

# HR2000+ES Application-Ready Spectrometer

Preconfigured for High Resolution and Sensitivity



## HR2000+ES

The HR2000+ES Spectrometer is a preconfigured system for enhanced sensitivity. This system integrates a high-resolution optical bench with a powerful 2-MHz A/D converter, programmable electronics and a 2048-element CCD-array detector for optical resolution to ~1.33 nm (FWHM).

The HR2000+ES has a slightly larger entrance slit (10  $\mu\text{m}$ ) and an L2 detector collection lens for additional sensitivity in extended-range applications. We also include a UV2 quartz window for UV transmission and the OFLV-200-1100 Variable Longpass Order-sorting Filter to eliminate second- and third-order effects.

## Features

- Up to 1,000 full spectra per second
- Programmable microcontroller
- High-resolution bench
- Plug and play operation

## Sample Applications for HR2000+CG/HR2000+ES

- Thin film measurements of various substrates
- Plasma monitoring
- Reflectance of nanoparticles
- Analysis of phosphors
- Characterization of lasers
- Solar irradiance
- Spectral output of light sources

Physical	
Dimensions:	148.6 mm x 104.8 mm x 45.1 mm
Weight:	570 g
Detector	
Detector:	Sony ILX511B linear silicon CCD-array
Detector range:	200-1100 nm
Pixels:	2048 pixels
Pixel size:	14 $\mu\text{m}$ x 200 $\mu\text{m}$
Pixel well depth:	~62,500 electrons
Sensitivity:	75 photons/count at 400 nm; 41 photons/count at 600 nm
Optical Bench	
Design:	f/4, Symmetrical crossed Czerny-Turner
Focal length:	101.6 mm input and output
Entrance aperture:	10 $\mu\text{m}$ wide slit
Grating:	HC-1 provides 200-1100 nm range
Detector collection lens:	Yes, L2
OFLV filter:	OFLV 200-1100 nm
UV enhanced window:	Yes, UV2 quartz window
Fiber optic connector:	SMA 905 to 0.22 numerical aperture single-strand optical fiber
Spectroscopic	
Wavelength range:	200-1100 nm (best response 200-1050 nm)
Optical resolution:	~1.33 nm FWHM
Signal-to-noise ratio:	250:1 (at full signal)
A/D resolution:	14 bit
Dark noise:	12 RMS counts
Dynamic range:	$8.5 \times 10^7$ (system); 1300:1 for a single acquisition
Integration time:	1 ms-65 seconds (20 s typical)
Stray light:	<0.05% at 600 nm; <0.10% at 435 nm
Corrected linearity:	>99%
Electronics	
Power consumption:	220 mA @ 5 VDC
Data transfer speed:	Full scans to memory every 1 ms with USB 2.0 port, 15 ms with USB 1.1 port
Inputs/Outputs:	Yes, 10 onboard digital user-programmable GPIOs
Analog channels:	One 13-bit analog input; one 9-bit analog output
Auto nulling:	No
Breakout box compatibility:	Yes, HR4-BREAKOUT
Trigger modes:	4 modes
Strobe functions:	Yes
Gated delay feature:	No
Connector:	30-pin connector



What puts the "Extra Sensitivity" into the HR2000+ES? In large part, it's the addition of a detector collection lens. We fix a cylindrical, aberration-free lens to the detector to focus the image from the tall slit (entrance aperture) of the spectrometer bench onto the shorter detector elements. Depending on the optical bench configuration, this helps increase light-collection efficiency considerably. In fact, the lens collects light so efficiently that in many HR2000+/HR4000 applications – especially laser characterization – adding the lens would cause detector saturation.