

2018 **INNOVATION**
BROCHURE



APPLIED **SPECTRAL** INNOVATION

What's Inside

Innovation. Discovery. Insight.

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- ▶ Rapid, Accurate Mid-IR Analysis with MZ5 Spectrometer

EXPLORE OUR LATEST PROMOTIONS

- ▶ High-Power UV-NIR LEDs
- ▶ Lab Services for Testing, Consultation and More
- ▶ Multispectral Sensors for PCR, PAR and Custom Applications
- ▶ Applied Spectral Knowledge at Work



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Applied Spectral Innovation

New Products, Services and Solutions

Ocean Optics is the Applied Spectral Knowledge company. For more than 25 years we have continuously innovated to deliver new ways to approach and solve problems with spectroscopy and imaging technologies. Our people embrace the curiosity to ask the “what-if” questions that will help scientists, researchers and developers harness the power of light in exciting and creative ways.

RESEARCH:

We work with the world's leading scientists and researchers in academia and industry to apply spectral knowledge to solve the world's most challenging problems. Our modular, miniature spectrometers provide a flexible toolkit for experimentation and discovery. But more than just products, we offer expert consultation, support and commitment.

“In Ocean Optics, we found a determined and talented team [whose solution] provides us with real-time answers.”

SOLUTIONS:

From supplying spectroscopy modules in volume to providing turnkey systems for a wide range of applications, we partner with the world's leading companies to deliver solutions that produce decisive results. Our sensing technologies, ability to engineer complex solutions and experience in applying spectral knowledge to solve measurement challenges are uniquely placed to deliver custom solutions from prototype to mass production.

“We extend our appreciation to Ocean Optics for identifying our targeted needs, articulating your product line and explaining how it can be applied to our application. Your knowledge of real-world applications and the challenges in a manufacturing environment are very much appreciated.”

Ocean Optics has the same passion for creating and applying sensing technologies that we've always had, backed by higher quality products, deeper applications knowledge and smarter analytical tools than ever. We look forward to taking on new challenges with you.

High Definition Optics in a Compact Spectrometer



The [Ocean HDX spectrometer](#) uses an innovative optical bench design to provide high throughput, low stray light and excellent thermal stability for integrated, industrial and research applications.

| | |
|----------------------------|---|
| Detector: | Back-thinned CCD |
| Spectral range: | 200-1100 nm |
| Optical resolution: | 0.61-0.72 nm (FWHM)* |
| Integration time: | 6 ms-10 seconds |
| Dynamic range: | 12,000:1 (single scan) |
| SNR: | 400:1 (single scan) |
| Throughput: | f/4 cone on detector with 300 μ m fiber |
| Stray light: | >3 AU |

| | |
|-------------------------------|--|
| Thermal stability: | +/- 1.0 pixels over 0-40 °C |
| Communications: | USB, Gigabit Ethernet, Wi-Fi, AP Wi-Fi, RS-232 |
| Onboard memory: | Store up to 50,000 spectra |
| Onboard averaging: | Up to 5,000 spectra |
| Operating temperature: | 0-40 °C |
| Size (mm): | 88.9 x 63.5 x 52.4 |

**Average over the entire spectral range using 10 μ m slit*

[Learn how Ocean HDX benefits both research and industrial customers.](#)

HDX Features and Benefits

| Features | Benefits | Example Use Cases |
|-----------------------------|--|--|
| High Definition Optics | Provides high resolution and excellent peak symmetry | <ul style="list-style-type: none"> Elemental analysis Endpoint detection Plasma monitoring |
| High throughput | Makes low-light applications possible | <ul style="list-style-type: none"> Bioluminescence Fluorescence |
| Low stray light performance | Enables high dynamic range and high absorbance linearity (>3 AU) | <ul style="list-style-type: none"> Absorbance of high optical density samples such as inks and dyes Unified color measurements |
| Great thermal stability | Reduces measurement error in challenging conditions | <ul style="list-style-type: none"> Industrial applications Variable measurement environments |
| X-Platform electronics | Offers multiple communications options and onboard processing and storage functions for data integrity | <ul style="list-style-type: none"> Integrated applications Process control QA/QC measurements |

Smarter, Faster Fruit Grading using Spectroscopy and Applied Analytics

Challenge: *Food processors and sorting machine manufacturers demand accurate, robust and simple optical sensing systems to ensure consistent quality and improve process efficiency.*

Solution: With robust hardware, application insight and advanced data analytics from Ocean Optics, food processors and sorting machine manufacturers are improving the quality of fruit and other foods throughout the food chain.

