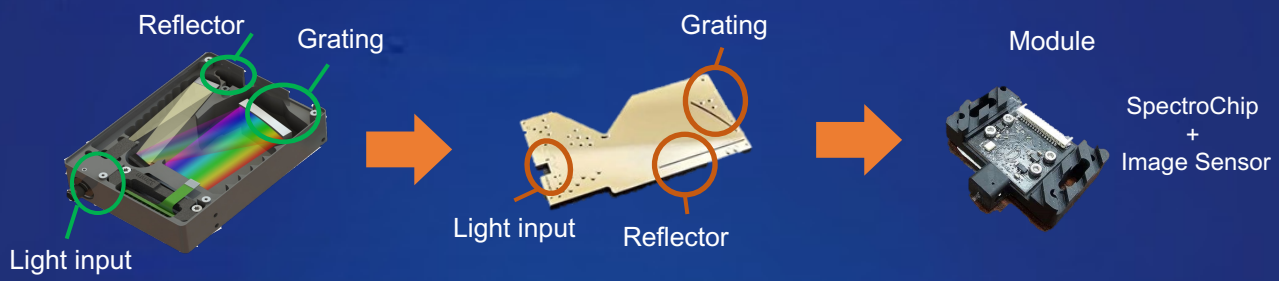
spectrochip *Breakthrough Technology*

SPECTROCHIP

An Optical System-on-Chip (SOC)
Manufactured via 0.5 nm X-ray Lithography

- ***High aspect ratio 400:1***
- ***4-10 Key photon energy lithography***
- ***Monolithic MEMS for mass production***

Packing the Full Function of A Spectrometer into a Fingernail-size Chip



Mechanical Structure Spectrometer

SpectroChip (1.7cm x 0.9cm)

Spectrum Processing Unit (SPU)

SpectroChip-based Modules Have Huge Application Potentials in Many Industries

MODULES & SENSORS IN PIPELINE

- **Micro VIS-NIR High Resolution Spectrometers**
- **In-situ Real-time Production Line Spectrum Profiling Sensors**
- **Regular Detection Sensors (ppm or ppb levels)**
- **High Sensitivity Detection Sensors (Sub-ppb levels)**
- **Compact Raman Spectrometers with SPU System embedded**

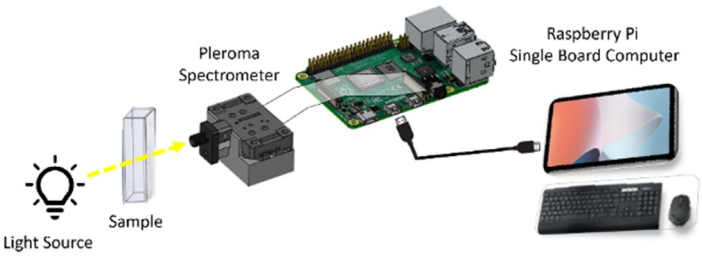
Opportunities for R&D Collaboration & Customized Service for Varous Applications

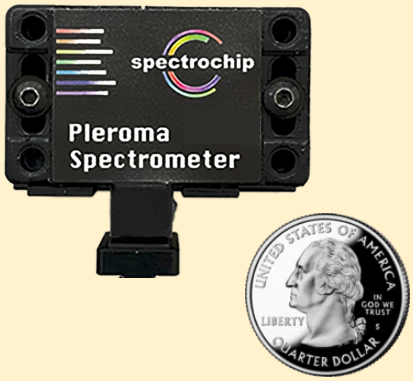
Pleroma Micro-Spectrometer

MSR-001

Micro-Spectrometer

A SPU designed for Raspberry Pi applications.





Features

- Spectral range : 300 ~ 1000 nm
- Flat-field micro concave grating chip
- Highly accurate optical characteristics
- Direct connection to Raspberry Pi SBC
- Python source code available
- Compact design for easy integration

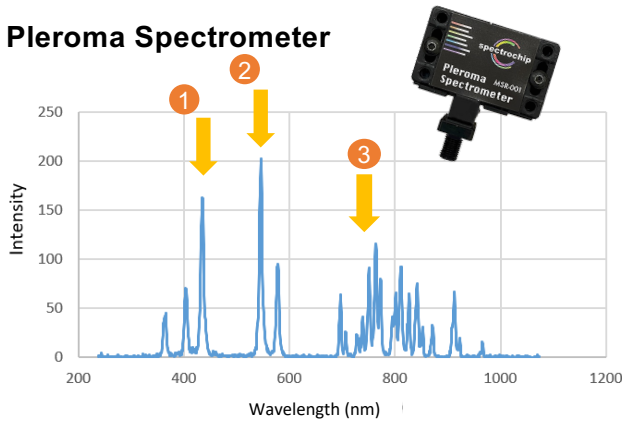
Specification

Optical	
Optical Module	SPU
Principle	Flat-field concave grating
Spectral Range	300 ~ 1000 nm
Spectral Resolution	5.0 nm
Spectral Accuracy	0.5 nm
Stray light	0.04%
Electrical / Mechanical / Dimension	
A/D conversion	8 bits
Integration time	0 ~ 1,000,000 μs
Total noise level	1.1 %
Data Interface	CSI camera connector
Power Consumption	158 mW
Image sensor	OV9281
Number of pixels	1280
Dimensions (WxDxH) / Weight (module only)	44 x 26.5 x 11 mm^3 / 12 g
Dimensions (WxDxH) / Weight (module + holder)	44 x 47.28 x 26.25 mm^3 / 50 g

