

# Optima 8000 ICP-OES Custom-Designed Solid- State Detector

## ICP-Optical Emission Spectroscopy



### Optimum design for superior quantum efficiency and maximum performance

The Optima™ 8000 ICP-OES uses a large area, dual backside-illuminated charge-coupled device (DBI-CCD) detector measuring 3 by 5.5 mm with two independent arrays, each with 176 by 64 pixels (see Figure 1 – Page 2). The detector is a backside-thinned CCD array, where the detector chip is thinned to a few microns and illuminated from the rear. This prevents absorption by control gates and maximizes quantum efficiency without the use of a fluorescent coating. The result is exceptional quantum efficiency over the entire wavelength range, particularly at the lower UV wavelengths (see Figure 2 – Page 2). Plus, the large active area of the detector allows the use of a more efficient optical system for exceptional analytical performance.

The detector is divided into two segments, one for the analytical measurement and a second to continuously monitor a reference spectrum.

### Simultaneous background correction

Sequential ICP-OES spectrometers have been limited by their inability to make background correction measurements simultaneously with the analyte measurement. If there was any variation in the analytical conditions between the two different measurement times, analytical precision could be degraded. The DBI-CCD detector allows the Optima to be the first CCD ICP-OES system to provide simultaneous background correction. The detector simultaneously measures a wavelength range around the analytical wavelength, including the background correction wavelength(s). The background correction readings are made at exactly the same time as analyte measurements, with significant improvements in analytical accuracy (see Figure 3 – Page 2).

### Dynamic Wavelength Stabilization system

With its unique scanning CCD design, the Optima ICP-OES provides exceptionally fast, accurate wavelength setting. Of course, the exact assignment of wavelengths to intensities is crucial to the accuracy and reproducibility of optical emission measurements. The unique design of the Optima optical system allows for the use of shorter focal lengths while maintaining high resolution.

### Key Benefits

- Superior quantum efficiency, for enhanced analytical performance and superior detection limits
- Simultaneous background correction, further improving analytical accuracy and detection limits
- Dynamic wavelength stabilization, increasing analytical reproducibility and reliability

Thermal effects are minimized by using short focal lengths, eliminating one of the major sources of wavelength error. And to virtually eliminate the effects of wavelength drift, the Optima ICP-OES includes Dynamic Wavelength Stabilization™ (DWS). DWS actively corrects for any residual spectral shifts. A reference spectrum from a low pressure neon discharge lamp is transferred directly to the intermediate slit using a fiber optic. The Echelle monochromator disperses the neon spectrum, with all orders superimposed on the exit plane (the detector) to create a well-defined wavelength pattern at each position of the grating. The top portion of the DBI-CCD detector is dedicated to continuously monitoring and recording this spectrum, effectively appending a wavelength calibration scale to each analytical reading. Wavelength calibration is checked with each and every reading, and any necessary corrections are made automatically without operator intervention. This real-time wavelength monitoring system produces exceptional stability (see Figure 4).

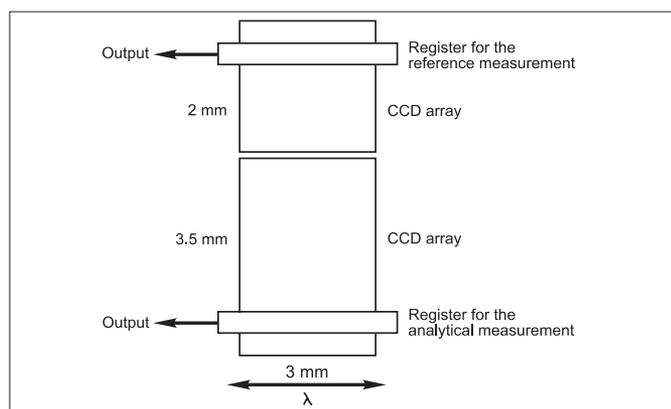


Figure 1. Simplified drawing of the Optima DBI-CCD.

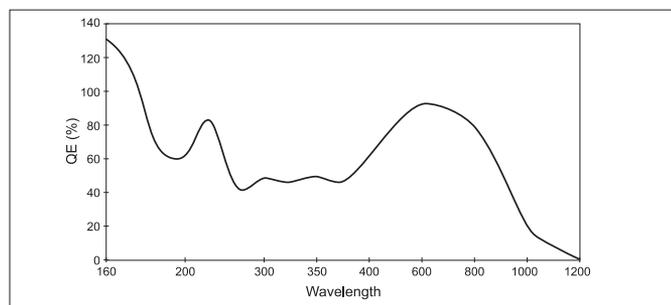


Figure 2. DBI-CCD quantum efficiency. The actual quantum efficiency of this detector is 60-80% in the UV range and up to 100% in the visible range, far superior when compared to conventional photomultipliers.

## Cost-efficient Peltier cooling

To provide the required high analytical stability and low detector “noise,” the temperature of the solid-state detector has to be precisely maintained. In the Optima 8000 ICP-OES, a single-stage Peltier cooling plate on the detector mount effectively removes the heat from the detector. Since this cooling plate is large compared to the size of the detector, near-perfect temperature stability at the detector is achieved without the need of a more expensive multi-stage cooling system. The Peltier element is integrated into the package so that only the low-mass chip is cooling, eliminating the need for cooling water. The detector housing is hermetically sealed and is filled with dry nitrogen to eliminate condensation.

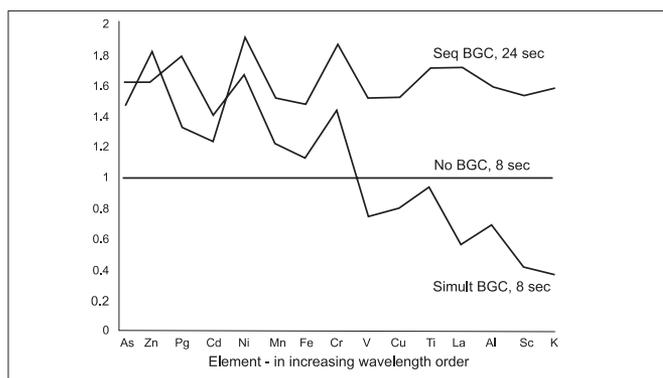


Figure 3. The effect of simultaneous background correction on detection limits. Relative detection limits have been normalized to results with no background correction. Note the significant improvement in detection limits at longer wavelengths with simultaneous background correction.

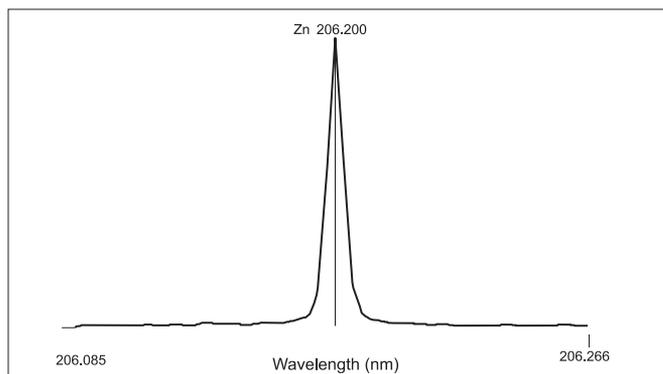


Figure 4. Optima dynamic wavelength stabilization. Wavelength stability is demonstrated by overlaying 60 consecutive measurements.