Traditionally, food sorting has been managed using visual inspection, although the introduction of [spectroscopic scanning](#) has added a more sophisticated level of analysis, with some instruments able to penetrate the fruit peel non-destructively to determine parameters including fat content, sugar values and moisture levels.

Case Study: [Lugo Machinery & Innovation](#), a leading supplier of fresh produce sorting products, approached Ocean Optics seeking an alternative to their manual method of sorting date fruit by moisture level. Their goals: Automate the sorting process to eliminate all manual inspection, and perform the measurements rapidly and non-destructively. Lugo's timeline was very short, with only four months to develop a solution in time for date season.

Because Lugo had little experience with spectroscopy, they focused primarily on identifying the typical moisture peak for dates. But based on our experience analyzing other fruits and vegetables, we extended the analytical range to include broader patterned spectral features, which would help us to develop machine learning algorithms. This approach -- broadband versus discrete wavelength spectral analysis -- yields more accurate results and makes the data less susceptible to deviations related to optical interference.

The date-sorting system was integrated into a conveyor-belt setup with algorithms running on a devoted PC. The data fed a programmable logic controller (PLC) that triggers a valve, sorting the dates according to moisture level.

Today, the fully integrated system scans 5 dates per second and is entirely automated. This has reduced overhead costs, improved safety and allowed Lugo to focus on refining other aspects of the sorting process. Also, with advanced statistical models now established, Lugo will be able to develop additional analyses without the need for modeling expertise.

With the fusion of spectroscopy, statistical modelling and machine learning architecture, sorting machine integrators and food processors can build more efficient sorting and grading systems.



Rapid, Accurate Mid-Infrared Analysis

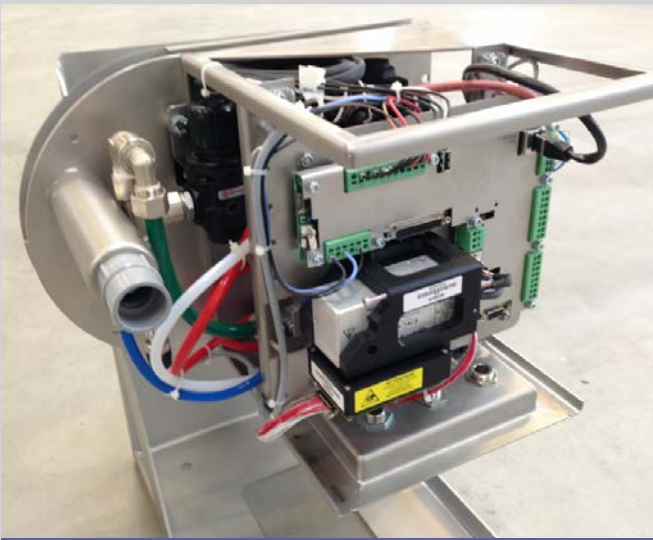
The Ocean MZ5 is a miniature ATR spectrometer with measurement capabilities from 1818-909 cm^{-1} (5.5-11 μm). With an integrated sample interface, light source and detector, the [MZ5](#) is a fast, easily deployed instrument for mid-infrared analysis of liquid samples in applications ranging from chemical discrimination, to food and flavorings analysis, environmental testing and scientific research.



| | | | |
|------------------------------------|---|-----------------------------|-------------------------------------|
| Detector: | 128-pixel uncooled pyroelectric array | SNR (single scan): | >300:1 (60 s measurement) |
| Spectral range: | 1818-909 cm^{-1} (5.5-11 μm) | Illumination source: | Electrically modulated MEMS emitter |
| Spectral bandwidth (FWHM): | 75 cm^{-1} (at CWL) | Sample surface area: | 17 mm x 27 mm |
| Measurement time (typical): | ~30 seconds | Size (mm): | 165 mm x 165 mm x 66 mm |