Spectral Performance

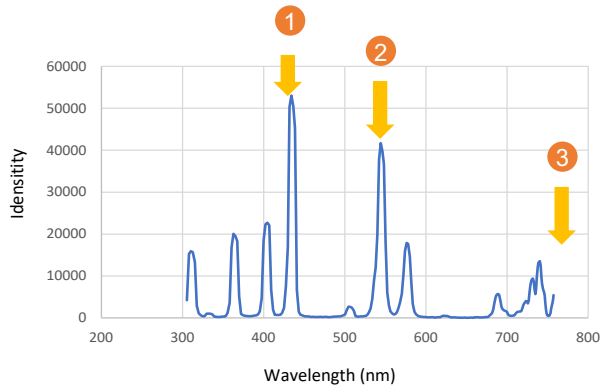
Hg-Ar Spectrum

Pleroma Spectrometer



Wider spectral range & better resolution

Other Micro-Spectrometer



Pleroma Spectrometer

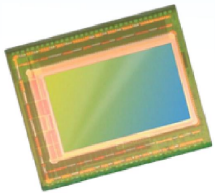
Customizable module

Designed to be compatible with Raspberry Pi

Dimension:
44 x 47.28 x 26.25 mm

Pleroma is a spectrometer integrated with Spectrochip and an image sensor. Light to be measured is guided into the entrance port of Pleroma (e.g. through an optical fiber) and the spectrum measured with the built-in image sensor is output from the CSI port for data acquisition. Pleroma allow accurate measurement with low noise. Can be customized for specific applications.

Specs of the Pleroma Micro-spectrometer module integrated with OV9281 image sensor:



- Spectral range: 300-1000 nm
- Spectral resolution (FWHM): 5 nm
- Spectral accuracy: +/- 0.375 nm
- Stray light: 0.04%
- Slit width: 20 um
- Acceptance numerical aperture (N.A.): 0.21
  (Full acceptance angle: 24 deg.)

0V9281-B&W image sensor specs:

- Pixel size: 3 um
- Pixel number: 1280 x 800
- A/D depth: 8 bits

(The OV9281 A/D depth reaches 10 bit, however the driver provided by Raspberry Pi can only operate in 8 bit mode).

Full well capacity and readout noise are related to the following factors:

- Max S/N ratio: 38 dB [1]
- Dynamic range: 68 dB [1]
- Sensitivity: 6500 to 13000 mV/uW [1]
- Dark current: not listed in the datasheet

Peak Quantum Efficiency:

The following figure shows the quantum efficiency of OV9281 and SONY IMX252.
The quantum efficiency is 67% at wavelength 530 nm.[2]

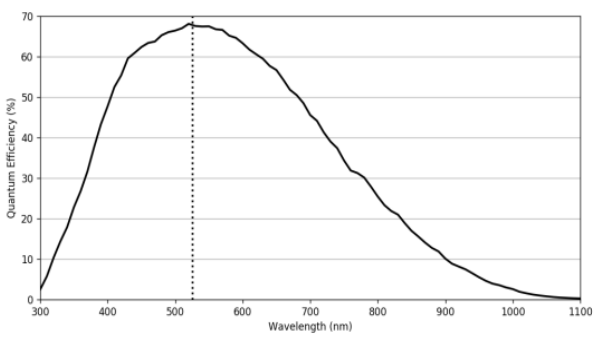


Fig. Quantum efficiency of OV9281 and SONY IMX252

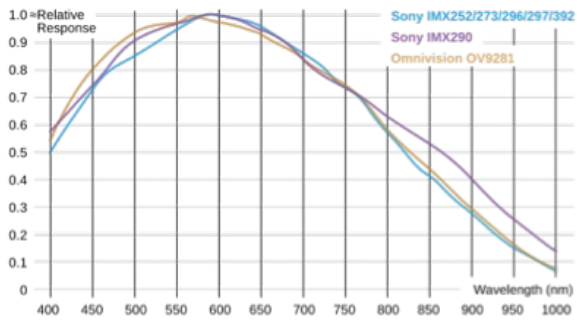


Fig. Relative spectral response of OV9281 vs. SONY IMX 252

References:

[1] Max S/N ratio, dynamic range and sensitivity
http://www.camera-module.com/product/globalshuttercameramodule/global-shutter-monochrome-ov9281-usb-camera-module.html
[2] Quantum efficiency of OV9281 and SONY IMX252
http://softwareservices.flir.com/BFS-U3-32S4/latest/EMVA/EMVA.html
[3] Relative spectral response of OV9281 vs. SONY IMX252
https://www.vision-components.com/fileadmin/external/documentation/hardware/VC_MIPI_Camera_Module/index.html

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