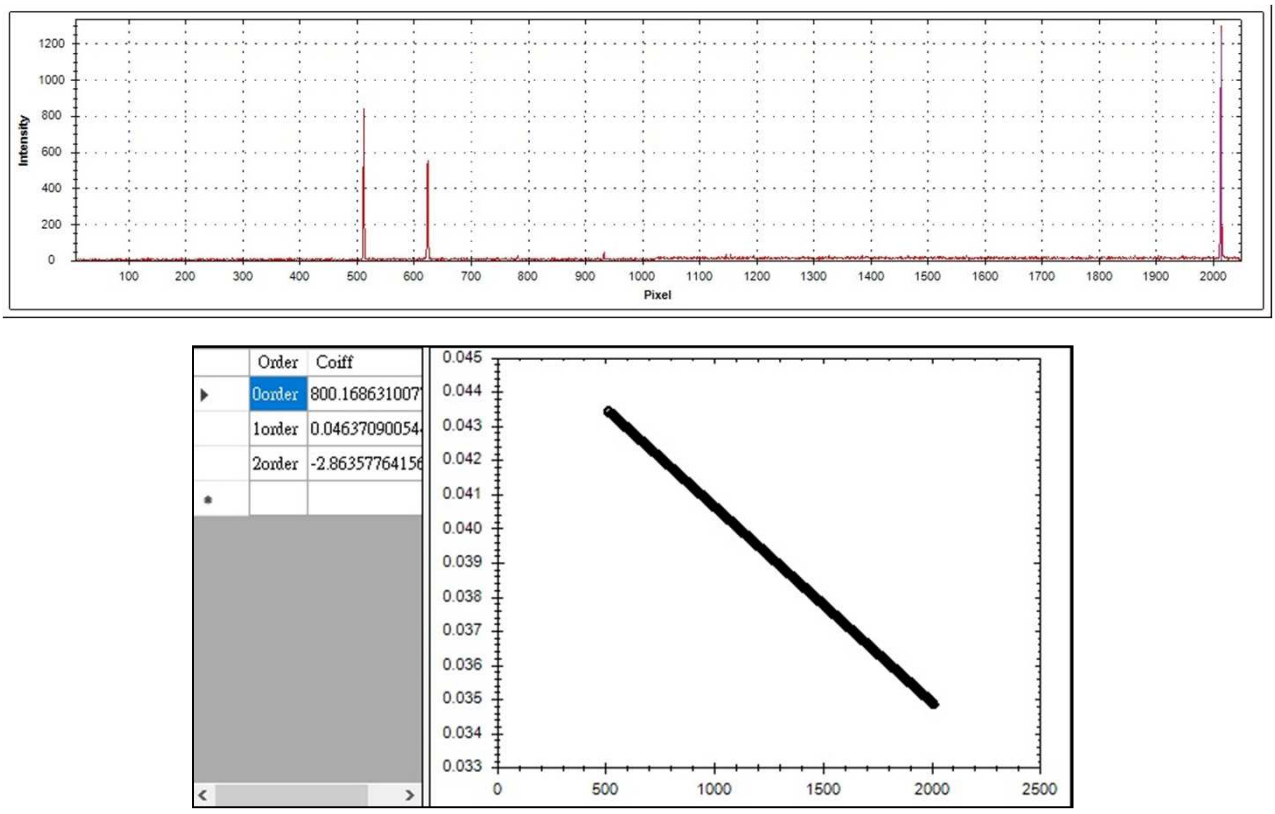


Figure 8. Screenshots of the wavelength calibration software