[Learn more about the benefits of Mid-IR spectroscopy.](#)

How Spectroscopy Saves Ship Owners Money While Reducing Emissions



Spectrometer assembly inside the maritime sensor housing

Challenge: Rigorous monitoring of exhaust emissions from cars, trucks, ships and other vehicles has significant implications for commercial interests, regulators and the public at large.

Solution: Spectral devices have become faster, more powerful and simpler to integrate into applications where real-time, in situ measurements help to analyze environmental conditions.

Case Study: The maritime industry faces challenges related to exhaust emission from ships: monitoring requirements driven by regulatory needs; commercial interests that put a premium on timely, cost effective and scalable technical solutions; and practical considerations for simple operation in demanding marine environments.

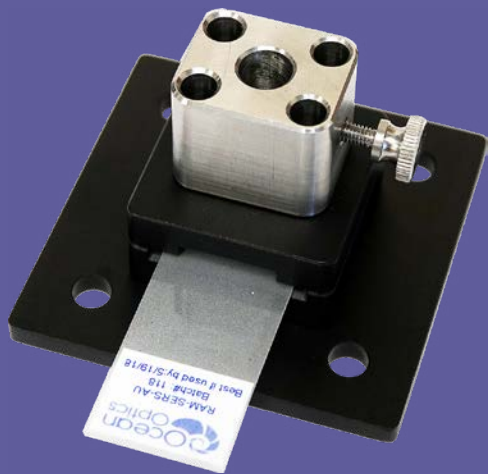
For instance, [Danfoss IXA](#) (Vejle, Denmark), which provides sensors for the maritime industry, has developed an emission sensor that uses an Ocean Optics spectrometer to provide continuous measurements of NO_x,

SO₂ and NH₃. This system has been adapted to withstand harsh marine conditions and ensure minimal maintenance during lengthy voyages.

The Danfoss system uses Differential Optical Absorption Spectroscopy (DOAS), a technique for measuring gases that absorb in the UV. Although proving measurement feasibility can be accomplished relatively quickly with a modular DOAS system, making it seaworthy is a bit more involved. [Danfoss and Ocean Optics worked closely for nearly three years to optimize the spectrometer for oceangoing vessels](#). The system had to be ruggedized to withstand the high temperature and vibration conditions at sea, for trips lasting up to six months at a time – an engineering task that required a careful combination of mechanical and optical design expertise.

Optical sensing technologies have remarkable potential to provide better insight into environmental monitoring applications, from open-path air quality monitoring in smog-choked cities to remote sensing measurements of coastal erosion. This insight – a type of applied spectral knowledge -- can help researchers, government regulators and manufacturers make precisely informed decisions.





NEW Raman Holders

The [RM-SERS-SHS holder](#) is optimized for surface enhanced Raman spectroscopy (SERS) measurements, accommodating a standard glass SERS slide, accurately positioning the Raman probe over its active measurement area, and mitigating the influence of ambient light.



The [RM-LQ-SHS holder](#) accommodates both vials and cuvettes for Raman analysis of liquids, powders and other solids. Its magnetic cover enables quick sample loading and unloading.



More Spectral Data in Less Time

The ultra-fast [Ocean FX](#) modular spectrometer acquires up to 4,500 scans per second, with onboard processing for improved SNR and reduced data transfer time for fast measurements. Onboard buffering and averaging ensure no data points are missed in applications like high-speed food sorting and grading, or monitoring of rapid events such as [flicker](#) and [fast color cycling of LEDs](#).

| | |
|----------------------------------|--|
| Detector: | High-sensitivity CMOS detector |
| Spectral range: | 200-1100 nm (configurable within this range) |
| Optical resolution (FWHM): | Configuration dependent; 0.8 nm (FWHM) w/600-line/mm grating and 5 μ m slit |
| Acquisition scan rate (maximum): | 4,500 scans/second* |
| Integration time: | 10 μ s-10 seconds |
| Dynamic range (single scan): | 5000:1 |
| SNR (single scan): | 290:1 |
| Communications: | USB, Gigabit Ethernet, RS-232 and Wi-Fi |
| Thermal stability: | \sim 0.11 pixels/ $^{\circ}$ C |

*Scan rate depends on many factors, including the performance of the operating computer and operating system.

