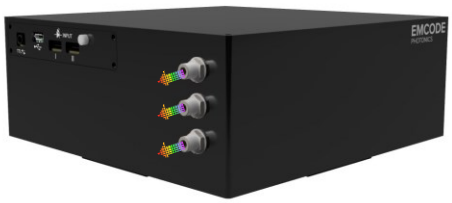
EMCODE
PHOTONICS

Emcode spectrometer system

FEATURES



Built-in light source with precision current control

Multiple coded outputs for flexible illumination

Two external receivers for two simultaneous spectral measurements

- Fully compatible with standard bench optics
- Choice of photodiodes and gain ranges

Choice of three spectral ranges

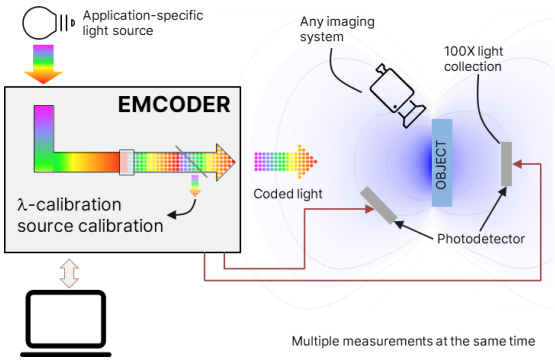
- Visible from 400 to 800 nm
- VIS-NIR from 400 to 1000 nm
- SWIR from 1000 to 2000 nm

Triggered acquisition

Built-in wavelength calibration and source spectral measurement

Ultra-stable, drift-free measurement

Complete set of APIs and UI for rapid integration



The standard spectrometer system ships with everything in a box that is required to start taking spectral data immediately. It features Emcode's coded light source, dual receivers (depending on the wavelength range), a complete set of Python APIs, fully functional stand-alone software, and all the cables and fibers.

Emcode system produces up to 240 spectra per second for 32-band system, 120 spectral per second for 64 channel system and 60 spectra per second for 128 channel system. These spectra are acquired continuously and there is no dead time between spectral readouts. Removal of 1/f noise and continuous measurement of source spectra allows long-term measurements without worrying about source drifts for tracking process changes or to improve SNR by averaging. While these spectra are measured over effective integration time given by inverse of spectra per second, they can be measured at any time via trigger with less than 10 μs jitter and can be "oversampled" for smoother following of variation in time.

The data is saved in an industry-standard format for seamless analysis.

THEORY OF OPERATION

Emcode's spectrometers can be best understood as multiple monochromator systems running in parallel. It comes with light source as well as two optimized photodiode receivers for high SNR spectroscopy in challenging environments. The Emcode system produces unique, high quality tagging of each of the wavelength bands which can be recovered by digital signal processing. Emcode offers three different systems covering three spectral regions from 400 nm to 2000 nm. Each system comes with a choice of built-in light source to produce three identical outputs on standard SMA ports. The coded light beams are internally sampled to track source spectra as well as produce wavelength calibration based on absorption bands of standard filter glasses. One can combine all three outputs or use them at three different sites. The light reflected or scattered from the sample can be measured by the included receivers. Emcode provides many different configuration of flexible low-noise, large area receivers. The receiver housing makes it easy to couple to user's optical system as it supports standard cage mounts from Thorlabs as well as post mounting.

We support up to 100 mm^2 of silicon photodiode area for light collection from dark diffuse surfaces, and up to 3 mm^2 for InGaAs photodiodes.

Key highlights are:

- Provided receivers allow measurements of sample at two different angles or one in transmission and one in reflection. Multiple outputs allow comparison to two different locations on the sample.
- All spectra are measured simultaneously making it easy to compare
- There is no dark measurement. Only coded light is measured. Ambient light is also rejected by the demodulation process.
- Direct division by built-in internal source spectra automatically provides source spectra independent spectral measurements. This division can be carried out for every spectral sample thus eliminating even short-term source fluctuations and longer term drift in source output and spectra.
- A single "external calibration" to a white or a reference standard to take into account any other optical transmission can be used to continuously reference all subsequent spectral measurements to the refrence standard.
- Saved data includes measured filtered light data for verification of wavelength calibration.
- Upgraded versions support additional 4 recievers to bring the total to 6 simulataneous measurements.

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SPECIFICATIONS

Parameter	Value	Comments
Wavelength range	VIS: 400 nm to 800 nm VISNIR: 430 nm to 1050 nm SWIR-I: 1000 nm to 2000 nm	
Number of spectral bands	32, 64, or 128	The highest spectral update rate is reduced proportionately with increasing number of bands
Spectral resolution examples	VIS-32 band: ~ 10 nm VISNIR-64 band: ~10 nm SWIR-64 band: ~ 20 nm	Evenly spread across spectral range
Wavelength calibration and source spectra	Built-in and available continuously	Continuously calibrated against an atomic glass filter
Software	Analyze, examine, and save spectra via UI or Python APIs.	See section on software
Dynamic Range	More than 10,000.	Spectral averaging reduces noise floor
SNR	> 60 dB for a single spectral acquisition	Increases as square root of number of spectral averages
Choices of light sources	White LED Tungsten Halogen bulb Energetiq's laser-pumped plasma Xenon flash lamp	Xenon flash rate sets the spectral update rate and limits it to < 2 spectra per second.
Trigger and sync	Input trigger as well as clock-out	
Spectrometer size	6.5" X 6.5" X 2.5"	Mounting holes for optical breadboard
PC requirements	Needs USB 2.0 for the Emcode system	Windows 10 or higher. 32 GB RAM Modern CPU recommended Python 3.12.

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BRIEF DESCRIPTION OF SOFTWARE

The Python-based user interface (UI) is built using Emcode's C++ APIs, serving as an example of how applications can be rapidly developed on top of robust APIs.

The UI offers powerful visualization and data analysis capabilities, including:

- Plotting and tracking spectra
- Averaging spectral data
- Saving time-series of spectra.

The APIs enable a wide range of functionalities, including:

- Initializing and configuring the Emcode system.
- Averaging spectra to optimize signal-to-noise ratio (SNR).
- Saving spectral data for further analysis.

Users have the flexibility to develop their own Python applications or operate the Emcoder system through scripting tools like Jupyter Notebook for streamlined data acquisition and analysis.

BUDGETARY PRICING

All systems include:

- Choice of white LED or tungsten halogen bulb, with precision software-controlled current source to control light output.
- Two external receivers with ultra-low-noise amplifiers that connect via standard USB-C cables for ultimate flexibility in placement.
- 2-m long output fibers to bring coded light to the sample

VISIBLE	~ $ 7,000
VISNIR	~ $7,500
SWIR-I	~ $8,000

Pricing is subject to change.

CUSTOMIZATION

There are limitless ways in which Emcode system can be customized. Call us about your needs and see how we can simplify spectroscopic measurements.

Contact: info@emcodephotonics.com for further information and to discuss your application.