[Download the Ocean FX brochure for additional specifications and use cases.](#)

Unlock the Value of Light with Handheld WaveGo

WaveGo puts accurate light measurement on your smartphone

WaveGo is a smartphone-connected device that enables quick, easy and accurate spectral light data capture. With this innovative, simple to access device and its complementary mobile application, users can view all light measurement data and built-in visualizations in real time.

[For WaveGo specifications and technical details, download the product sheet.](#)

WaveGo Applications

- Characterize light in built environments
- Test and prove quality throughout manufacturing operations
- Ensure museum object safety, longevity and viewing quality
- Monitor lighting parameters for human centric lighting design

WaveGo is an innovation of Wave Illumination, a groundbreaking business unit from Ocean Optics. Learn more at

WaveIllumination.com.

WaveGo Features and Benefits

| Features | Benefits |
|-----------------------------------|--|
| High-resolution spectral analysis | Accurate, reliable measurements, even at low or high lux levels, from 350-800 nm |
| Simple use | Intuitive smartphone app lets users make real-time measurements and save, view and share measurements right out of the box |
| Measurement versatility | Calculate parameters including absolute irradiance, lux, color temperature, color rendering, TM30, Melanopic lux and PAR |
| Cloud connection | Connect the WaveGo App to a WaveCloud account to automatically save measurements, access reports that calculate measurement parameters and export results for further analysis |



Discover the Unseen with Ground-breaking Multispectral Imaging

PixelCam™ Delivers High-Contrast Spectral Data in Real Time



PixelCam™ multispectral imagers provide simultaneous live imaging of 3-9 spectral bands, with multi-channel "snapshot" acquisition that extracts high-contrast spectral information at visible and infrared wavelengths. [PixelCam](#) comes in 4- and 6-band VIS-NIR and 3- and 4-band NIR-SWIR modules; is easily integrated into handheld and mobile cameras; and supports applications in agriculture, life sciences, machine vision, safety and security and more.

| | VIS-NIR | NIR + SWIR |
|--|--|---|
| Spectral response: | 400-1000 nm | 700-1700 nm |
| Resolution: | 2 MP: 1600 x 1200 px 4 MP: 2048 x 2048 px | 640 x 512 px |
| Sensor: | Si interline CCD 7.4 µm pixel pitch | InGaAs 25 µm pixel pitch |
| Spectral bands: (examples) *Custom spectral bands and mosaics available on request | *4-band: RGB + NIR (760 nm long-wave pass) *6-band: RGB + 3xNIR (740/60 nm, 840/60 nm, 940/60 nm) | *4-band: 900/400 nm, 1200/100 nm, 1400/100 nm, 1650/100 nm *3-band: 900/400 nm, 1350/200 nm, 1625/150 nm |
| Digital output: | GigE Vision® | Camera Link®, 14 bit |

PixelCam™ Features and Benefits

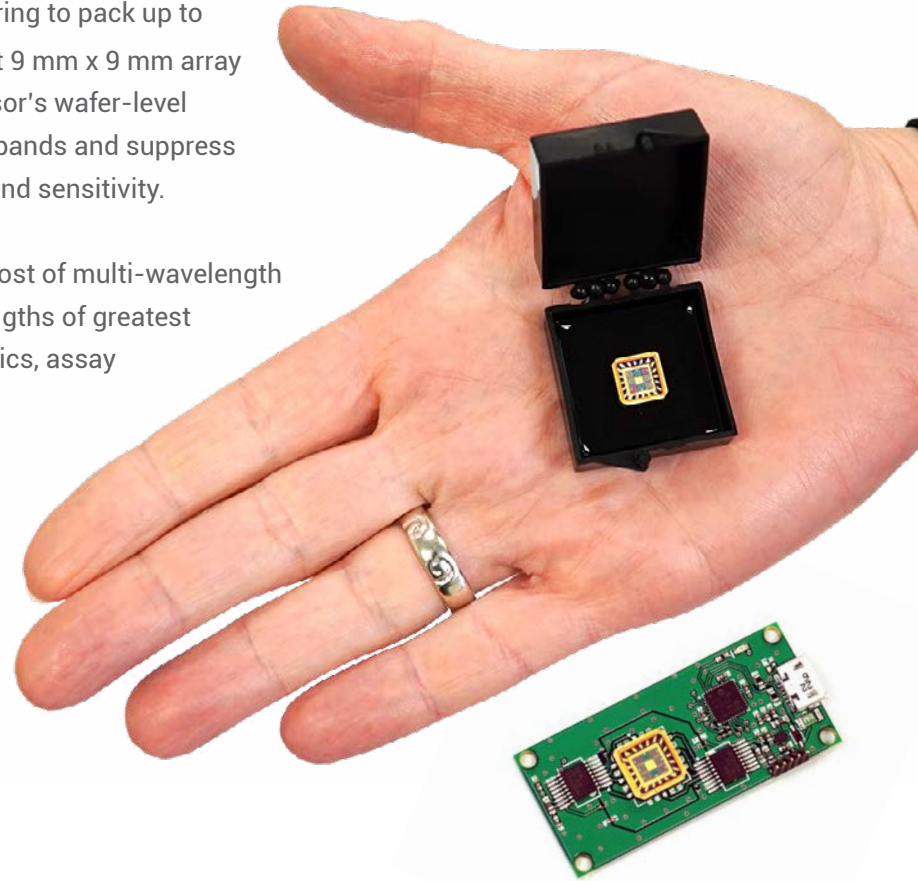
| Features | Benefits | Example Use Cases |
|-----------|--|---|
| Real-time | Simultaneous multi-band imaging yields rich, immediate data without scene change or pixel shift | <ul style="list-style-type: none"> • Aerial mapping • Biomedical imaging |
| Portable | Compact size, low weight and minimal power consumption integrate easily into handheld and process line devices | <ul style="list-style-type: none"> • Machine vision • Product screening |
| Flexible | Choose standard or custom filter arrays to cover the spectral bands for your application | <ul style="list-style-type: none"> • Remote sensing • Surveillance and authentication • Unmanned systems |

PixelSensor Multispectral Sensors

PixelSensor multispectral sensors use on-chip filtering to pack up to 8 wavelength-selective photodiodes into a compact 9 mm x 9 mm array for simple integration into optical devices. The sensor's wafer-level optical filters split the spectrum into discrete color bands and suppress out-of-band background light, improving contrast and sensitivity.

PixelSensor reduces the complexity, footprint and cost of multi-wavelength instrumentation, collecting data only at the wavelengths of greatest interest for applications including medical diagnostics, assay analysis and colorimetry measurements.

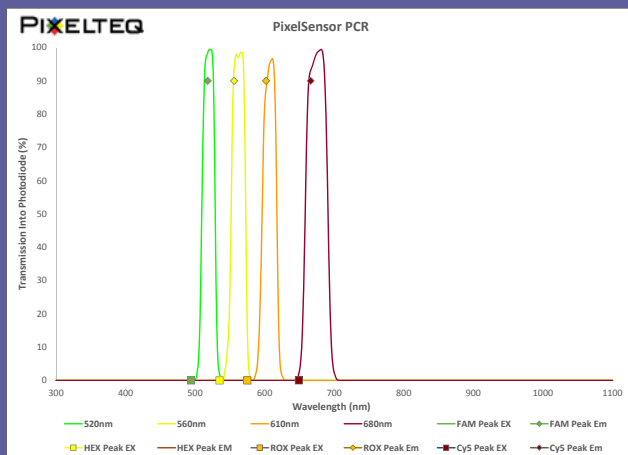
- Up to 8 sensors in a 9 mm x 9 mm LCC package
- Options include preconfigured (application-specific) or custom spectral bands from 400-1000 nm
- Available with or without electronics board and accessories for rapid prototyping and development



Preconfigured PixelSensor Options for PCR or PAR

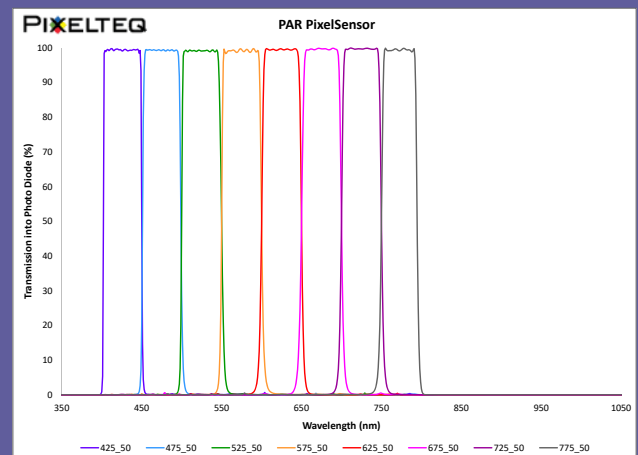
Select from sensors-only or sensors-with-electronics versions with spectral bands appropriate for [PCR analysis](#) or PAR (photosynthetically active radiation) measurements.

PCR Spectral Response



[Learn more about PixelSensor PCR options.](#)

PAR Spectral Response



[Explore additional agricultural applications.](#)

Using Multispectral Imaging to Improve Wound Intelligence and Save Lives

[Spectral MD](#) (Dallas, Texas) is a medical device developer of non-invasive diagnostic tools allowing clinicians to look deep into the body for wound management, burn analysis and assessment of chronic conditions such as diabetic ulcers and peripheral vascular disease. Their DeepView™ Wound Imaging System uses [multispectral imaging technology](#) from Ocean Optics.

Recently, we interviewed Spectral MD's Brian McCall, an Imaging Systems Engineer, about the challenges of wound assessment and his experience in working with Ocean Optics.

OO: How are innovative imaging technologies affecting wound management?

BM: Wound care is a challenging practice, especially in burn victims. Improving the tools used to provide and manage this care not only lowers health care costs, but reduces patient pain and suffering. For burn victims, from adults to young children, the suffering can be particularly acute, and helping these patients is what gets us up in the morning.

OO: How does Spectral MD's DeepView Wound Imaging System help clinicians?

BM: Currently in burn care, care providers make treatment decisions with clinical judgment alone. Scientific literature indicates expert burn care providers make incorrect diagnoses of burn depth in as often as 30% of cases. Our non-invasive technology has the potential to make burn diagnosis earlier, with high accuracy. This could reduce diagnosis errors, lessen hospital stays, and even allow non-burn experts such as emergency room physicians to make better triage decisions.

OO: We have worked with Spectral MD for several years now. What made you choose us?

BM: Ocean Optics had the hardware, software and support we needed to get started on the project quickly. As our research has developed and matured, our use of Ocean Optics has grown as well, and your offerings have been able to meet our growing needs. We wouldn't be where we are without Ocean Optics, and are excited about what your new technology means for the next generation of our devices!

[Learn more about the wound management technology described here.](#)

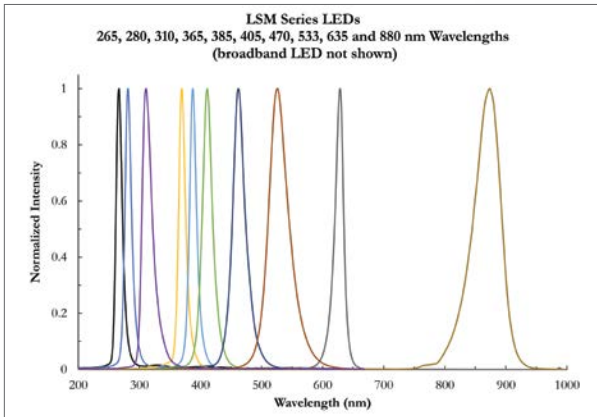


Providing Insights into Intelligent Wound Management video.



High-Power UV-NIR LEDs

New LSM Series LEDs for Fluorescence Excitation and More



When every photon counts, [LSM Series LEDs](#) deliver efficient optical fiber coupling for high-power fluorescence excitation, narrowband measurements and broadband illumination. Multiple LED wavelength options are available across the UV-NIR, with a single-channel driver and controller unit for advanced functionality and programming.

- ▶ Choose from discrete and broadband UV-NIR wavelength options
- ▶ Operate LEDs using smart controller with **LCD touch screen**
- ▶ Use continuous or modulation modes and **optional triggering**
- ▶ Experiment with various waveforms and frequencies



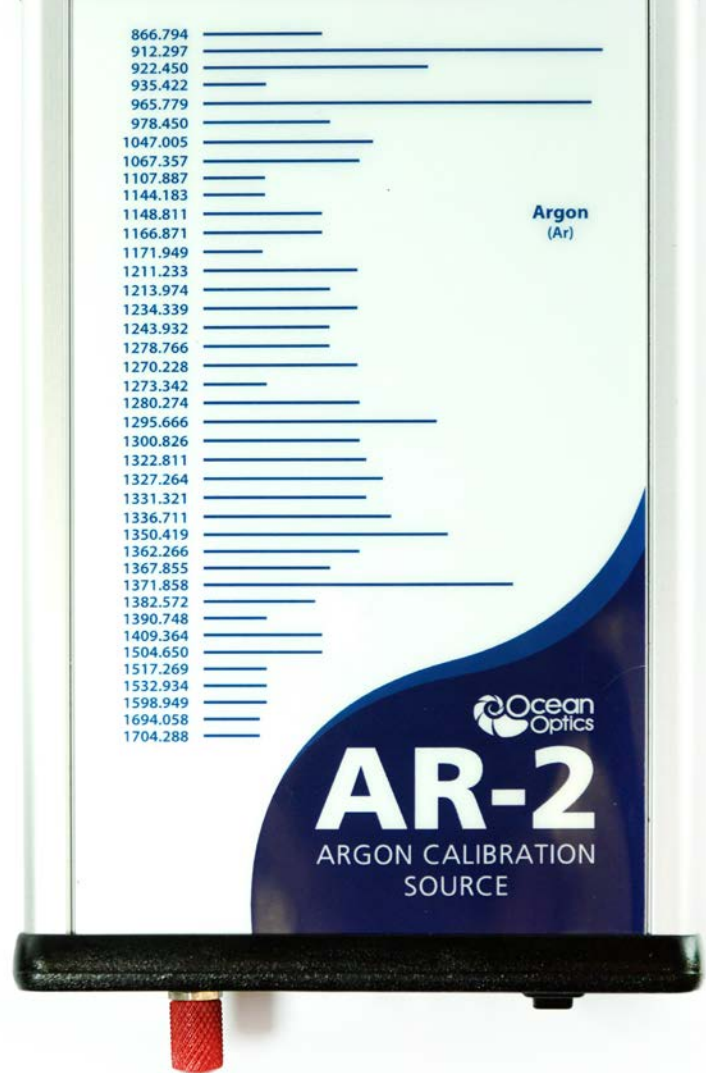
Flexible Inline Filter Holders Connect Optical Fibers

The [INLINE-SFH inline filter holder](#) conveniently connects an illumination fiber to a read fiber for sampling. Permanently aligned during production, the adjustment-free holder accepts filters ranging from 10-12.7 mm diameter and up to 9 mm thickness (single filter or up to 3 filters at one time). It's best for use with 200 μ m diameter or greater optical fiber.

Protect Your Data, Calibrate Your Spectrometer

New [spectrometer wavelength calibration](#) sources are now available with more emission lines to utilize. Maintaining optimum spectrometer performance is simpler than ever to achieve, with the additional spectral lines making it easier to correct for baseline drift and other spectral phenomena. A robust battery, remote on/off, and LED indicators for battery charge and lamp activation complete the package.

| Source | Gas Type | Wavelength Range |
|--------|---------------|------------------|
| HG-2 | Mercury Argon | 253-1700 nm |
| KR-2 | Krypton | 427-893 nm |
| NE-2 | Neon | 540-754 nm |
| AR-2 | Argon | 696-1704 nm |
| XE-2 | Xenon | 916-1984 nm |



Rather leave calibration to the pros? Read on to learn about calibration with [Ocean Care](#).

Protect Your Spectrometer, Choose Ocean Care

Rapid Turnaround on Calibration and Repairs, Plus Accessory Discounts



Ocean Care Service Plans are the easiest way to maintain dependable spectrometer performance and protect the quality of your measurements. Plans provide access to live tech support, software upgrades, and spectrometer maintenance and repair. Two levels of coverage are available: Ocean Care and Ocean Care Plus. See a brief [Ocean Care Plans](#) video.

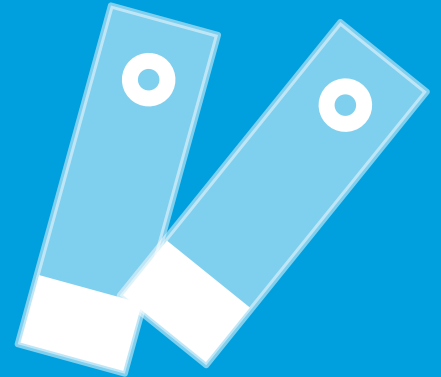
| | Ocean Care | Ocean Care Plus |
|--|--|--------------------------|
| 1-, 3- or 5-year Coverage Plans | ✓ | ✓ |
| Annual Calibration and Repair Coverage | Discounted Fixed Cost (varies by spectrometer) | Free (all spectrometers) |
| Annual Accidental Damage Protection | Discounted Fixed Cost (varies by spectrometer) | Free (all spectrometers) |
| Software Upgrades | ✓ | ✓ |
| Live Tech Support | ✓ | ✓ |
| Discounted Sampling Accessories | Up to 10% off | Up to 20% off |

NEW Ocean Optics Lab Services Deliver the Power of Insight

Resources. Time. Knowledge. Three things always in scarcity, yet three things critical to moving your operation forward. With our new [Lab Services](#) offering, Ocean Optics shifts stress away from your organization and accelerates your progress by teaming you with our scientists, applying our next-generation machine learning architecture and utilizing our world-class laboratory facilities. We offer a special level of custom insight you won't find from most other companies.

▶▶ Fixed Price Insight

Our Fixed Price Insight option allows you to submit up to three samples to be measured for analysis. For a single, affordable price, you can see where your samples are optically active, or which spectral technique is most effective, or which hardware offers optimized results. This saves you time, money and stress by building the confidence upfront that you are purchasing the best system for your goals.



▶▶ Custom Insight

For deeper investigation, we offer a custom package that lets you outline your project scope and maintain a close partnership with the scientists conducting your study. Perhaps your team has a new product idea but is not quite ready to dive into a formal OEM agreement. This service lets you investigate your idea with a well-defined study, at an hourly rate, to generate results that can be the stepping stones to more meaningful OEM integration discussions.

▶▶ Consultancy Services

Consultancy helps you design the experiments most meaningful to your project goals. Whether you are just getting your spectroscopy system set up or have begun to make measurements, we are happy to offer expert insight via digital video conferencing or an onsite visit. Also, if you need guidance on designing and building a powerful study with the tools you have available, we are here to help at every step.

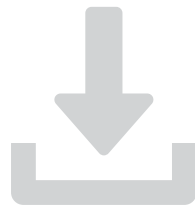
Every great adventure begins with first steps. Whether you are just starting your journey or have reached an unusually difficult stretch, Ocean's team of experts is here to help you achieve your next set of goals. Talk to us about your vision and how we can help make it a reality through the power of spectroscopy and developmental partnership.

[Learn more about Lab Services today.](#)

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